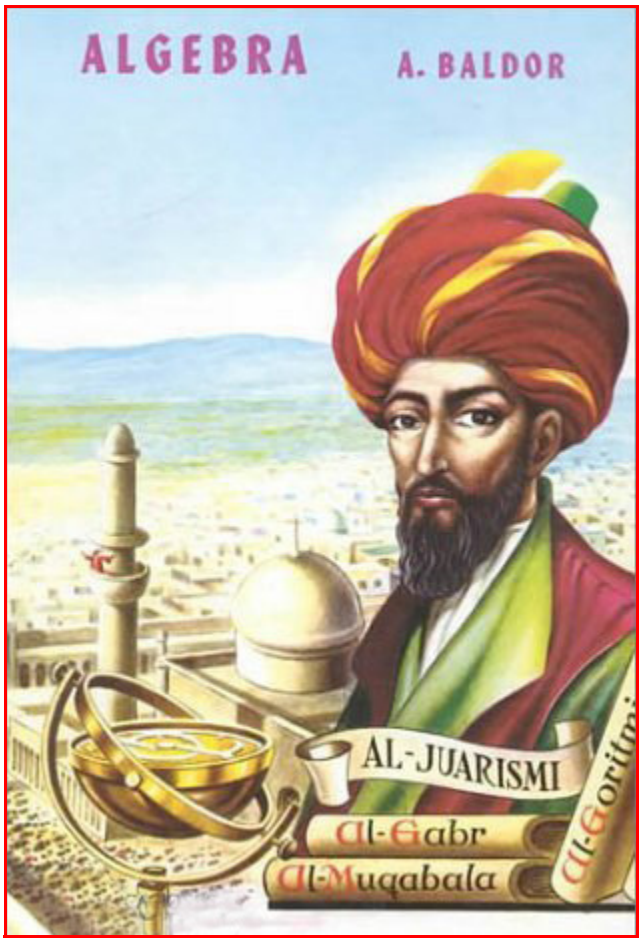
THOREAUVIAN MATHEMATICS



"To what end do I lead a simple life at all, pray? That I may teach others to simplify their lives? —and so all our lives be simplified merely, like an algebraic formula?— Or not, rather, that I may make use of the ground I have cleared — to live more worthily and profitably?"

— Henry Thoreau, September 26, 1855

"We have heard much about the poetry of mathematics, but very little of it has yet been sung. The ancients

THOREAUVIAN MATHEMATICS

had a juster notion of their poetic value than we. The most distinct and beautiful statement of any truth must take at last the mathematical form. We might so simplify the rules of moral philosophy, as well as of arithmetic, that one formula would express them both."

— Henry Thoreau, A WEEK

This "Thoreauvian Mathematics" isn't about abstract algebra so much as it is about a puzzling issue Henry Thoreau posed in 1852 and 1853 in regard to the "helicoidal flow" of the waters of meandering Nut Meadow Brook in Concord — an applied-mathematics perplexity that after Henry died in his 45th year would need to wait three generations, until an explication would be published by Albert Einstein of the Institute for Advanced Studies in Princeton, New Jersey as of 1926. Waldo Emerson had expressed zero patience for Thoreau's preoccupation with the hydraulics of the basin of the Concord River and in a letter to one of his Concord-lady acquaintances, made a snide remark about this. Ha ha. –But what if Henry's health had allowed him to continue this sort of hydrological research? I submit that had Henry not succumbed to tuberculosis it might well have been he, in the 1860s or 1870s or 1880s, who would have been able to explicate the complexities of this helicoidal current flow. Looking back on this, it needn't have required a Professor Einstein to address adequately and resolve that perplexity to which Thoreau had given voice. We've had a poet-mathematician before –Al-Khayyām of Khurassan– and didn't we just about have ourselves a poet-mathematician again — Al-Thoreau of Massachusetts?

DO I HAVE YOUR ATTENTION? GOOD.

300 BCE

It was at about this point that Euclid, teaching in Alexandria, was laying the foundations for a theoretical geometry, of course basing this work upon the existing practical geometry of the Egyptians.
In his *OPTICA* he noted that light travels in straight lines, and described the law of reflection. He persisted, nevertheless, in an easily refuted attitude that vision must involve some sort of rays that shoot out of one's eyes and strike the objects which one perceives.

HISTORY OF OPTICS

"NARRATIVE HISTORY" AMOUNTS TO FABULATION,
THE REAL STUFF BEING MERE CHRONOLOGY

295 BCE

In about this year, in Alexandria, Euclid was developing the elements of mathematics.

290 BCE

In Alexandria, Euclid set out the principles of geometry.

ELEMENTS OF GEOMETRY

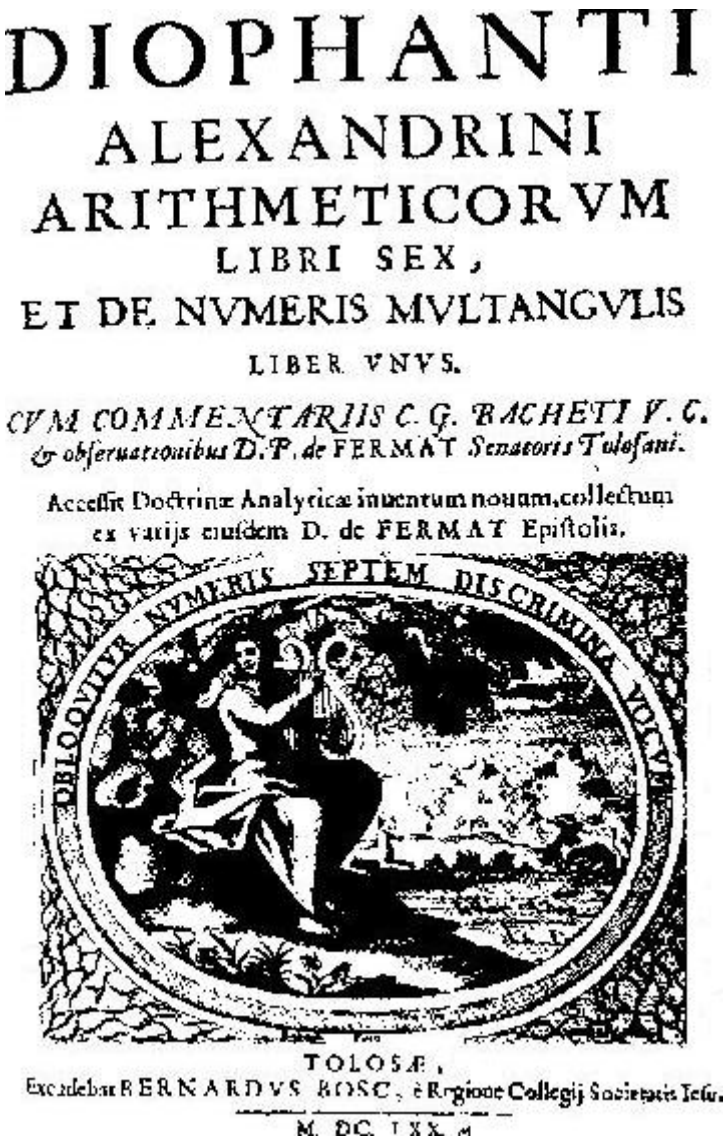
THE FUTURE IS MOST READILY PREDICTED IN RETROSPECT

224 CE

Creation of the Bakhshali manuscript, a mathematical text written on pieces of birch bark that would be found in 1881 in what has since become Pakistan. This contains a place-holding dot that appears to be the earliest known Indian use of a symbol meaning zero (the writing appears to be a copy of a previously existing and more ancient text and radiocarbon dating indicates that some of these 70 strips originated during the years 224-383 CE).

250 CE

We're not even sure in what century Diophantus of Alexandria lived in, but by convention we assign some date like this to his putting out the 1st Western treatise on algebra and the theory of numbers, his *ARITHMETICA*, of which a few of the books have survived. Many of the problems involve solutions in integers only (Diophantine equations). When he obtained negative numbers as solutions to some of his equations, he dismissed them as "absurd."



DIOPHANTI
ALEXANDRINI
ARITHMETICORVM
LIBRI SEX,
ET DE NVMERIS MVLTANGVLIS
LIBER VNVS.

CVM COMMENTARIIS C. G. BACHETI V. C.
& obſeruationibus D. P. de FERMAT Senatoris Tuloſani.

Acceſſit Doctrinæ Analyticæ inuentum nouum, collectum
ex variis eiuſdem D. de FERMAT Epiſtolis.

TOLOSÆ,
Excudebat BERNARDVS BOSC, è Regione Collegij Societatis Ieſu.
M. DC. LXX. [illegible]

325 CE

Metrodorus, who compiled the arithmetical epigrams in the Greek Anthology, may have flourished around 325, but may have been as much later as 500. These puzzle problems, such as one of a pipe filling a cistern, would today be solved by algebra. Sir Thomas Heath believes that such arithmetic/algebra problems date back to at least the 5th century BC.

499 CE

Aryabhata wrote his Aryabhatiya, which uses decimal place-value numeration, algebra, and geometry, and assigns to pi the value 3.1416.

628 CE

Brahmagupta wrote on geometry and algebra.

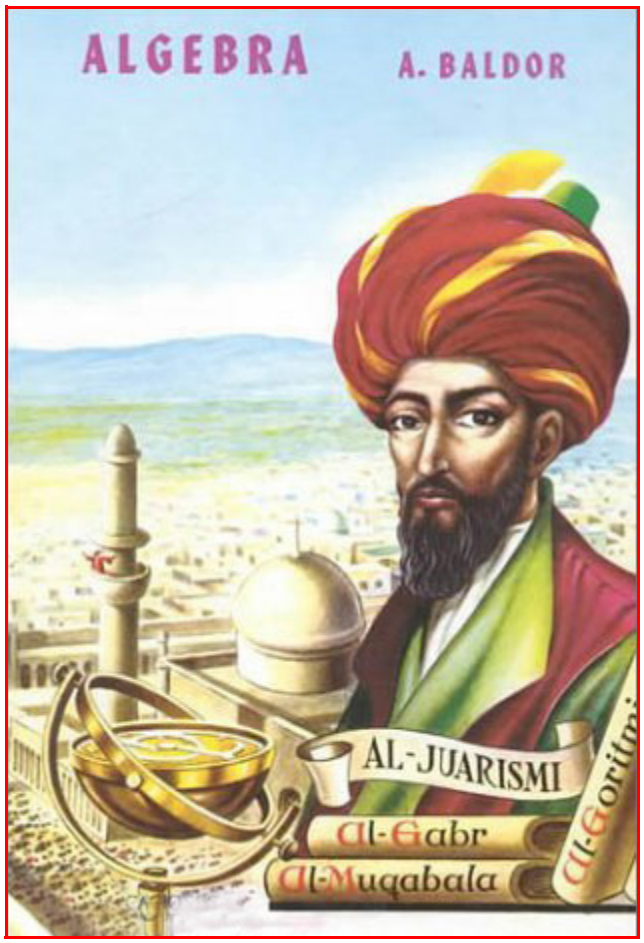
820 CE

During this decade, the Persian mathematician Mohammed ibn Musa al-Khowarizmi would, in *De Numero Indorum* "Concerning the Hindu Art of Reckoning," be developing a system of algebra, giving a set of rules for computation with Hindu-Arabic numerals. (Now we call these rules "algorithms," the very name of the topic being based upon the name of this person.)

Hrabanus Maurus wrote a Computus.

830 CE

During this decade Mohammed ibn Musa al-Khwarizmi would be publishing his *AL-JABR WA'L MUQABALAH* which gives algorithms for finding the positive solutions to all equations of the 1st and 2d degree, both linear and quadratic, and from which may or may not derive our term "algebra."



His works, along with those of Euclid, would be translated from Arabic into Latin by Adelard of Bath (*circa* the first half of the 12th Century) and Robert of Chester (*circa* the last half of that century).

850 CE

Mahavira wrote on arithmetic, algebra, and mensuration.

Sahl ibn Bishr wrote on arithmetic, algebra, and astronomy.

890 CE

Ahmed ibn al-Taiyib wrote on algebra.

Ahmed ibn Da-ud wrote on algebra.

900 CE

Abu Kamil Shuja ibn Aslam ibn Muhammad ibn Shuja (*circa* 850-*circa* 930) wrote on geometry and algebra.

950 CE

In more or less this timeframe, Bhakshali was writing on algebra.

1,000 CE

At about this point Hamid ibn al-Khidr was writing on algebra, and on the astrolabe, and Al-Hasan (al-Haitam) of Basra was writing on geometry and on algebra.

1020 CE

Al-Karkhi wrote on *al-gebra*, algebra.

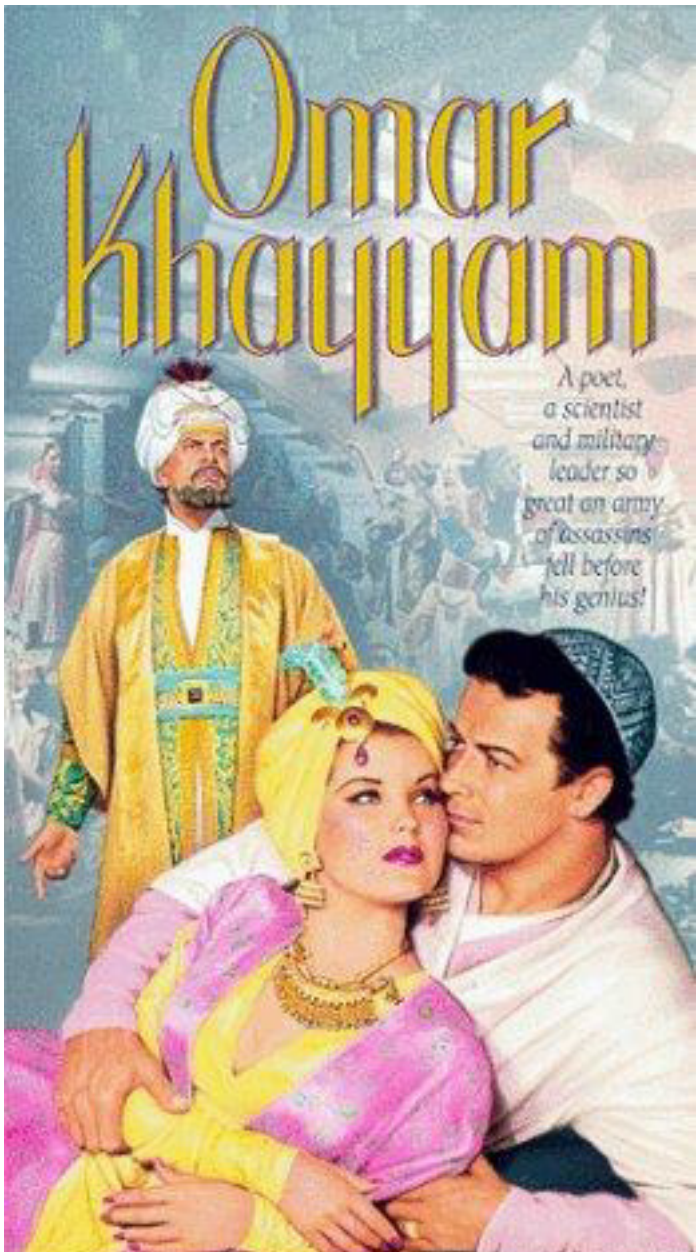
The Iranian poet Firdawsi described polo, a Central Asian equivalent of jousting, a favorite sport of Turkish aristocrats (according to Nizami, by the 13th Century their women also would be engaging in this horseback competition).

The Muslim polymath ibn Sina (known to the West as Avicenna) compiled THE CANON OF MEDICINE, but he also wrote about erosion and (perhaps) produced an account of superposition.

PALEONTOLOGY

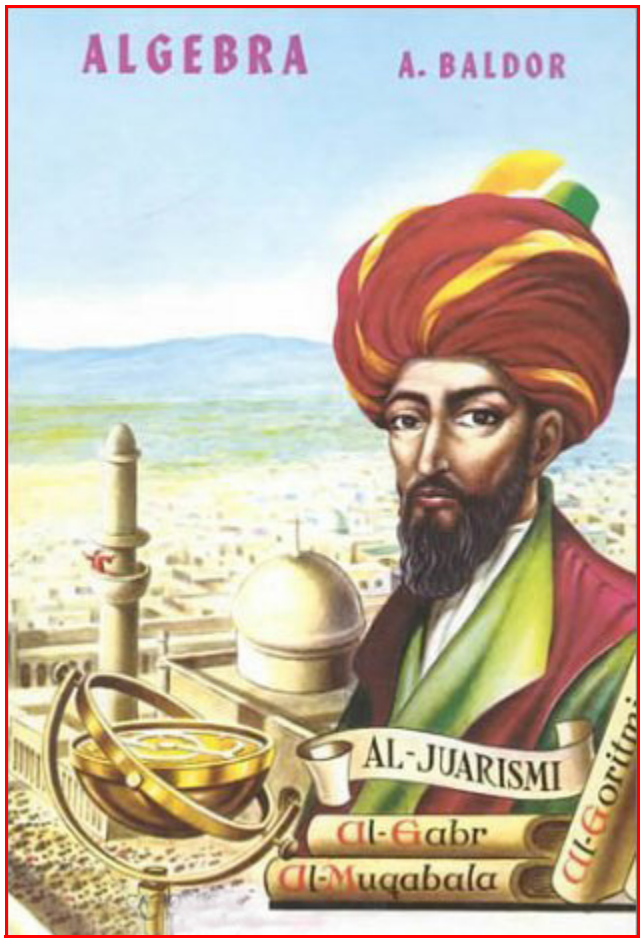
1068 CE

Omar Khayyam was 24 when he wrote his pioneering treatise on algebra — so it would have been in about this year. The *MAQALAT FI AL-JABR WA AL-MUQABILA* classified many algebraic equations based on their complexity and recognized 13 different forms of cubic equation. It pioneered a geometrical approach to solving equations which involved an selection of proper conics, which is to say, the mathematician was able to solve cubic equations by intersecting a parabola with a circle. This was the first mathematical treatise to develop the binomial expansion when the exponent is a positive integer. Al-Khayyam has been considered to be the first to find the binomial theorem and determine binomial coefficients. He extended Euclid's work giving a new definition of ratios and included the multiplication of ratios. He contributed to the theory of parallel lines. Although he referred in this Algebra book to another of his works, on what we now know as Pascal's triangle, this other mathematical treatise is now unfortunately lost. (Ten books and thirty monographs have survived. These include four books on mathematics, one on algebra, one on geometry, three on physics, and three on metaphysics.)


Omar
Khayyam
A poet,
a scientist
and military
leader so
great an army
of assassins
fell before
his genius!

1145 CE

Al-Khowarizmi's algebra was translated from Arabic into Latin, by Robertus Castrensis (Robert of Chester).



If any student should ask you in what sense the trigonometric function *sine* is similar to a bay or an inlet, the correct answer is "OK, so it's not like a bay or an inlet. Get over it." Translating a notation in this Arabic work –a notation which of course was written without vowels– into Latin, Robert added the vowels which he supposed would be implicit for a speaker of Arabic and the result was use of the word *sinus* (which in Latin means a bay or an inlet). From this effort by Robert of Chester we have derived the trigonometric function now termed the *sine,* and the terminology has long since become cast in concrete. In fact, however, that notation in the Arabic text had not been Arabic at all, but instead had been a loan notation from Hindi — and thus the whole *sine* terminology originated as a misunderstanding (not that this matters in the slightest, since a *sine* by any other name would smell as sweet).

1191

Tea bushes were planted as Korean Buddhists introduced Chinese tea-drinking ceremonies, and Zen paradoxes, into Japan.

PLANTS

At this point Chinese mathematicians were beginning to experiment with the Indo-Arabic zero placeholder notation ("gap," they termed it). The transmitters were more likely Indo-Iranian merchants than Zen Buddhist monks, for had it been Zen Buddhists who transmitted this from India, then Chinese mathematicians would already for three centuries have been toying with such a notation.

1220

During this decade Jordanus Nemorarius would be the first to use letters to represent the variables in algebra, as explained in his treatise *ARITHMETICA* (before this, writers had simply generalized on the basis of specific numerical examples). He would also write *ALGORIISMUS DEMONSTRATUS* "The Algorithm Demonstrated," and *DE NUMERIS DATIS* "On Given Numbers," collecting together various problem-solving rules and methods. He would also produce *MECHANICA*, a treatise on the law of the lever and the law of composition of movements, and his *ELEMENTA JORDANI SUPER DEMONSRATIONEM PONDERIS* "Elements for the Demonstration of Weights" would provide a early version of the later principle of virtual displacements as applied in this case to the lever.

LIFE IS LIVED FORWARD BUT UNDERSTOOD BACKWARD?
— NO, THAT'S GIVING TOO MUCH TO THE HISTORIAN'S STORIES.
LIFE ISN'T TO BE UNDERSTOOD EITHER FORWARD OR BACKWARD.

1247

Ch-in Kiu-shao, a soldier who had by 1244 made himself the governor over two provinces in China, wrote about numerical higher equations in "The Nine Sections of Mathematics," almost, applying algebra to trigonometry, using "O" for zero, and variously calculating pi as 3, as 22/7, and as the square root of 10. He came close to devising something we now term "Horner's Method," which would come into use in algebra as of 1819.

CHANGE IS ETERNITY, STASIS A FIGMENT

1249

In China, Li Yeh (1178-1265), governor of Chun Chou, wrote “The Sea Mirror of the Circle Measurement.” He would produce other books but would order his son to burn all but this one. Although he had a talent for representing complicated problems as equations in algebra, we don’t know for sure that he was able to solve these equations.

1258

Born in roughly this year in Morocco, deriving from a family of Granada, the scholar Albanna (Ibn al-Banna, also known as al-Marrakushi) would become best known for his *TALCHIS*, a treatise on arithmetic. He would also treat, however, of algebra, the astrolabe, astronomy, mensuration, and proportion.

1200 Chimneys were not known in England.
Surnames now began to be used; first amongst the nobility.
1208 London incorporated, and obtained their first charter, for electing their Lord Mayor and other magistrates, from king John.
1215 Magna Charta is signed by king John and the barons of England.
Court of Common Pleas established.
1227 The Tartars, a new race of heroes, under Gingis-Khan, emerge from the northern parts of Asia, over-run all the Saracen empire, and, in imitation of former conquerors, carry death and desolation wherever they march.
1233 The Inquisition, begun in 1204, is now trusted to the Dominicans.
The houses of London, and other cities in England, France, and Germany, still thatched with straw.
1253 The famous astronomical tables are composed by Alonzo, king of Castile.
1258 The Tartars take Bagdad, which finishes the empire of the Saracens.
1263 Acho, king of Norway, invades Scotland with 160 sail, and lands 20,000 men at the mouth of the Clyde, who are cut to pieces by Alexander III. who recovers the western isles.
1264 According to some writers, the commons of England were not summoned to parliament till this period.
1269 The Hamburgh company incorporated in England.
1273 The empire of the present Austrian family begins in Germany.
1282 Llewellyn, prince of Wales, defeated and killed by Edward I. who unites that principality to England.
1284 Edward II. born at Caernarvon, is the first prince of Wales.
1285 Alexander III. king of Scotland, dies, and that kingdom is disputed by twelve candidates, who submit their claims to the arbitration of Edward, king

1494

Luca di Pacioli wrote on algebra, including a study of the problems of cubic equations.

1647

In Concord, Richard Griffin was deputy and representative to the General Court.

The General Court of the Massachusetts Bay Colony required of each town constituted of more than 50 householders that it establish for itself a Town School (which is to say, a grammar school) adequate to prepare its progeny for matriculation at that colony's Harvard College. The schools would need to be offering instruction in general history, algebra, trigonometry, rhetoric, and logic, in addition of course to Latin and Greek. This act would come to be generally known as the "ye olde deluder Satan" act because in its preamble there was a reference to the design of that old deluder, Satan, to keep laity in ignorance of the BIBLE, the easier to tempt them. Teaching children to read would protect them from becoming Catholics, and keeping them in school would protect them from idleness:

> It being one chief project of the old deluder, Satan, to keep men from the knowledge of the Scriptures, as in former times by keeping them in an unknown tongue, it is therefore ordered that every township in this jurisdiction, after the Lord has increased them [in] number to fifty householders, shall then forthwith appoint one within their town to teach all such children as shall resort to him to write and read, whose wages shall be paid either by the parents or masters of such children, or by the inhabitants in general.

It is to be noted that his new requirement would not have been imposed as yet upon the town of Concord, since in this year it had but 55 adult males only 36 of which were freemen.[1]

> EDUCATION.— Many of the original inhabitants of Concord were well educated in their native country; and, "to the end that learning be not buried in the graves of the forefathers," schools were provided at an early period for the instruction of their children. In 1647, towns of 50 families were required to have a common school, and of 100 families, a grammar school. Concord had the latter before 1680. An order was sent to this town, requiring "a list of the names of those young persons within the bounds of the town, and adjacent farms, who live from under family government, who do not serve their parents or masters, as children, apprentices, hired servants, or journeymen ought to do, and usually did in our native country"; agreeably to a law, that "all children and youth, under family government, be taught to read perfectly the English tongue, have knowledge in the capital laws, and be taught some orthodox catechism and that they be brought up to some honest employment." On the back of this order is this return: "I have made dillygent inquiry according to this warrant and find no defects to return. Simon Davis, Constable. March 31, 1680." During the 30 years subsequent to this period, which I [Dr. Lemuel Shattuck] have denominated the *dark age* in Massachusetts, few towns escaped a

1. This percentage, 65%, was a high percentage for the towns of Massachusetts. Boston was only 53% free at that time, and Salem only 42%.

fine for neglecting the wholesome laws for the promotion of education. Though it does not appear that Concord was fined, a committee was appointed in 1692, to petition the General Court, "to ease us in the law relating to the grammar school-master," or to procure one "with prudence for the benefit of learning, and saving the town from fine." From that time, however, this school was constantly maintained. For several years subsequent to 1700, no appropriations were made to any other school. In 1701, grammar scholars paid 4*d.* and reading scholars 2*d.* per week towards its support; and from that time to 1712, from £20 to £30 were annually raised. In 1715, it was kept one quarter, in different parts of the town, for £40. The next year £50 were raised for schools; £35 for the centre, and £5 for each of the other three divisions. In 1722, Timothy Minott agreed to keep the school, for ten years, at £45 per year. In 1732, £50 were raised for the centre and £30 for the "out-schools"; and each schoolmaster was obliged to teach the scholars to read, write, and cipher, — all to be free. In 1740, £40 for the centre, and £80 for the others. These grants were in the currency of the times. In 1754, £40 lawful money were granted, £25 of which were for the centre. Teachers in the out-schools usually received 1*s.* per day for their services. The grammar-school was substituted for all others in 1767, and kept 12 weeks in the centre, and 6 weeks each, in 6 other parts, or "school societies" of the town. There were then 6 schoolhouses, 2 of which were in the present [1835] limits of Carlisle, and the others near where Nos. 1, 2, 4, and 6, now [1835] stand. This system of a *moving school*, as it was termed, was not, however, continued many years. In 1774 the school money was first divided in proportion to the polls and estates.

The districts were regulated, in 1781, nearly as they now [1835] are. The town raised £120, in 1784, for the support of schools, and voted, that "one sixteenth part of the money the several societies in the out-parts of the town pay towards this sum, should be taken and added to the pay of the middle society for the support of the grammar-school; and the out-parts to have the remainder to be spent in schools only." This method of dividing the school-money was continued till 1817, when the town voted, that it should be distributed to each district, including the centre, according to its proportion of the town taxes.

The appropriations for schools from 1781 to 1783, was £100; from 1784 to 1792, £125; 1793, £145; 1794 and 1795, £200; 1796 to 1801, £250; 1802 to 1806, $1,000; 1807 to 1810, $1,300; 1811, $1,600; 1812 to 1816, $1,300; 1817 and since, $1,400. There are 7 districts, among which the money, including the Cuming's donation, has been divided, at different periods, as follows. The last column contains the new division as permanently fixed in 1831. The town then determined the amount that should be paid annually to each district, in the following proportions. The whole school-money being divided into 100 parts, district, No. 1, is to have 52½ of those parts, or $761·25 out of $1,550; district, No. 2, $7\frac{5}{8}$ parts; district, No. 3, 8¼ parts; district,

No. 4, $8^{5}/_{8}$ parts; district, No. 5, 8¼ parts; district, No. 6, $7^{1}/_{8}$ parts; district No. 7, $7^{1}/_{8}$ parts; and to individuals who pay their money in Lincoln and Acton, ½ a part.

District. Old Names.	1801.	1811.	1821.	1830.	1832.
No. 1. Central	$382·92	$791·48	$646·15	$789·18	$761·25
No. 2. East	95·28	155·45	160·26	109·69	110·56¼
No. 3. Corner	68·49	135·48	142·48	117·00	119·62-½
No. 4. Darby	70·53	130·69	123·10	138·23	125·06¼
No. 5. Barrett	107·29	163·51	145·89	125·11	119·62¼
No. 6. Groton Road	64·63	105·41	93·55	79·16	103·31¼
No. 7. Buttrick	67·64	126·68	114·16	84·77	103·31¼
Individuals	22·22	41·30	24·41	6·86	7·25
	$884.00	1,650.00	1,450.00	1,450.00	1,450.00

At the erection of new school-houses in 1799, the first school committee was chosen, consisting of the Rev. Ezra Ripley, Abiel Heywood, Esq., Deacon John White, Dr. Joseph Hunt, and Deacon George Minott. On their recommendation, the town adopted a uniform system of school regulations, which are distinguished for enlightened views of education, and which, by being generally followed since, under some modification, have rendered our schools among our greatest blessings.

The amount paid for private schools, including the Academy, was estimated, in 1830, at $600, making the annual expenditure for education $2,050. Few towns provide more ample means for acquiring a cheap and competent education. I [Dr. Lemuel Shattuck] have subjoined the names of the teachers of the grammar-school since the Revolution, — the year usually

beginning in September.

Nathaniel Bridge	1785,	9 mo.	Isaac Warren	1812,	1 yr.
JOSEPH HUNT	1786,	2½ yr.	JOHN BROWN	1813,	1 yr.
William A. Barron	1788,	3 yr.	Oliver Patten	1814,	1 yr.
Amos Bancroft	1791,	1 yr.	Stevens Everett	1815,	9 mo.
Heber Chase	1792,	1 yr.	Silas Holman	1815,	3 mo.
WILLIAM JONES	1793,	1 yr.	George F. Farley	1816,	1 yr.
Samuel Thatcher	1794,	1 yr.	James Howe	1817,	1 yr.
JAMES TEMPLE	1795,	2 yr.	Samuel Barrett	1818,	1 yr.
Thomas O. Selfridge	1797,	1 yr.	BENJAMIN BARRETT	1819,	1 yr.
THOMAS WHITING	1798,	4 yr.	Abner Forbes	1820,	2 yr.
Levi Frisbie	1802,	1 yr.	Othniel Dinsmore	1822,	3 yr.
Silas Warren	1803,	4 yr.	James Furbish	1825,	1 yr.
Wyman Richardson	1807,	1 yr.	EDWARD JARVIS	1826,	1 yr.
Ralph Sanger	1808,	1 yr.	Horatio Wood	1827,	1 yr.
Benjamin Willard	1809,	1 yr.	David J. Merrill	1828,	1 yr.
Elijah F. Paige	1810,	1 yr.	John Graham	1829,	1 yr.
Simeon Putnam	1811,	1 yr.	John Brown,	1831.	

The *Concord Academy* was established, in 1822, by several gentlemen, who were desirous of providing means for educating their own children and others more thoroughly than they could be at the grammar-school (attended, as it usually is, by a large number of scholars) or by sending them abroad. A neat, commodious building was erected, in a pleasant part of the town, by the proprietors, consisting of the Hon. Samuel Hoar, the Hon. Abiel Heywood, and Mr. Josiah Davis, who own a quarter each, and the Hon. Nathan Brooks and Colonel William Whiting, who own an eighth each. Their intention has always been to make the school equal to any other similar one. It was opened in September, 1823, under the instruction of Mr. George Folsom, who kept it two years. He was succeeded by Mr. Josiah Barnes and Mr. Richard Hildreth, each one year.

Mr. Phineas Allen, son of Mr. Phineas Allen of Medfield, who was born October 15, 1801, and graduated at Harvard College in 1825, has been the preceptor since September, 1827.[2]

1705

From the preface to George Berkeley's *ARITHMETICA ABSQUE ALGEBRA AUT EUCLIDE DEMONSTRATA*, this writing would appear to have been in existence at this point, though he would not have it published until 1707. The volume is dedicated to Mr. Palliser, son of the archbishop of Cashel, and is followed by a MATHEMATICAL MISCELLANY containing some observations and theorems inscribed to his pupil Mr. Samuel Molyneux.

2. Lemuel Shattuck's 1835 A HISTORY OF THE TOWN OF CONCORD;... Boston: Russell, Odiorne, and Company; Concord MA: John Stacy
(On or about November 11, 1837 Henry Thoreau would indicate a familiarity with the contents of at least pages 2-3 and 6-9 of this historical study.)

1777

April 30, Wednesday: Johann Carl Friedrich Gauss was born.

Reorganization of the "Second Troop of Horse of Middlesex," formed in 1669, as the "Concord Light Infantry." The town sent 5 of its citizen soldiers to serve for 6 months with the Continental Army at an expense of £40 each plus an enlistment bounty of £8.

AMERICAN REVOLUTION

TABLE OF REVOLUTIONARY CAMPAIGNS[3]

WHEN REQUIRED	MEN	TIME	WHERE EMPLOYED	BOUNTY	AMOUNT
January 26, 1777	44	3 years	Continental Army	£20	£880
These [the above] were the first three-year men enlisted. Col. James Barrett mustered all the men from this county. Ephraim Wood paid the bounty of those enlisted in Concord. Nathan Wheeler, Ephraim Wheeler, Ephraim Minott, and Wareham Wheeler, were Lieutenants in the three years' service. The forty-four names follow. Thomas Wood, Matthew Jameson, Amos Nutting, Job Spaulding, John Hodgman, William Wilson, Josiah Blood, Patrick Neiff, David Jenners, Abraham Davis, Thomas B. Ball, Pomp Cady, James Bray, Daniel Brown, James Barrett, Edward Butt, Edward Wilkins, John Sherwin, Samuel Dutton, John Corneil, Samson Yammon, Daniel Stearns, Amos Darby, William Wheeler, Nathaniel Draper, Oliver Rice, Stephen Stearns, James Melvin, James Allen, Richard Anthony, Oliver Barnes, John McGath, Thomas Fay, Cesar Minott, Samuel Butler, Francis Legross, Charles Swan, James Marr, Nathaniel Taylor, Tilly Holden (died), Samuel Blood, Daniel Cole.					
April 12, 1777	11		Rhode Island	6	66
This [the above] was a detachment to reinforce General Spencer. Amos Hosmer and Thaddeus Hunt were Lieutenants.					
April 30, 1777	5	6 months	Continental Army	8	40
July 1777	29		Rhode Island	10	290
Abishai Brown was Captain [of the above]; Daniel Davis, of Acton, 1st Lieutenant; James Brown, of Lexington, 2d Lieutenant; Thaddeus Blood, Orderly Sergeant; Abel Davis, Drummer. They left about the 1st of June. Dr. Isaac Hurd was Surgeon of the regiment, which was commanded by John Jacobs and Lt. Colonel Robinson, and was under Gen. Spencer. Abishai Brown was appointed Major in this campaign. The town estimate gives fourteen only in this campaign, but is probably incorrect. Dea. White's MS. says, "July 23, 1777, an alarm, — draughted the following persons to go to R. Island [Rhode Island]," and gives the names of twenty-nine.					
August 9, 1777	16	5 months	Northward	35	560

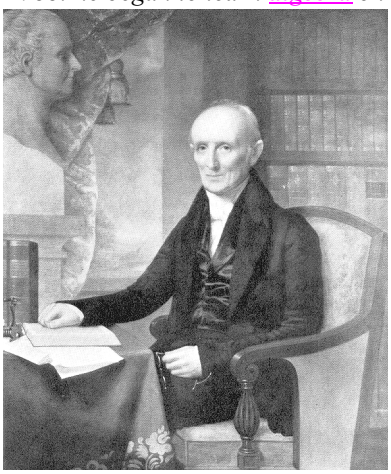
WHEN REQUIRED	MEN	TIME	WHERE EMPLOYED	BOUNTY	AMOUNT
These [the above] constituted one sixth of the militia. George Minott was Captain. They were at the battle of Saratoga, and at the taking of Burgoyne. They subsequently marched to New Jersey.					
September 22, 1777	46	41 days	Taking of Burgoyne	16	640
This [the above] was a volunteer company of sixty-three men from Concord and Acton, commanded by John Buttrick. John Heald and Silas Mann, were Lieutenants; John White, Samuel Piper, Reuben Hunt, and Peter Wheeler, Sergeants. They were under Colonel Reed. They left Concord, October 4th, passed through Rutland, Northampton, &c., and arrived at Saratoga on the 10th, where they encamped two days. The 13th they went to Fort Edward. The 14th and 15th, went out on a scout, and the 16th brought in fifty-three Indians, several Tories (one of whom had 100 guineas), and some women. The 17th "we had an express," says Deacon White's Journal, "to return to Saratoga, and had the pleasure to see the whole of Burgoyne's army parade their arms, and march out of their lines; a wonderful sight indeed; it was the Lord's doing, and it was marvellous in our eyes." They guarded the prisoners to Cambridge. $206 were subscribed to encourage these men, beside the bounty specified in the table. Samuel Farrar commanded a company from Lincoln and Lexington in this campaign.					
November 28, 1777	23	5 months	Guard at Cambridge	9	207
Capt. Simon Hunt, of Acton, commanded the company [above] to which most of the Concord men were attached, under Col. Eleazer Brooks and Gen. Heath. Nine companies guarded Burgoyne's troops down, five marching before and four behind.					

3. Lemuel Shattuck's 1835 A HISTORY OF THE TOWN OF CONCORD;... Boston: Russell, Odiorne, and Company; Concord MA: John Stacy
(On or about November 11, 1837 Henry Thoreau would indicate a familiarity with the contents of at least pages 2-3 and 6-9 of this historical study.)

1788

August 23, Saturday: A notebook bears the first entry:

"Algebra and Mathematics: Nathaniel Bowditch his book;
Aug. 23 1788: he began to learn algebra on the 1st of August 1787."



1796

March 30, Wednesday: Johann Carl Friedrich Gauss proved that a regular heptagon could not be constructed by ruler and compass. He discovered that it was possible, however, to create a 17-sided regular polygon with just a ruler and compass.

NOBODY COULD GUESS WHAT WOULD HAPPEN NEXT

July 10, Sunday: 19-year-old Johann Carl Friedrich Gauss wrote in his diary in Göttingen, a university city in Lower Saxony, that every positive integer was the sum of no more than 3 triangular numbers.

THE FUTURE CAN BE EASILY PREDICTED IN RETROSPECT

1805

Under Ching Shih, a former prostitute from the Canton area born in 1775 who had made herself a great pirate leader, the 5 most powerful crime families in China combine into a single syndicate. The syndicate defined zones of influence, and created an elaborate series of hand signs, passwords, and initiation rites to reduce the risk of accidental confrontations between unsuspecting fellow criminals. (Ching Shih bore sons to one pirate leader, Zheng Yi, then married his adopted son Zhang Pao following his death. Cutting a deal with the Chinese government in 1843 according to which of her navy of 17,318 pirates only 126 were executed for crimes and only 250 others awarded any sort of punishment, she would retire to Canton and take charge of a gambling and prostitution house.)

Linear regression analysis, perhaps one of the oldest topics in mathematical statistics, a way in which to approximate the solution of overdetermined systems (sets of equations in which there are more equations than unknowns) began in this year when the least squares method was published by Adrien-Marie Legendre. Johann Carl Friedrich Gauss, who would begin to publish about this in 1809, who was generally recognized as the *Princeps mathematicorum* or greatest mathematician since antiquity, actually had been using this technique of analysis since his calculation of the orbit of Pallas in 1795 but had not considered it as any big deal (until in this year Legendre made a really big deal about being 1st to proclaim it and asserted priority as himself having pioneered the technique). Both Gauss and Legendre applied the method to the problem of determining, from astronomical observations, the orbits of bodies about the sun (non-linear regression analysis is a whole lot more difficult to calculate and would need to wait for a later timeframe).

CHINESE

1818

Doctor Walter Channing became the initial Professor of Obstetrics and Medical Jurisprudence at Harvard College.

Professor John Farrar published for the use of his pupils an English version of Professor Sylvestre François Lacroix's *ÉLÉMENS D'ALGÈBRE*, titled ELEMENTS OF ALGEBRA. He would follow this with selections from Legendre, Blot, Bezant, and others. Harvard, the US military academy at West Point, and other institutions of higher education would at once adopt these works as textbooks.

Thomas Say accompanied his friend William Maclure (1763-1840), president of the Academy of Natural Sciences of Philadelphia (1817-1840), the geologist Gerard Troost (1776-1850), and others scientists on an expedition to the offshore islands of Georgia and Florida.

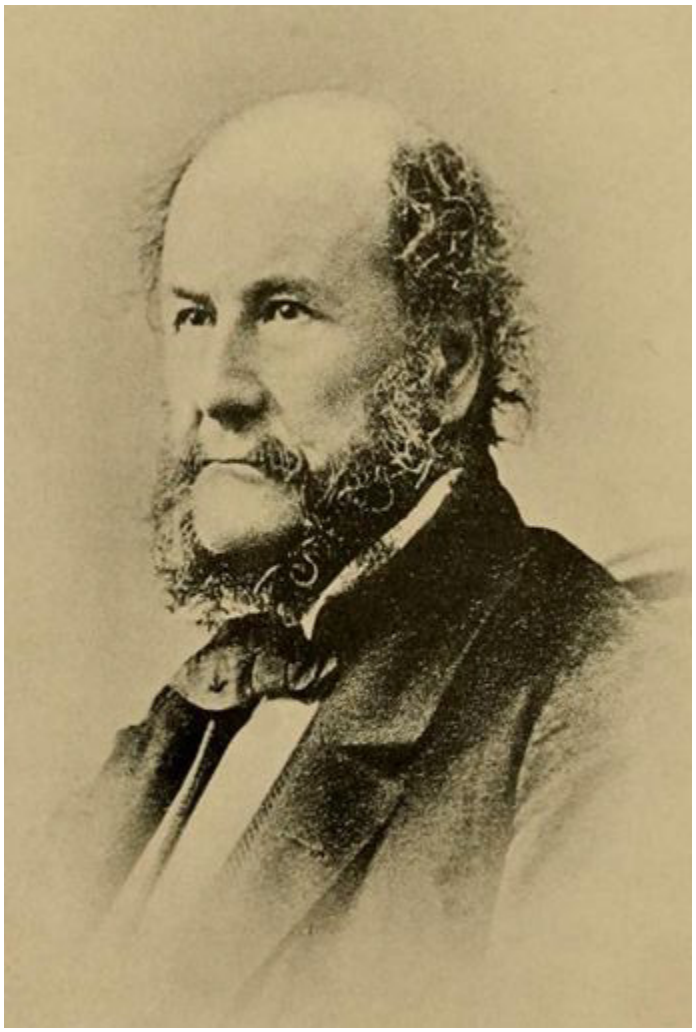
Say would have occasion to notice the US federal government to be engaging in "most cruel and inhuman war" against swamp dwellers, "these poor wretches whom we call savages." This was our 1st attempt at a final solution[4] of the problem presented by the "Black Seminole." General Andrew "Long Knife" Jackson was establishing that he had a perfect right to be hanged, or to be President of the United States of America — or *Der Führer* or something. Our hero was riding through the Spanish territories exterminating entire villages of women and children (and at night he wrote home to describe the villages as "Sodom and Gomorrah" to his beloved wife Rachel Jackson on their slave plantation — we find no response in which the beloved Rachel wrote "Well, I'm glad to hear you're behaving yourself"). To close out the 1st Seminole War after the loss of Pensacola and St. Marks, and to obtain US assurances about Spain's claim to Texas, Spain would cede Florida and the Oregon Territory to the United States.

4. In the German language, *Auflösung* is used for the answer to a word problem in algebra. Although its meaning is "final solution," it is not exactly the same as the *Endlösung* or "genocide" which our favorite general was seeking.

1819

Edward Tyrrell Channing succeeded Joseph McKean as Boylston Professor of Rhetoric and Oratory at Harvard College.

George Barrell Emerson became a tutor in natural philosophy and mathematics.



By this point Gauss's contributions to the "method of least squares" in what is now termed statistical inference had come to be so well known that even a gymnasium prospectus such as M.G. Paucker's *Ueber die Anwendung der Methode der kleinsten Quadratsumme auf physikalische Beobachtungen* (Johann Friedrich Steenhagen und Sohn, Mitau) was able to cite Legendre and Gauss. Gauss's process, that ties together into one package what we now term linear algebra with what we now term optimization theory, despite it not yet having been fully recognized by mathematicians, and his probabilistic justification for the

inferences he was able to make, seems to have been being slowly adopted during this period by geodesists for purposes of navigation, for their research into the tools of cartography, and for their developments in timekeeping.

A food fight broke out between the Freshmen and the Sophomores in the dining hall at the college, and as punishments several of the identified participants were “rusticated.” The Sophomore class met beneath “Rebellion Elm” to issue a series of demands and then resigned en masse — but within two weeks the students had individually straggled back without having succeeded in getting these banishments rescinded. You can read about this if you have the stomach for it, in a poem of four atrocious cantos entitled “Rebelliad; Or Terrible Transactions at the Seat of the Muses.” [SOMEBODY OUGHT TO TAKE A LOOK AT THE WILLIAM FURNESS SERIES OF CONTEMPORARY DRAWINGS OF THIS FOOD FIGHT, FROM THE HARVARD ARCHIVES, AND SEE WHETHER THIS DRAWING IS ONE OF THEM]

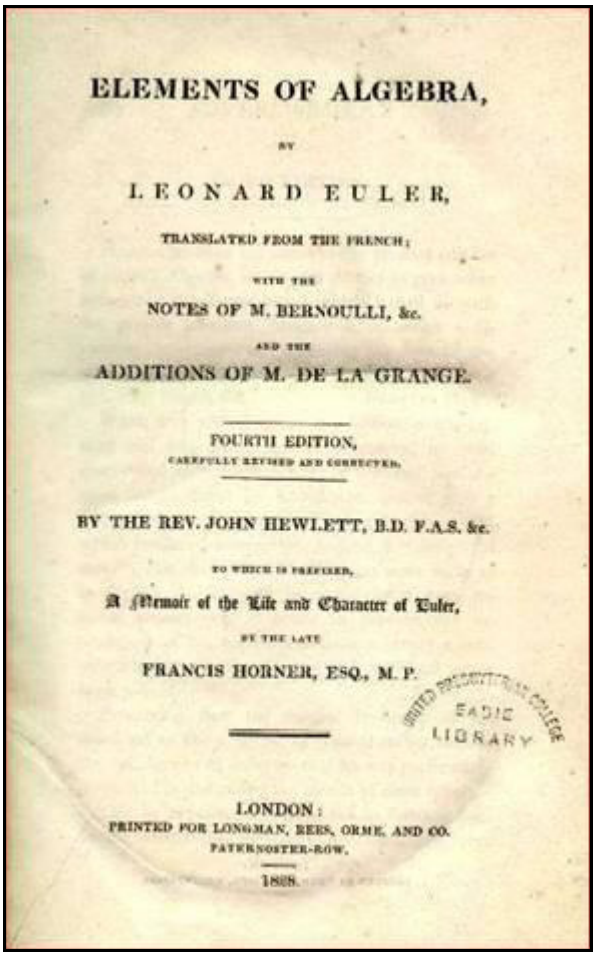
REBELLIAD; OR TERR...

1828

Publication by Hilliard, Gray, Little, and Wilkins in Boston of the 3d edition of Professor John Farrar of Harvard College's AN INTRODUCTION TO THE ELEMENTS OF ALGEBRA, DESIGNED FOR THE USE OF THOSE WHO ARE ACQUAINTED ONLY WITH THE FIRST PRINCIPLES OF ARITHMETIC / SELECTED FROM THE ALGEBRA OF EULER.

ELEMENTS OF ALGEBRA

Here is the 1828 English edition of Leonard Euler's ELEMENTS OF ALGEBRA, from which the more elementary materials in this school textbook had been extrapolated:



ELEMENTS OF ALGEBRA,

BY

LEONARD EULER,

TRANSLATED FROM THE FRENCH;

WITH THE

NOTES OF M. BERNOULLI, &c.

AND THE

ADDITIONS OF M. DE LA GRANGE.

FOURTH EDITION,

CAREFULLY REVISED AND CORRECTED.

BY THE REV. JOHN HEWLETT, B.D. F.A.S. &c.

TO WHICH IS PREFIXED,

A Memoir of the Life and Character of Euler,

BY THE LATE

FRANCIS HORNER, ESQ., M. P.

LONDON:

PRINTED FOR LONGMAN, REES, ORME, AND CO.

PATERNOSTER-ROW.

1828.

Professor Farrar married for a 2d time, with Eliza Ware Rotch.

The 3d and final volume of royal governor Thomas Hutchinson's THE HISTORY OF THE COLONY AND PROVINCE OF MASSACHUSETTS-BAY.

(The initial volume had been published in 1764, and the manuscript of the 2d volume had been recovered soiled from the street after the trashing of the governor's mansion, and published in 1767.)

CAMBRIDGE HISTORY OF ENGLISH AND AMERICAN LITERATURE

READ HUTCHINSON TEXT

1833

During this year Johann Carl Friedrich Gauss and Wilhelm Weber were inventing an electric telegraph.

May 6, Monday: Faced with Russian intervention, Egypt acceded to the Peace of Kutahya with the Sultan in exchange for Turkey accepting the independence of Egypt, and ceding to it Syria and Aden.

Johann Carl Friedrich Gauss and Wilhelm Weber were granted permission to construct an electromagnetic telegraph in Göttingen, Gauss's home town.

Robert B. Randolph, a federal officeholder who had been dismissed for embezzlement, took a punch at President Andrew Jackson (Jackson would not press further charges against the man).

August 9, Friday: Waldo Emerson left London on a visit to Oxford.

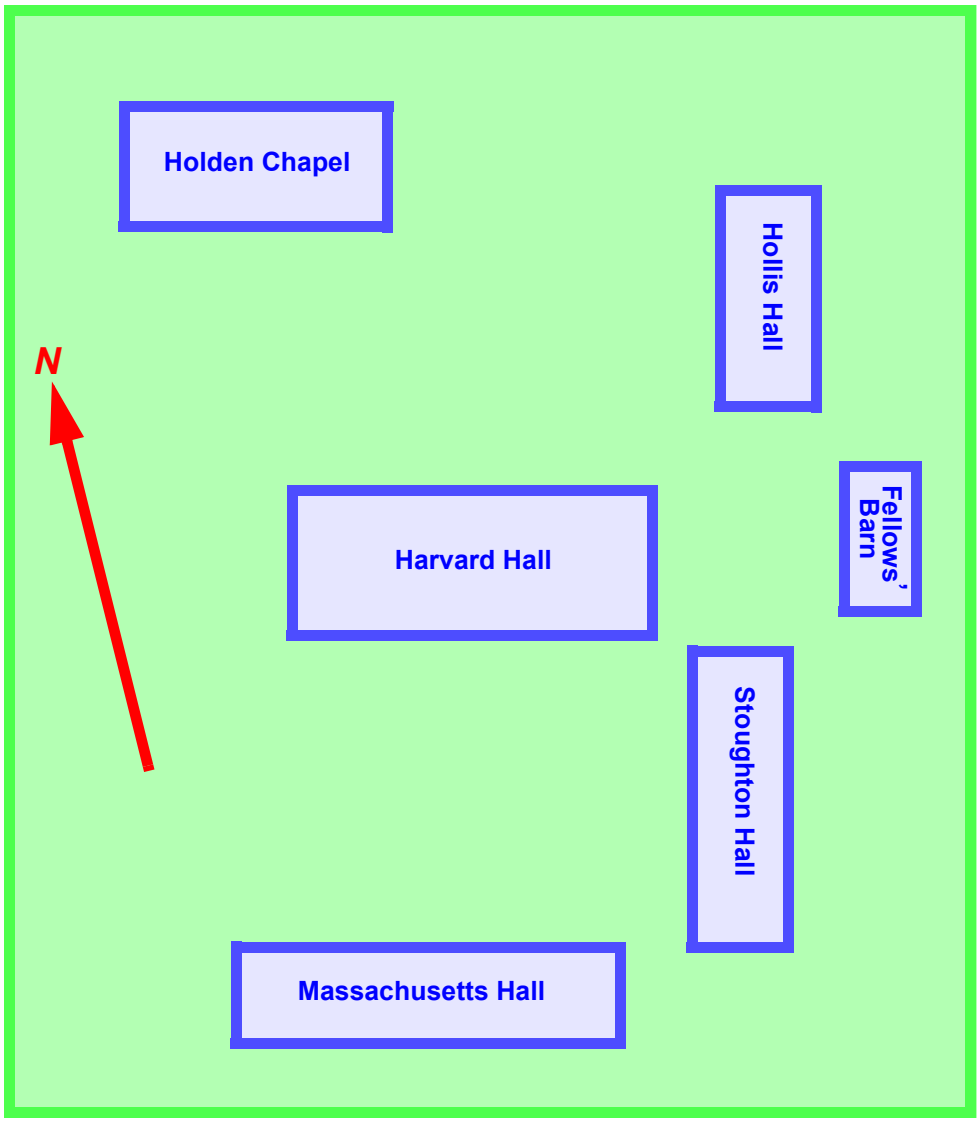
David Henry Thoreau, accepted as a charity scholar, left home for Harvard College.[5] While an undergraduate at Harvard 1833-1837 in what essentially was its "Comp Lit" program, he would reside initially with Charles Stearns Wheeler of Lincoln in an upstairs room, 20 Hollis Hall, that had (has) a fine view of the sunsets across the Common.[6]

COMPARATIVE LITERATURE

5. Since the native-son undergraduates Lemuel Shattuck mentions in Chapter XVI of his history of Concord were in the Harvard College classes of 1834 (George Moore) and 1835 (Hiram Dennis and Ebenezer Hoar), this material would have needed to have been written between May 1833 and May 1834. The earlier date is more likely than the later date since Marshall Meriam, who graduated from Yale College with its Class of 1833, is carried as still an undergraduate there. David Henry Thoreau of Concord was unmentioned as a current Harvard College undergraduate in that 1835 history, therefore, simply because at the time the material was being penned, he had not yet matriculated.
6. He later occupied other rooms nearby in the same dormitory.

FRESHMEN.

NAMES.	RESIDENCE.	ROOMS.
Adams, Joseph Henry,	*Boston,*	H. 18
Allen, William,	*Bridgewater,*	Mr. J. Foster's
Bacon, John,	*Boston,*	H. 2
Barnes, Henry,	*Marlborough,*	
Barstow, Simon Forrester,	*Salem,*	Mr. Saunders's
Belcher, Clifford,	*Farmington, Me.*	D. 7
Benjamin, Henry Benjamin,	*Boston,*	Dr. Stearns's
Bigelow, Henry Jacob,	*Boston,*	H'y 18
Clarke, Manlius Stimson,	*Norton,*	H. 4
Dale, William Johnson,	*Gloucester,*	H'y 9
Dall, Charles Henry Appleton,	*Boston,*	H. 2
Davis, William,	*Plymouth,*	St. 17
Eustis, John Fenwick,	*Norfolk, Va.*	St. 4
Forrester, George Hely Hutchinson,	*Salem,*	H. 7
Greenough, William Whitwell,	*Boston,*	Dr. Stearns's
Hale, Horatio Emmons,	*Boston,*	St. 20
Haskins, David Greene,	*Roxbury,*	Miss Parker's
Hawes, William,	*Boston,*	Dr. Stearns's
Hayward, Charles,	*Boston,*	H. 3
Hildreth, Samuel Tenney,	*Gloucester,*	Mr. J. Foster's
Holmes, Christopher Columbus,	*Kingston,*	St. 17
Holmes, Nathaniel,	*Peterborough, N. H.*	Mrs. Howe's
Hubbard, Henry,	*Charlestown, N. H.*	St. 3.
Kendall, Samuel Austin,	*Augusta, N. Y.*	St. 3
Kettell, Edward Henry,	*Boston,*	St. 20
Kimball, Benjamin Gage,	*Needham,*	St. 19
Lane, John Foster Williams,	*Boston,*	H'y 18
Maxwell, John Bayard,	*New Castle Co., Del.*	H. 19
Peabody, Augustus Goddard,	*Boston,*	H. 18
Perry, Amos,	*Natick,*	St. 19
Phelps, Francis,	*Hadley,*	H. 4
Rice, Charles Wyatt,	*Brookfield,*	2 C. H. 8
Richardson, James,	*Dedham,*	H. 1
Russell, Charles Theodore,	*Princeton,*	St. 26
Stone, Henry Orne,	*Salem,*	Dr. Ware's
Thomas, Charles Grandison,	*Denmark, N. Y.*	M. 1.
Thoreau, David Henry,	*Concord,*	H. 20
Treat, Samuel,	*Portsmouth, N. H.*	M. 1
Trull, Samuel,	*Boston,*	Mr. W. Warland's
Vose, Henry,	*Dorchester,*	Rev. H. Ware's
Weiss, John,	*Worcester,*	H. 1
Wheeler, Charles Stearns,	*Lincoln,*	H. 20
Whitney, Giles Henry,	*Boston,*	D. 8
Whitwell, Benjamin,	*Boston,*	H'y 9
Wight, Daniel,	*Natick,*	Miss Robbins's
Williams, Henry,	*Boston,*	H'y 1
Williams, Francis Stanton,	*Boston,*	H'y 1
Clap, Harvey Erastus,	*Walpole,*	H. 7
Ferguson, Jordan Goodwin,	*South Berwick, Me.*	Mrs. Howe's

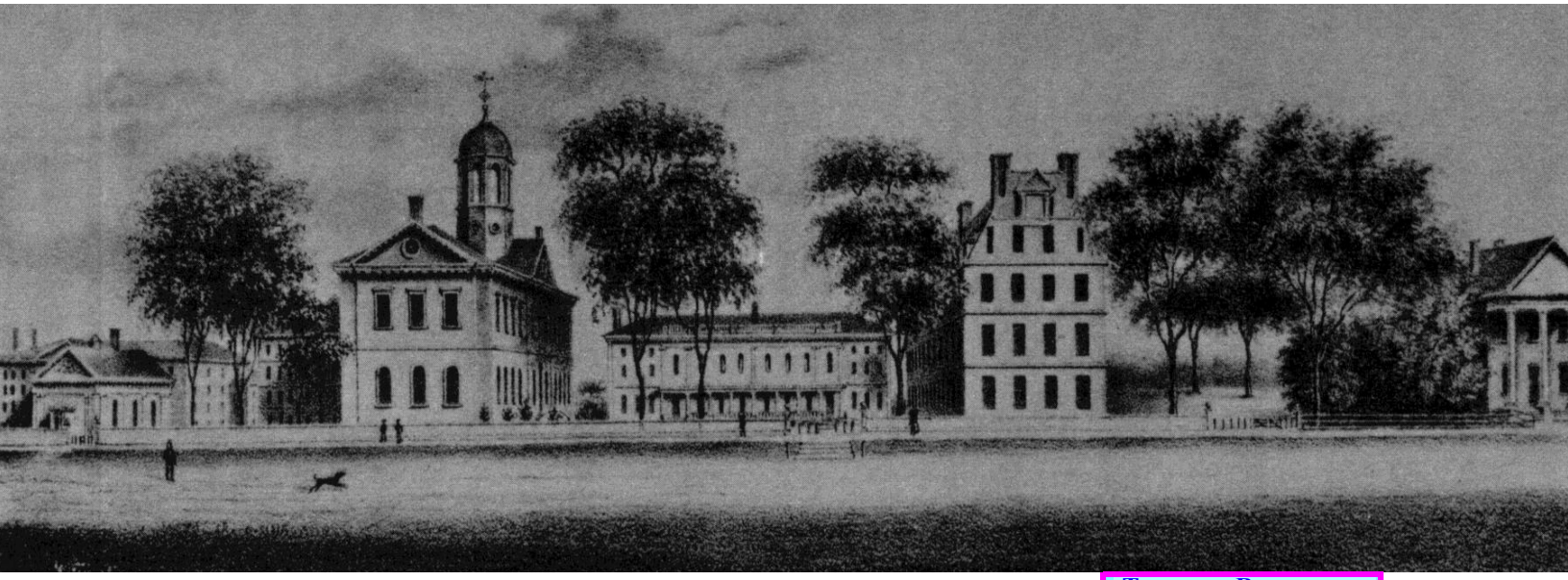

Holden Chapel
Hollis Hall
N
Fellows' Barn
Harvard Hall
Stoughton Hall
Massachusetts Hall

He had "many and noisy neighbours, and a residence in the fourth storey." At that time tuition was $55.^{00}$ per year, Harvard had a faculty of perhaps 25 and a student body of perhaps 425, and the library boasted perhaps 40,000 books. Meals at the commons were $1.^{35}$ a week. From the 1820s into the 1840s, the regulation student attire was a "black-mixed" suit consisting of pantaloons, waistcoat, coat, tie, hat, shoes, and buttons of prescribed color, and various versions of this regulation attire were available at stores near campus for between $15.^{00}$ and $25.^{00}$. Thus although the top hat and the cane did not become *de rigeur* for the Harvard Man until the 1840s, to outfit Freshman Thoreau properly for his college career in 1833 would have required 30% to 50% of his scholarship money, and was just out of the question. In addition, President Josiah Quincy, Sr. informed Thoreau that his performance on the entrance examination had been such that

> *One branch more, and you had been turned by entirely. You have barely got in.*

We need not ask why, in the 19th Century, David Henry was favored by his family over Helen and over Sophia for this expensive education, but one of the unresolved questions in my mind is how it came about that, in a family in which first son and namesake John clearly was regarded as the more capable manchild, and in which there had been talk of apprenticing little brother to a carpenter, it came about that it was young David Henry

who went off to college to be partly supported by the earnings of his siblings.



THOREAU RESIDENCES

During this initial year at Harvard, David Henry would be subjected to a "thorough course" of "Plane Trigonometry, Analytic Geometry, and Algebra with practical application to Heights and Distances, and Surveying and Navigation." It would appear clear from the presence of a copy of Ebenezer Bailey's FIRST LESSONS IN ALGEBRA; BEING AN *EASY INTRODUCTION TO THAT SCIENCE*. DESIGNED FOR THE USE OF ACADEMIES AND COMMON SCHOOLS. BY EBENEZER BAILEY, PRINCIPAL OF THE YOUNG LADIES' HIGH SCHOOL, BOSTON; AUTHOR OF "YOUNG LADIES' CLASS BOOK," ETC. in Thoreau's personal library, and from the fact that this text was published by Carter, Hendee & Co. during July of this year in Boston, that the book

must have been useful for this course.

1ST LESSONS IN ALGEBRA

This course on navigation is still being offered and happens now to be the longest continuously running subject-matter offered there! “It’s the most practical course you can take at Harvard,” commented Dan Justicz ’91, an alum. “You find your way by watching the movements of the sun and stars. You even construct your own navigation instruments. There’s a minimum of lecturing.” “We use the historical instrument collection at [Harvard] Science Center, maps dating back to the 13th century at Pusey Library, and ships’ logbooks as old as 200 years,” says the instructor, Dr. Sadler. “Students come to appreciate how difficult it was for Columbus, or Magellan, to find their way without accurate clocks.” The course is now offered as endowed under the Francis W. Wright Lectureship in Celestial Navigation.
(Thoreau’s Harvard curriculum would include eight terms of Greek under Professor Cornelius Conway Felton and [Instructor?] Dunkin. These eight terms would begin with Greek composition and grammar, and continue into “Greek Antiquities” and works by Xenophon, Demosthenes, Aeschines, Sophocles, Euripides, and Homer. –What, your college education was not like that?

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CHARLES BECK, P. D.
CORNELIUS C. FELTON, A. M., *Tutor to Sophomores.*
HENRY S. McKEAN, A. M., *Tutor to Seniors and Freshmen.*
JOEL GILES, A. B., *Tutor to Juniors.*
BENJAMIN PEIRCE, A. M.

— Perhaps you didn't major in Comp Lit! :-)

NEW "HARVARD MEN"

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——— ———, *Eliot Professor of Greek Literature.*
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BARZILLAI FROST, A. B., *Proctor.*
EDGAR BUCKINGHAM, A. B., *Proctor.*
WILLIAM G. ELIOT, A. B., *Instructer in Hebrew.*
CHRISTOPHER DUNKIN, *Instructer in Greek.*

———

OLIVER SPARHAWK. *Steward.*

1834

Relying upon measurements of the earth's magnetic field made by the physicist Paul Erman in 1828, Johann Carl Friedrich Gauss was able to demonstrate that the origin of the planet's magnetic field could only be deep inside the planet itself.

1836

At Harvard College the Hollis Professor of Mathematics and Natural Philosophy, John Farrar, resigned his chair for reasons of health. Mrs. Eliza Ware Rotch Farrar would be beside her invalid husband both in Cambridge and abroad until his finally succumbing to this ailment, in 1853.

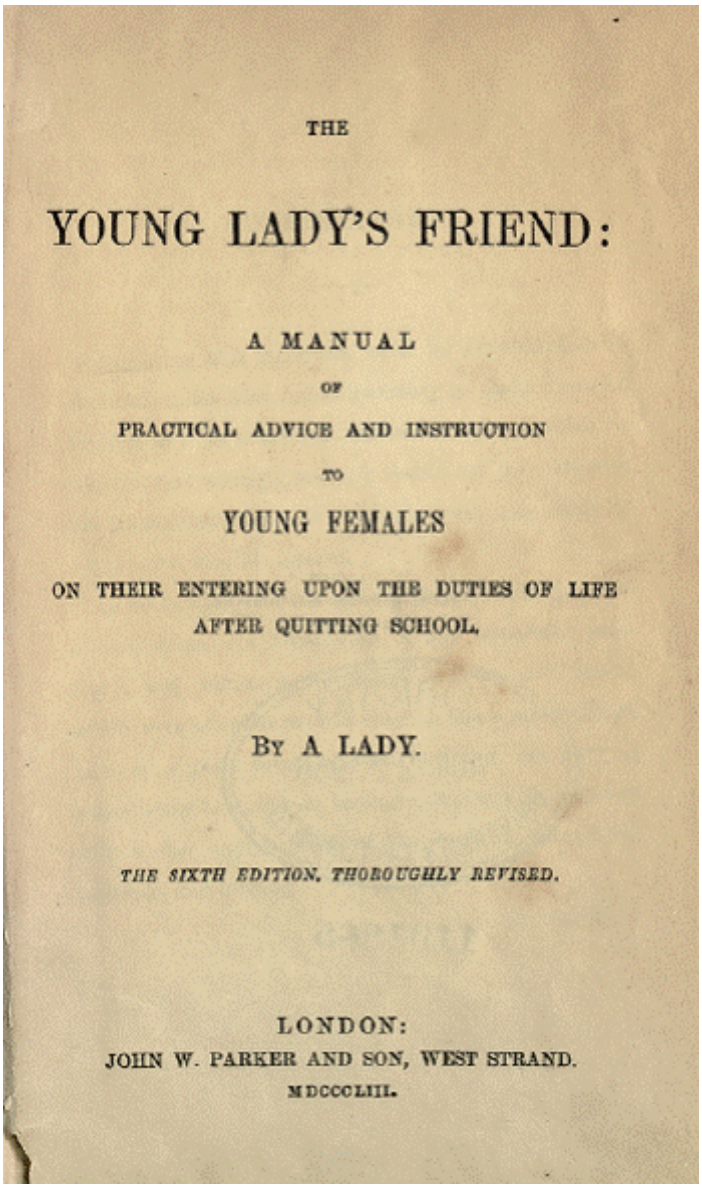
From a partial index of college reading made in about this year, we learn that at one point or another Harvard College undergraduate David Henry Thoreau had accessed Vicar John William Cunningham's A WORLD WITHOUT SOULS (Boston: Manning & Loring, 1810).

A WORLD WITHOUT SOULS

In about this year Thoreau cited his reading of Antoine Court de Gébelin, in "Miscellaneous Extracts."

Mrs. Eliza Ware Rotch Farrar's manual of advice for aspiring young ladies of the middle class, THE YOUNG LADY'S FRIEND (this would be being reprinted both in America and in England as late as 1880). Women, it seems, have a "peculiar calling," and it is one the proper fulfilment of which required a great deal of cautious

common sense.



THE

YOUNG LADY'S FRIEND:

A MANUAL

OF

PRACTICAL ADVICE AND INSTRUCTION

TO

YOUNG FEMALES

ON THEIR ENTERING UPON THE DUTIES OF LIFE AFTER QUITTING SCHOOL.

By A LADY.

THE SIXTH EDITION, THOROUGHLY REVISED.

LONDON:
JOHN W. PARKER AND SON, WEST STRAND.
MDCCCLIII.

Sit not with another in a place that is too narrow; read not out of the same book; let your eagerness to see anything induce you to place your head close to another person's.

1837

At the Smolensk Lutheran Cemetery on Vasilievsky Island near St. Petersburg, Russia, a headstone was added to the gravesite of Leonhard Euler.

Is it possible that Henry Thoreau derived his life motto "Simplify, simplify" from the method used in algebra class?

"To what end do I lead a simple life at all, pray? That I may teach others to simplify their lives? —and so all our lives be simplified merely, like an algebraic formula?— Or not, rather, that I may make use of the ground I have cleared — to live more worthily and profitably?"

— Henry Thoreau, September 26, 1855

WHAT I'M WRITING IS TRUE BUT NEVER MIND YOU CAN ALWAYS LIE TO YOURSELF

December 31, Sunday: Friend Stephen Wanton Gould wrote in his journal:

1st day 31 of 12 M 1837 / We have had good Meetings today, solid

> *quiet & well attended*
> *In the Morning Father Rodman was engaged in testimony & in the Afternoon Our friends John D Lang from Berwick Maine attended & was engaged in a very pertinent & well Authorized testimony —On the whole we have had a good day & I am thankful for the favour, here ends the Year & the end crowns all. -*
>
> RELIGIOUS SOCIETY OF FRIENDS

In his journal on this day Henry Thoreau provided us with some clue as to the nature of his classical education by the making of an allusion to a one-liner from Horace's SATIRES, "*Invenias etiam disiecti membra poetae*." What Thoreau writes in his journal is "We go picking up from year to year and laying side by side the *disjecta membra* of truth." (Although it is true that one might nowadays pick up a phrase such as "*disjecta membra*" from anywhere in the general culture, such as out of a TV sitcom, it is clear from numerous other such references that in Thoreau's 19th-Century context he had been obtaining these materials in the course of his formal education and that he had acquired considerable familiarity with Horace's body of work.)

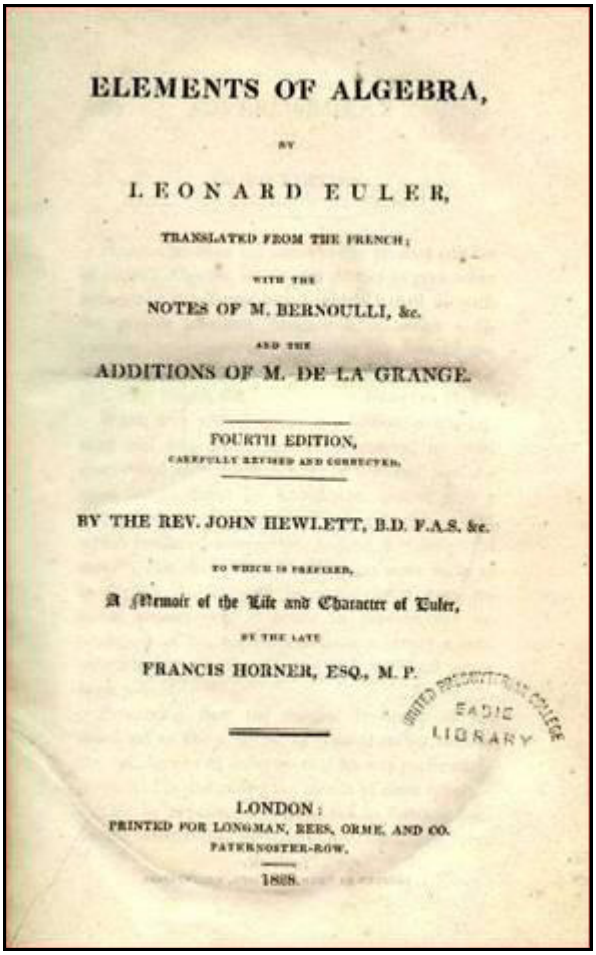
Thoreau had occasion to reflect on, and to recycle, a problem from his algebra textbook at the Concord Academy, Professor John Farrar of Harvard College's AN INTRODUCTION TO THE ELEMENTS OF ALGEBRA, DESIGNED FOR THE USE OF THOSE WHO ARE ACQUAINTED ONLY WITH THE FIRST PRINCIPLES OF ARITHMETIC / SELECTED FROM THE ALGEBRA OF EULER (3d ed. Boston: Hilliard, Gray, Little and Wilkins, 1828), some of the examples of which he had calculated as a student of ten or eleven years of age:[7]

> As the least drop of wine tinges the whole goblet, so the least particle of truth colors our whole life. It is never isolated, or simply added as treasures to our stock. When any real progress is made, we unlearn and learn anew what we thought we knew before. We go picking up from year to year and laying side by side the disjecta membra of truth, as he who picked up one by one a row of a hundred stones, and returned with each separately to his basket.

7. Thoreau also had in his personal library Professor Farrar's 1825 textbook AN ELEMENTARY TREATISE ON MECHANICS, his 1826 textbooks ELEMENTS OF ELECTRICITY, MAGNETISM, AND ELECTROMAGNETISM and AN EXPERIMENTAL TREATISE ON OPTICS, his 1827 textbook AN ELEMENTARY TREATISE ON ASTRONOMY, and his 1834 translation of Professor Sylvestre François Lacroix's AN ELEMENTARY TREATISE ON ARITHMETIC, all of which were required texts either at the Concord Academy or at Harvard.

LACROIX ON ARITHMETIC

Christian P. Grueber had the following to offer in his 1853 PhD dissertation "The Education of Henry Thoreau, Harvard 1833-1837": "John Farrar, the compiler of the four books which were the basis of the course in natural philosophy, rightly calls each of them a treatise. In this area of 'mixed mathematics,' the student began with mechanics, and then proceeded through electricity, optics, and finally astronomy. If Thoreau's grades are any indication of attitude, the theoretical approach to the mixed mathematics was not to his liking. In calculus, the last of the pure mathematics, Thoreau's grades averaged 6.7, not far below the 6.9 average he was maintaining in Greek and for which he merited the honor of an exhibition part. But in mechanics, for which he supposedly had a natural aptitude and some practice in the family business, his grades dropped to a very mediocre 4.9." (Unfortunately, Dr. Grueber tells us nothing about Thoreau's classroom performance in regard to Farrar's Lacroix's ARITHMETIC.)



ELEMENTS OF ALGEBRA,

BY

LEONARD EULER,

TRANSLATED FROM THE FRENCH;

WITH THE

NOTES OF M. BERNOULLI, &c.

AND THE

ADDITIONS OF M. DE LA GRANGE.

FOURTH EDITION,

CAREFULLY REVISED AND CORRECTED.

BY THE REV. JOHN HEWLETT, B.D. F.A.S. &c.

TO WHICH IS PREFIXED,

A Memoir of the Life and Character of Euler,

BY THE LATE

FRANCIS HORNER, ESQ., M. P.

LONDON:

PRINTED FOR LONGMAN, REES, ORME, AND CO.

PATERNOSTER-ROW.

1828.

QUESTIONS FOR PRACTICE.

1. Required the sum of an increasing arithmetical progression, having 3 for its first term, 2 for the common difference, and the number of terms 20.

   Ans. 440.

2. Required the sum of a decreasing arithmetical progression, having 10 for its first term, $\frac{1}{3}$ for the common difference, and the number of terms 21.

   Ans. 140.

3. Required the number of all the strokes of a clock in twelve hours, that is, a complete revolution of the index.

   Ans. 78.

4. The clocks of Italy go on 24 hours; how many stokes do they strike in a complete revolution of the index?

   Ans. 300.

5. One hundred stones being placed on the ground, in a straight line, at the distance of a yard from each other, how far will a person travel who shall bring them one by one to a basket, which is placed one yard from the first stone?

   Ans. 5 *miles* and 1300 *yards*.

1840

January 10, Friday: Henry Thoreau worked a problem out of an algebra textbook by the Reverend Jeremiah Day (August 3, 1773-August 22, 1867, Professor of Mathematics and Natural Philosophy, in Yale College,

eventually the successor to the Reverend Timothy Dwight as President of Yale College), AN INTRODUCTION TO ALGEBRA, BEING THE FIRST PART OF A COURSE OF MATHEMATICS, ADAPTED TO THE METHOD OF INSTRUCTION IN THE AMERICAN COLLEGES (New-Haven, Published by Howe & Deforest, Oliver Steele, Printer, 1814). The problem he selected is to identify a four-number geometric progression series in which the 4th number of the series is 24 more than the 2d number of the series, and the sum of the 1st number and 4th number is to the sum of the 2d number and 3d number, in the ratio of 7 to 3.

Thoreau's first move was to identify the four numbers of the series as respectively x, xy, xy^2, and xy^3.

Then he stated the first of the constraints, that the 4th number of the series is 24 more than the 2d number of the series, as $xy^3 - xy = 24$.

Then he stated the second of the constraints, that the sum of the 1st number and 4th number is to the sum of the 2d number and 3d number in the ratio of 7 to 3, as $3x + 3xy^3 = 7xy + 7xy^2$. Not bothering to write down the steps of the transformation, this immediately became $y^3 = (7y + 7y^2)/3 - 1$.

Then, putting $y^3 = (7y + 7y^2)/3 - 1$ into $xy^3 - xy = 24$ and freeing the denominator and reducing immediately generated $7xy^2 + 4xy - 3x = 72$.

Then comparing $7xy^2 + 4xy - 3x = 72$ with $3x + 3xy^3 = 7xy + 7xy^2$ and eliminating xy and reducing $7xy^2 - 3x + 4xy^3 = 168$ on $xy^2 = 24 + (3x - 4xy^2)/7$ giving xy^3 its value obtained from $xy^3 - xy = 24$, putting the value of xy^2 as it then stands in the geometric progression series and taking the product of the means equal to that of the extremes x^2y [hole in the paper] $4x = 24xy + (3x^2y - 4x^2y^2 - 95xy)/7$.

Then finding by x, freeing of the denominator, and reducing, results in $xy + xy^2 = 18y - 42$.

Then putting the value of xy^2 obtained from this into $3x + 3xy^3 = 7xy + 7xy^2$ and reducing, results in $x + xy^3 = 42y - 98$.

Then putting the value of xy^3 obtained from this in $xy^3 - xy = 24$ and reducing, generates

$x + xy = 42y - 122$.

This is followed by $xy + xy^2 = 18y - 42$.

This is followed by $18y - 42 = 42y^2 - 122y$.

This is followed, on the basis of $xy^3 - xy = 24$, by $x = 24/(y^3 - y)$

By comparing $xy + xy^2 = 18y - 42$ he obtained y=3, hence x=1, and so the geometric progression that solves these simultaneous equations would have to be "1 3 9 27."

Henry would place this scrap of paper in his copy of Professor John Farrar of Harvard College's AN INTRODUCTION TO THE ELEMENTS OF ALGEBRA, DESIGNED FOR THE USE OF THOSE WHO ARE ACQUAINTED ONLY WITH THE FIRST PRINCIPLES OF ARITHMETIC / SELECTED FROM THE ALGEBRA OF EULER (Boston: Hilliard, Gray, Little, and Wilkins, 1828).

ELEMENTS OF ALGEBRA

In a much later timeframe, Franklin Benjamin Sanborn would come across this holograph fragment and attach it inside the front cover of copy #105 of his THE PERSONALITY OF THOREAU. This volume with its holographic fragment is now copy #3 in the special collections of Brown University, at the John Hay Library in Providence, Rhode Island.

Last Ques in Geom. Prog. in Day's Algebra.

(There is a Geom. Prog. of four numbers, such that the last is 24 more than the second, and the sum of the extremes is 9 times the means, as 1 to 3.) $x \quad xy \quad xy^2 \quad xy^3$ Then $(xy^3 - xy = 24)$ (1)

and $(3x + 3xy^3 = 7xy + 7xy^2)$ (2) From Relat $y^3 = \frac{7y + 7y^2}{3} - 1$

Putting this in N° 1, freeing of the denominator, and reducing-

$7xy^2 + 4xy - 3x = 72$ Comparing N° 2, eliminating xy,

and reducing $7xy^2 - 3x + 4xy^3 = 168$ or

$xy^2 = 24 + \frac{3x - 4xy^3}{7}$ Giving xy^3 its value obtained from N° 1,

putting the value of xy^2 as it then stands in the Prog.

and taking the product of the means equal to that

of the extremes. $x^2y + 4x = 24xy + \frac{3x^2y - 4x^2y^3 - 96xy}{7}$

Reducing by x, freeing of the denominator, and reducing-

$(xy + xy^2 = 18y - 42)$ (3) Putting the value of xy^2 obtained

from this in N° 2 and reducing. $x + xy^3 = 42y - 98$

Putting the value of xy^3 obtained from this in N° 1,

and reducing $x + xy = 42y - 122$ Comparing N° 3

$xy + xy^2 = 18y - 42$ we obtain

$18y - 42 = 42y^2 - 122y$ Hence $y = 3$

From N° 1 $x = \frac{24}{y^3 - y}$ Hence $x = 1$

Prog. = 1 3 9 27

Concord, Mass. 18th 1844

1845

George Phillips Bond, George Frisbie Hoar, son of Concord's Squire Samuel Hoar, and Gorham Bartlett, son of Concord's Dr. Josiah Bartlett, graduated from Harvard College.

NEW "HARVARD MEN"

Benjamin Apthorp Gould went to Germany to study mathematics and astronomy under Johann Carl Friedrich Gauss at the University of Göttingen (he would make himself the 1st American to earn a doctorate in this field).

Having entered Harvard, it has been asserted, "at an early age," in this year Thomas Russell graduated at the age of 20 with high honors. He had been (and this would matter) a classmate of Horace Gray. He would study law in the office of the honorable Jacob Hersey Loud at Plymouth, Massachusetts.

The following tabulation would be Horace Rice Hosmer's sarcastic take on a Franklin Benjamin Sanborn piece of eugenic engineering (and piece of typical Concord conceit), to wit, "Perpetuity, indeed, and hereditary transmission of everything that by nature and good sense can be inherited, are among the characteristics of

Concord":

The Harvard Apples that do or do not fall far from the Tree

CLASS	NAME	FATHER	SON
1834	George Moore	Abel Moore, the county sheriff in Concord, "came from Sudbury a rich farmer"	"Mason by trade and rich"
1835	Hiram Barrett Dennis	"came from Boston because he was a drunkard"	"died a drunkard's death when about 30"
1835	Ebenezer Rockwood Hoar	Judge Samuel Hoar	"came from Lincoln a rich lawyer"
1837	Henry D. Thoreau	"little, deaf pencil maker"	"never free from pecuniary difficulties the greater part of his life"
1841	John Shepard Keyes	John Keyes, founder of The Republican during the 1840 election, "came from Westford"	"Lawyer" [State Senator, District Judge]
1844	George M. Brooks	"came from Lincoln"	"Lawyer" [Judge]
1844	Edward Sherman Hoar	"came from Lincoln a rich lawyer"	"brother of Ebenezer R. Hoar"
1845	Gorham Bartlett	Dr. Josiah Bartlett, the Thoreau family physician, "came from Chelmsford"	[a pupil in Concord Academy who became a] "Doctor"
1846	George Frisbie Hoar	"came from Lincoln a rich lawyer"	"brother of Ebenezer R. Hoar"
1847	George Haywood	Dr. Abiel Heywood, long term town clerk and chairman of the Concord Board of Selectmen	"was a Doctor, and wealthy, of Concord"
1849	Joseph Boyden Keyes	"brother of Thomas L. Keyes"	became a lawyer
1851	Nathan H. Barrett	Captain Nathan Barrett "was a rich farmer of Concord"	Nathan Henry Barrett became a government clerk

1852

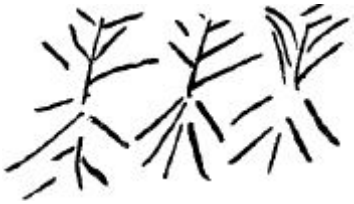
April 11, Easter Sunday: Lieutenant William Lewis Herndon arrived at the port of Pará, Brazil, on the Atlantic seaboard south of the mouths of the Amazon River.

In the afternoon Henry Thoreau walked to Second Division Brook at the West corner of the town.

Professor Robert M. Thorson points up the remarkable fact that in h is journal entry for this day Thoreau "revealed his genius for river-channel hydraulics, something readers of WALDEN would never suspect. In that passage, he described the three-dimensional helicoidal flow responsible for shaping the meandering channel of Nut Meadow Brook, putting him ahead of the state geologist [Edward Hitchcock] in his understanding": "The sight of Nut Meadow Brook in Brown's land – reminds me that the attractiveness of a brook depends much on the character of its bottom. I love just now to see one flowing through soft sand like this where it wears a deep but irregular channel – now wider & shallower with distinct ripple marks – now shelving off suddenly to indistinct depths. meandering as much up & down as from side to side.– deepest where narrowest – & ever gullying under this bank or that – its bottom lifted up to one side or the other – the current inclining to one side."

> Finally, in the boldest stroke of his inductive genius during the Walden years, Thoreau linked the side-to-side meandering with up-and-down meandering to recognize an even more fundamental type of three-dimensional meandering known as helicoidal flow. This is a corkscrew motion in which the forward-propagating sine curve of momentum rotates around the line of gravitational flow. In this conception, line, wave, and circle become a single entity. This unification took place in Thoreau's mind on the bank of Nut Meadow Brook on a lovely spring day in 1852 [April 11, 1852 journal entry below] when he noticed the streamlines of flow "meandering as much up and down as from side to side, deepest where narrowest, and ever gullying under this bank or that, its bottom lifted up to one side or the other, the current inclining to one side." At this point, the only thing Thoreau lacked was the explanation for the helical pattern he was seeing. Still searching a year later, he asks [refer to March 10, 1853 journal entry] "What is the theory of these sudden pitches, or steep shelving places, in the sandy bottom of the brook?" Thoreau's unwillingness to let go of an observation he does not fully understand brands him as a curiosity-driven scientist, hardly the trope-seeing transcendentalist he had left behind him a few years earlier.

Professor Thorson also notes an interesting "fractal" mathematics in Thoreau's illustration of the reflections of maple sapling twigs on the water surface below them:



He goes on, in his Figure 12 on his page 101, to compare and contrast this fractal math of twigs and their reflections with the fractal math seen in Thoreau's illustrations of (in date sequence) the leaf hoarfrost on January 6, 1853:

the serrated edge of wind-disturbed water on May 14, 1853:

and the embedded crenulations on the top surface of the molars of Mr. Pratt's muskrat on July 24, 1853:

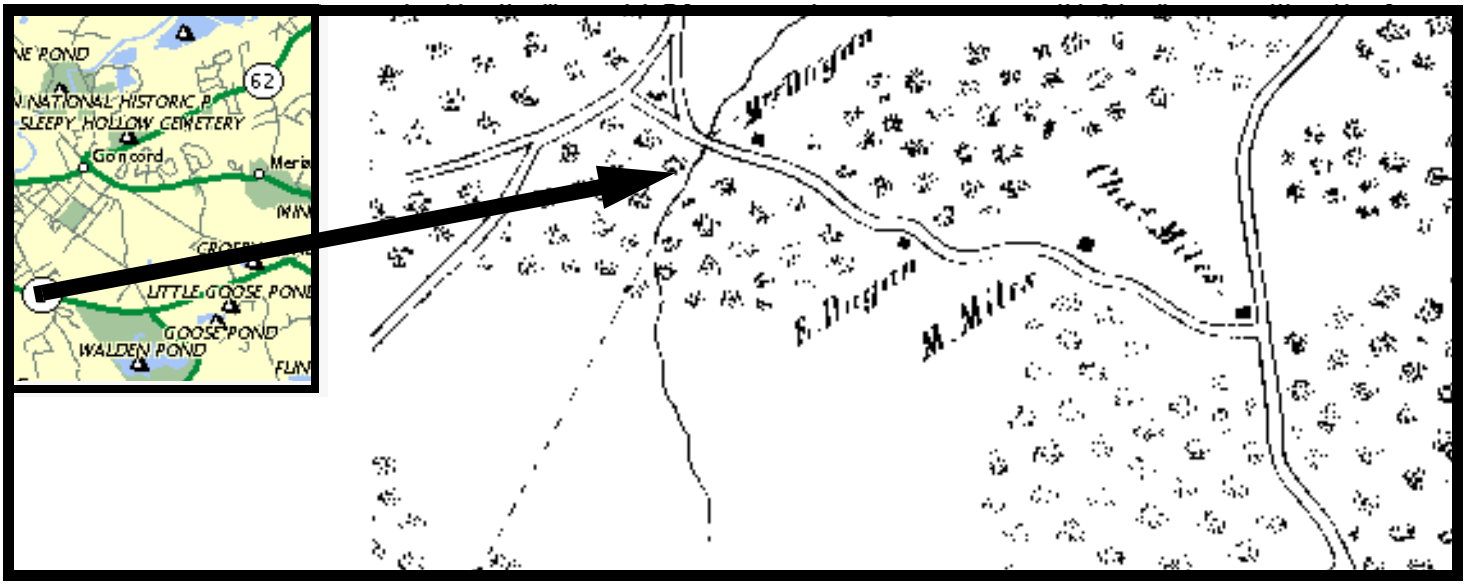
> Thoreau would have made a fine glaciologist, given his quantitative abilities and his obsession with the physical properties of ice and snow. During the cold winter of WALDEN's completion, he could often be found walking on the frozen Sudbury River where he observed, described, and classified winter phenomenon [refer to journal entry for December 2, 1853]. On New Year's day of 1854 he was enthralled by snowdrifts. His JOURNAL account of that experience reveals his insights into the continuum mechanics of fluids at steady state, and with the balance of forces involved: "The drifts mark the standstill or equilibrium between the currents of air ... The snow is like a mould, showing the form of the eddying currents of air which have been impressed on it, while the drift and all the rest is that which fell between the currents or where they counterbalanced each other." [refer to journal entry for January 1, 1854] By February he had become intrigued by the crystallography of slab ice, using the mathematical word "tessellation" to characterize the regular spatial packing of

large ice crystals on the surface of the Sudbury River, which may have resembled hexagonal floor tiles [refer to journal entry for February 12, 1854]. In early March, a cold snap caused the frozen ground near his house to contract to the threshold of rupture [refer to journal entry for March 4, 1854]. He sketched the resulting fractures with detail and accuracy, and with a pattern identical to those mapped by geologists studying fault zones in the Earth's crust. Specifically his sketch includes the fractal scaling of *enechelon* failures.

April 11, Sunday: 2 $^{1}/_{2}$ Pm to 2nd Div. Brook.
The ground is now for the most part bare – though I went through drifts 3 feet deep in some places. I hear that Simmonds had planted his potatoes!! before the snow a week ago. As I go over the RR. Bridge I hear the Pewee singing *Pewet Pewee – Pe-e-wet Pe-e-we-e*. The last time rising on the last syllable some times repeating it thus many times *Pe-we-e* The maple beyond the RR Bridge is not yet in blossom. though that at the Red Bridge is. The sight of Nut Meadow Brook in Brown's land – reminds me that the attractiveness of a brook depends much on the character of its bottom. I love just now to see one flowing through soft sand like this where it wears a deep but irregular channel – now wider & shallower with distinct ripple marks – now shelving off suddenly to indistinct depths. meandering as much up & down as from side to side.– deepest where narrowest – & ever gullying under this bank or that – its bottom lifted up to one side or the other – the current inclining to one side. I stop to look at the circular shadows of the dimples over the yellow sand–& the dark brown clams on their edges in the sand at the bottom. I hear the sound of the piano below as I write this and feel as if the winter in me were at length beginning to thaw – for my spring has been even more backward than nature's. For a month past life has been a thing incredible to me. None but the kind gods can make me sane– If only they will let their south winds blow on me. I ask to be melted. You can only ask of the metals that they be tender to the fire that **melts** them. To nought else can they be tender. The sweet flags are now starting up under water 2 inches high–& minnows dart. A pure brook is a very beautiful object to study minutely – it will bear the closest inspection – even to the fine air bubbles like minute globules of quicksilver that lie on its bottom. The minute particles or spangles of golden mica in these sands when the sun shines on them reminds one of the golden sands we read of.– Everything is washed clean & bright & the water is the best glass through which to see it–
I asked W.E.C. yesterday if he had acquired fame. He answered that giving his name at some place the bystanders said– 'Yes sir, We have heard of you– We know you here sir– Your name is mentioned in Mr. ___'s book.' That's all the fame I have had to be made known by another man.

JENNY DUGAN

Great flocks of slate colored snow-birds still about–& uttering their jingling note in the sun. In the brook behind Jenny Dugans I was pleased to find the Alnus incana (?) in bloom in the water its long sterile aments – yellowish brown hanging in panacles or clusters at the ends of the drooping branchlets – while all the twigs else are bare & the well-cased & handsome leaf buds are not yet expanded at all – it is a kind of resurrection of the year these pliant & pendulous blossoms on this apparently dead bush while all is sere & tawny around, withered & bleached grass. A sort of harbinger of spring – this & the maple blossoms especially & also the early willow catkins. Even these humble & inconspicuous aments are as grateful now as the most beautiful flowers will be a month hence– They are 2$^{1}/_{2}$ inches long & more. This appears to be more forward and the aments larger than what I take to be the common alder hereabouts. This & the maple & the earliest willow are the most flowerlike now– The skunk cabbage is not yet fairly in blossom nor the may flower– In all the brooks I see the spotted tortoise *emys guttata* now– –& in some fields & on some hill sides have seen holes apparently dug by turtles– but I have not yet noticed their tracks over the sand. The neat compact catkins of the hazel – fawn-colored? The birches still rather hard.



If I am too cold for human friendship – I trust I shall not soon be too cold for natural influences. It appears to be a law that you cannot have a deep sympathy with both man & nature. Those qualities which bring you near to the one estrange you from the other. 2nd Div. Brook– This is of similar character, but deeper than Nut Meadow Brook. It is pleasant that there be on a brook the remains of an old flume or dam or causeway as here – overgrown with trees – & whose rocks make stepping stones– Large skaters & small black water bugs are out now on the surface– Now then migrating fishes may come up the streams– The expanding may-flower buds show a little pinkish tint under the snow– The cress is apparently all last years– The cowslip does not yet spring– Very little change in anything since I was last here. Is that the *viburnum lentago* with the spear shaped buds?

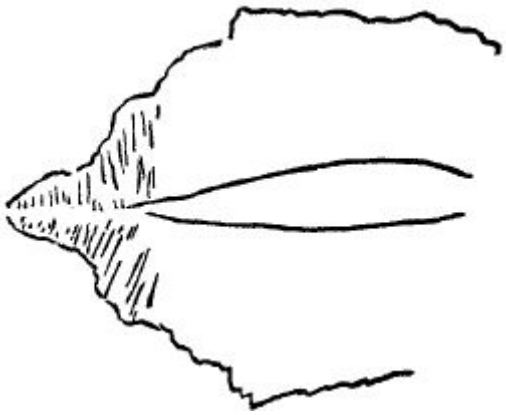
They have cut down the black aspens that used to stand on the white Pond road – the Dantean trees. Thought I heard a snipe or an owl. White Pond about $^{1}/_{4}$ or $^{1}/_{5}$ open at the north end. NB A man who passed Walden today says it is melted 2 rods wide on N. side Here are large flocks of *fringilla hiemalis* in the stubble. Every man will be a poet if he can – otherwise a philosopher or man of science. This proves the superiority of the poet.

It is hard for a man to take money from his friends for any service– This suggests how all men should be related. –Ah! when a man has travelled, and robbed the horizon of his native fields of its mystery & poetry – its indefinite promise – tarnished the blue of distant Mts with his feet!! When he has done this he may begin to think of another world – what is this longer to him? I see now the mosses now in pastures bearing their light colored capsules on the top of red filaments. When I reach the bridge – it is become a serene evening – the broad waters are more & more smooth–& everything is more beautiful in the still light.

The view toward Fair Haven whose woods are now cut off is beautiful. No obvious sign of spring– The hill now dimly reflected – the air not yet quite still– The wood on conantum abuts handsomely on the water–& can ill be spared– The ground on which it stands is not level as seen from this point but pleasantly varied & swelling – which is important.

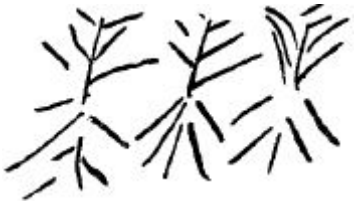
(Before my neighbors pig is cold his boys have made a football of his bladder!) So goes the world. No matter how much the boy snivles at first – he kicks the bladder with extacy.) This is the still evening hour – insects in the air The black birds whistle & sing "conqueree" the robin peeps & sings – the blue bird [**Eastern Bluebird** ***Sialia sialis***] warbles.– The light of the setting sun on the pitch pines on Fair Haven & Bear Hill lights them up warmly – for the rays fall horizontally on them through the **mellow** evening atmosphere– They do not

appear so bright to us at noon. nor do they now to the hawk that comes soaring sluggishly over them – (the brown & dusky bird seen even from beneath) Of course the pines seen from above have now more of the evening shades in them than seen from the earth on one side. The catkins of the willow are silvery. The shadow of the wood named above at the river end is indispensable in this scene – and what is remarkable I see where it has reached across the river and is creeping up the hill with dark pointed spears – though the intermediate river is all sunny– The reflection of the sunny hill covered with withered grass being seen through the invisible shadow. A river is best seen breaking through highlands – issuing from some narrow pass– It imparts a sense of power. The shadow at the end of the wood makes it appear grander in this case. The serenity & warmth are the main thing after the windy & cool days we have had. You may even hear a fish leap in the water now. The lowing of a cow advances me many weeks towards summer. The reflections grow more distinct every moment.– At last the outline of the hill is as distinct below as above. And every object appears rhymed by reflection By partly closing my eyes & looking through my eyelashes – the wood end appears thus



Now the shadow reaching across the river has crept so far up the hill that I see its reflection on the hill side in the water–& in this way it may at length connect itself with its source. Clouds are now distinctly seen in the water. The bridge is now a station for walkers. I parted with my companion here, told him not to wait for me. Maple in the swamp answers to maple birch to birch. There is one clump of 3 birches particularly picturesque

In a few minutes the wind has thus gone down. At this season the reflections of deciduous trees are more picturesque and remarkable than when they are in leaf – because the branches being seen they make with their reflections a more wonderful rhyme– It is not mere mass or outline corresponding to outline but a kind of geometrical figure. The maples look thus &c



The twilight must to the extent above mentioned – be earlier to birds soaring in the sky, i.e. they see more decided shades of evening than a man looking east. The Frogs peep thinly.

My nature may be as still as this water – but it is not so pure & its reflections are not so distinct. The snow has turned yellow the opening leaves of the Nuphar. The song of a robin on an oak in Hubbard's Grove sounds far off – so I have heard a robin within 3 feet in a cage in a dark bar room (how unstained by all the filth of that place!) with a kind of ventriloquism so singing that his song sounded far off on the elms. It was more pathetic still for this. The robins are singing now on all hands while the sun is setting. At what an expense any valuable

work is performed – at the expense of a life. If you do one thing well what else are you good for in the meanwhile?

1853

March 10, Thursday: A detachment of U.S. Marines disembarked at San Juan del Norte, Nicaragua to prevent Cornelius Vanderbilt's Accessory Transit Company from being evicted by the local government. This would be the 1st of many such interventions by the United States in Nicaragua.

US MILITARY INTERVENTIONS

Having heard crows and cocks in the distance, Henry Thoreau quoted Anacreon's "the works of men shine" in his journal and amplified the thought as "so the sounds of men and birds are musical."

In his journal for this day Thoreau is still turning over and over in his mind a conundrum having to do with helicoidal flow in a meandering stream bed, that he had commented upon in his journal entry for April 11, 1852. He fully grasped that he had arrived at an observation, but not at an explanation.[8] Here is Professor Robert M. Thorson again:

> Finally, in the boldest stroke of his inductive genius during the Walden years, Thoreau linked the side-to-side meandering with up-and-down meandering to recognize an even more fundamental type of three-dimensional meandering known as helicoidal flow. This is a corkscrew motion in which the forward-propagating sine curve of momentum rotates around the line of gravitational flow. In this conception, line, wave, and circle become a single entity. This unification took place in Thoreau's mind on the bank of Nut Meadow Brook on a lovely spring day in 1852 [April 11, 1852 journal entry below] when he noticed the streamlines of flow "meandering as much up and down as from side to side, deepest where narrowest, and ever gullying under this bank or that, its bottom lifted up to one side or the other, the current inclining to one side." At this point, the only thing Thoreau lacked was the explanation for the helical pattern he was seeing. Still searching a year later, he asks [refer to March 10, 1853 journal entry] "What is the theory of these sudden pitches, or steep shelving places, in the sandy bottom of the brook?" Thoreau's unwillingness to let go of an observation he does not fully understand brands him as a curiosity-driven scientist, hardly the trope-seeing transcendentalist he had left behind him a few years earlier.

8. Explanation for the helicoidal flow of meandering streams would need to wait, either for 1876 and Professor James Thomson, LL.D., F.R.S.E.'s "On the Origin of Windings of Rivers in Alluvial Plains, with Remarks on the Flow of Water round Bends in Pipes," Proceedings of the Royal Society of London. From May 4, 1876, to February 22, 1877. Volume XXV, pages 5-8,

ON THE ORIGIN OF WINDINGS

or for 1926 and Albert Einstein's "*Die Ursache der Mäanderbildung der Flußläufe und des sogenannten Baerschen Gesetzes*," (*Die Naturwissenschaften*, 1926, 11, S. 223-224) translated as "The cause of the Formation of Meanders in the Courses of Rivers and of the so-called [Karl Ernest von] Baer's Law," as pages 249-253 of IDEAS AND OPINIONS (New York: Bonanza Books, 1954).

FORMATION OF MEANDERS

March 10. This is the first really spring day. The sun is brightly reflected from all surfaces, and the north side of the street begins to be a little more passable to foot-travellers. You not think it necessary to button up your coat.

P.M. — To Second Division Brook.

As I stand looking over the swollen river, looking from the bridge into the flowing, eddying tide, –the almost strange chocolate-colored water,– the sound of distant crows and cocks is full of spring. As Anacreon says "the works of men shine," so the sounds of inert and birds are musical. Something analogous to the thawing of the ice seems to have taken place in the air. At the end of winter there is a season in which we are daily expecting spring, and finally a day when it arrives.

I see many middling-sized black spiders on the edge of the snow, very active. By John Hosmer's ditch by the riverside I see the skunk-cabbage springing freshly, the points of the spathes just peeping out of the ground, in some other places three inches high even. The radical leaves of innumerable plants (as here a dock in and near the water) are evidently affected by the spring influences. Many plants are to some extent evergreen, like the buttercup now beginning to start. Methinks the first obvious evidence of spring is the pushing out of the swamp willow catkins, then the relaxing of the earlier alder catkins, then the pushing up of skunk-cabbage spathes (and pads at the bottom of water). This is the order I am inclined to, though perhaps any of these may take precedence of all the rest in any particular case. [*Vide* next page.]

What is that dark pickle-green alga (?) at the bottom of this ditch, looking *somewhat* like a decaying cress, with fruit like a lichen?

At Nut Meadow Brook crossing we rest awhile on the rail, gazing into the eddying stream. The ripple-marks on the sandy bottom, where silver spangles shine in the river with black wrecks of caddis-cases lodged under each shelving sand, the shadows of the invisible dimples reflecting prismatic colors on the bottom, the minnows already stemming the current with restless, wiggling tails, ever and anon darting aside, probably to secure some invisible mote in the water, whose shadows we do not at first detect on the sandy bottom, — when detected so much more obvious as well as larger and more interesting than the substance, — in which each fin is distinctly seen, though scarcely to be detected in the substance; these are all very beautiful and exhilarating sights, a sort of diet drink to heal our winter discontent. Have the minnows played thus all winter? The equisetum at the bottom has freshly grown several inches. Then should I not have given the precedence on the last page to this and some other water-plants? I suspect that I should, and the flags appear to be starting.

I am surprised to find on the rail a young tortoise, an inch and one sixteenth long in the shell, which has crawled out to sun, or perchance is on its way to the water, which I think must be the *Emys guttata*, for there is a large and distinct yellow spot on each dorsal and lateral plate, and the third dorsal plate is hexagonal and not quadrangular, as the *E. picta* is described to be, though in my specimen I can't make it out to be so. Yet the edges of the plates are prominent, as is described in the *E. insculpta*, which, but for the spots and two yellow spots on each side of the hind head and one fainter on the top of the head, I should take it to be. It is about seven eighths of an inch wide. Very inactive. When was it hatched and where?

What is the theory of these sudden pitches, or steep shelving places, in the sandy bottom of the brook? It is very interesting to walk along such a brook as this in the midst of the meadow, which you can better do now before the frost is quite out of the sod, and gaze into the deep holes in its irregular bottom and the dark gulfs under the banks. Where it rushes rapidly over the edge of a steep slope in the bottom,

the shadow of the disturbed surface is like sand hurried forward in the water. The bottom, being of shifting sand, is exceedingly irregular and interesting. What was that sound that came on the softened air? It was the warble of the first bluebird from that scraggy apple orchard yonder. When this is heard, then has spring arrived. It must be that the willow twigs, both the yellow and green, are brighter-colored than before. I cannot be deceived. They shine as if the sap were already flowing under the bark; a certain lively and glossy hue they have. The early poplars are pushing forward their catkins, though they make not so much display as the willows.

Still in some parts of the woods it is good sledding. At Second Division Brook, the fragrance of the senecio, which is decidedly evergreen, which I have bruised, is very permanent and brings round the year again. It is a memorable sweet meadowy fragrance. I find a yellow-spotted tortoise (*Emys guttata*) in the brook. A very few leaves of cowslips, and those wholly under water, show themselves yet. The leaves of the water saxifrage, for the most part frost-bitten, are common enough. Near the caltha was also green frog-*spawn*, and Channing says he saw pollywogs. [Thoreau's footnote: "Possibly lizards." What Thoreau has been interpreted by the 1906 editor to mean in this footnote is newts, or salamanders.] Perhaps it is a particularly warm place. The alder's catkins –the earliest of them– are very plainly expanding, or, rather, the scales are loose and separated, and the whole catkin relaxed.

Minott says that old Sam Nutting, the hunter, –Fox Nutting, Old Fox, he was called,– who died more than forty years ago (he lived in Jacob Baker's house, Lincoln; came from Weston) and was some seventy years old then, told him that he had killed not only bear about Fair Haven among the walnuts, but *moose*!

"NARRATIVE HISTORY" AMOUNTS TO FABULATION, THE REAL STUFF BEING MERE CHRONOLOGY

1855

September 26, Wednesday: Fantasie und Fuge über den Choral 'Ad nos, ad salutarem undam' for organ by Franz Liszt was performed for the initial time, at the inauguration of a new organ at Merseburg Cathedral.

State Whigs and Republicans convened in Syracuse and formed a coalition under Thurlow Weed. An anti-slavery stand was stressed, rather than alcoholic prohibition. The Free Democratic and Liberty parties nominated Stephen A. Douglas for secretary of state and anti-slavery orator Lewis Tappan for comptroller.

Henry Thoreau wrote to H.G.O. Blake.

Concord Sep 26th 55
Mr Blake,
The other day I thought that
my health must be better,—that
I gave at last a sign of vitality,—
—because I experienced a slight cha-
grin. But I do not see how
strength is to be got into my legs
again. These months of feeble-
ness have yielded few if any
thoughts, though they have
not passed without serenity, such
as our sluggish Musketaquid
suggests. I hope that the harvest
is to come. I trust that you
have at least warped up
the stream a little daily, holding
fast by your anchors at
night, since I saw you—
and have kept my place
for me while I have been
absent.
Mr Ricketson
of New Bedford has just
made me a visit of a
day and a half, and I
have had a quite good
time with him. He and

FRIEND DANIEL RICKETSON

Channing have got on par-
ticularly well together. He is a

ELLERY CHANNING

man of very simple tastes, not-
withstanding his wealth, a lover
of nature, but, above all, sin-
gularly frank and plain-spoken.
I think that you might enjoy
meeting him. Sincerity is a
great but rare virtue, and we
pardon to it much complain-
ing, and the betrayal of many
weaknesses[.] *R. says of himself*
that he sometimes thinks that
he has all the infirmities of
genius, without a hair-pillow,
&c[ ]*expresses a great and awful*
uncertainty with regard to "God",
"Death," his "immortality", says,
"If I only knew"—&c. He loves
Cowper's Task better than any
thing else,—& thereafter perhaps
Thompson, Gray, & even Howitt.
He has evidently suffered for
want of sympathising companions.
He says, that he sympathises
with much in my books, but
much in them is nought to
him— "namby-pamby",— "stuff",—

Page 3
"mystical". Why will not I having
common sense, write in plain
English always,—teach men
in detail how to live a simpler
life, &c.,—not go off into—?
But I say, that I have no
scheme about it,—no designs
on men at all; and, if I had,
my mode would be to tempt
them with the fruit, and not
with the manure. To what
end do I lead a simple life
at all, pray? That I may
teach others to simplify their
lives?—and so all our lives
be simplified merely, like an

[a]*lgebraic formula?— Or not,*
rather, that I may make
use of the ground I have
cleared—to live more worthily
and profitably? I would fain
lay the most stress forever
on that which is the most
important,—imports the most
to me,—though it were only (what
it is likely to be) a vibration
in the air. As a preacher, I
should be prompted to tell men
not so much how to get their

Page 4
wheat bread cheaper,—as of
[the] *bread of life compared*
with which that is bran. Let
a man only taste these loaves,
and he becomes a skilful econ-
omist at once. He'll not
waste much time in earning
those. Dont spend your time
in drilling soldiers who may turn
out hirelings after all, but
give to undrilled peasantry a
country to fight for. The schools
begin with what they call the
elements, and where do they
end?
I was glad to hear the other
day that Higginson and Brown
were gone to Ktadn; it must
be so much better to go to than *or Abolition*
a [W]*oman's* [R]*ight's Convention;—* [better still], ^ *to the delecta-*
ble primitive mounts within you, which you have
dreamed of from your youth
up,—& seen perhaps in the
horizon,—but never climbed.
But how do you do?
Is the air sweet to you?

Page 5
Do you find anythin[g] *at*

which you can work[ ] *accomplish-*
ing something solid from day to
day? Have you put sloth
& doubt behind considerably?
—had one redeeming dream
this summer? —I dreamed
last night that I could vault
over any height it pleased me.
That was <u>something</u>, and I
contemplated myself with a
slight satisfaction in the morn-
ing for it.
Methinks I will write to
you, methinks you will be
ready to hear[—] *We will stand*
on solid foundations to one
another—I a column planted
on this shore, you on that.
We meet the same sun
in his rising. We are built
slowly, and have come to our
bearing; we will not mutually
fall over that we may
meet, but will grandly
and eternally guard the
straights. Methinks I see an
inscription on you, which the
architect made, the stucco

Page 6
being worn off to it— The name
of that ambitious worldly king
is crumbling away— I see it toward
sunset in favorable lights. Each
must read for the other as
might a sailer by. Be sure
you are star-y-pointing still.
How is it on your side?
I will not require an answer
until you think I have paid
my debts to you.
I have just got a letter from
Ricketson urging me to come
to New Bedford,—which possibly I

may do. He says, I can wear my
old clothes there.
Let me be remembered in
your quiet house.
Henry D. Thoreau.

WILLIAM HOWITT

"To what end do I lead a simple life at all, pray? That I may teach others to simplify their lives? —and so all our lives be simplified merely, like an algebraic formula?— Or not, rather, that I may make use of the ground I have cleared — to live more worthily and profitably?"

— Henry Thoreau, September 26, 1855

THOREAUVIAN MATHEMATICS

A WEEK: We have heard much about the poetry of mathematics, but very little of it has yet been sung. The ancients had a juster notion of their poetic value than we. The most distinct and beautiful statement of any truth must take at last the mathematical form. We might so simplify the rules of moral philosophy, as well as of arithmetic, that one formula would express them both. All the moral laws are readily translated into natural philosophy, for often we have only to restore the primitive meaning of the words by which they are expressed, or to attend to their literal instead of their metaphorical sense. They are already **supernatural** philosophy. The whole body of what is now called moral or ethical truth existed in the golden age as abstract science. Or, if we prefer, we may say that the laws of Nature are the purest morality. The Tree of Knowledge is a Tree of Knowledge of good and evil. He is not a true man of science who does not bring some sympathy to his studies, and expect to learn something by behavior as well as by application. It is childish to rest in the discovery of mere coincidences, or of partial and extraneous laws. The study of geometry is a petty and idle exercise of the mind, if it is applied to no larger system than the starry one. Mathematics should be mixed not only with physics but with ethics, **that** is **mixed** mathematics. The fact which interests us most is the life of the naturalist. The purest science is still biographical. Nothing will dignify and elevate science while it is sundered so wholly from the moral life of its devotee, and he professes another religion than it teaches, and worships at a foreign shrine. Anciently the faith of a philosopher was identical with his system, or, in other words, his view of the universe.

Sept. 26. Went up Assabet for fuel. One old piece of oak timber looks as if it had been a brace in a bridge. I get up oak rails here and there, almost as heavy as lead, and leave them to dry somewhat on the bank.

Stumps, partially buried, which were brought by the freshet from some newly cleared field last spring; bleached oak trees which were once lopped for a fence; alders and birches which the river ice bent and broke by its weight last spring. It is pretty hard and dirty work. It grieves me to see how rapidly some great trees which have fallen or been felled waste away when left on the ground. There was the large oak by the Assabet, which I remember to have been struck by lightning, and afterward blown over, being dead. It used to lie with its top down-hill and partly in the water and its butt far up. Now there is no trace of its limbs, and the very core of its trunk is the only solid part, concealed within a spongy covering. Soon only a richer mould will mark the spot.

1858

Arthur Cayley presented matrixes in the context of a theory of invariant transformations, and matrix algebra had its beginning.

NOBODY COULD GUESS WHAT WOULD HAPPEN NEXT

1859

Henry Thoreau copied into his 2d commonplace book extracts from an article on Hydrodynamics having to do with the velocity and carrying power of river currents, in APPLETON'S DICTIONARY OF MACHINES, MECHANICS, ENGINE-WORK AND ENGINEERING (New York: D. Appleton and company, 1857-1858, Volume II), a book in the Concord town library.

ANCIENT GEOGRAPHY

August 3, Wednesday: After his graduation from Harvard College, Francis Ellingwood Abbot and Katharine "Katie" Fearing Loring were secretly married by a minister in Nashua, New Hampshire. The bride would almost immediately become pregnant. Despite this marriage and pregnancy, the bride would be moving with her parents to Winona MN while the groom would remain behind at the Divinity School. Over the years five of their children would die, two at birth and three in infancy, but eventually this couple would have three surviving children — Everett Vergnies Abbot (Harvard LL.B. 1886), Edward Stanley Abbot (Harvard MD 1887, a psychiatrist), and Fanny Larcom Abbot.

Waldo Emerson wrote without comprehension and with considerable condescension to Elizabeth Sherman Hoar in Liverpool (she was in the process of returning from her "grand tour of Europe, with a winter and early spring in Italy in the middle of it") that "Henry T. occupies himself with the history of the river, measures it, weighs it, and strains it through a colander to all eternity."

The primary intent of the remark, I would suggest, was to remind the Concord lady that for a personage of the stature of Emerson to "occupy himself" with such activities and concerns would be *infra dig*, and that therefore there was a class difference which needed to be pointed to, with he and the touring Miss Hoar on near side of the class divide as gentle folk and with our good "Henry T.," despite an education having been attempted upon him, beyond the pale as a mere crafts person without a really good money-earning craft. I find the remark not humorous, nor in good humor, but quite offensively condescending and demeaning. Is this just me? I wonder what Elizabeth, knowing Henry Thoreau as well as she knew Waldo, thought of this letter when she opened it in Europe. Presumably "Boys need to fight each other."

August 3: 6 A.M.– River fallen one inch since 2.30 P.M. yesterday; *i.e.*, it is now a quarter of an inch

above summer level. *Juncus Greenei* grows in river meadow opposite Dodd's; long done.
I saw (the 31st *ult*.) that the river was narrowed to a third its width by a large mass of button-bushes sunk in the middle of it above the Sudbury causeway. The low water reveals a mass of meadow sunk under the railroad bridge. Both this and Lee's Bridge are thus obstructed this year.
I should say the origin of these holes was that the river, being shallow and therefore crowded, runs swiftly and digs into the bank and so makes a deep hole and a bend. The three large lakes may perhaps be considered as three deep holes made by a larger river or ocean current in former ages.
The almost constant occurrence of a bay, or stagnant expansion, on the convex side at the bends is remarkable. It seems to be a place where the river has formerly flowed, but which, by wearing into the opposite bank, it has left.
There are about twenty-one weedy places (*i.e.*, where the weeds extend quite across), all together about two miles in length. These weedy places, you may say (notwithstanding the frequent winding of the river), generally occur at bends (the Island shoal, perhaps, and Barrett's Bar, and above Middlesex Turnpike Bridge are exceptions).
The most remarkable bend between Framingham and the Dam is the Ox-Bow in Framingham.
Since our river is so easily affected by wind, the fact that its general course is northeast and that the prevailing winds in summer are southwest is very favorable to its rapid drainage at that season.
If by fall you mean a swifter place occasioned by the bottom below for a considerable distance being lower than the bottom above for a considerable distance, I do not know of any such between Pelham Pond and the Falls. These swifter places are produced by a contraction of the stream,– chiefly by the elevation of the bottom at that point,– also by the narrowing of the stream.
The depths are very slight compared with the lengths. The average depth of this twenty-five miles is about one seventeen thousandth the length; so that if this portion of the river were laid down on a map four feet long the depth would be about equal to the thickness of ordinary letter paper, of which it takes three hundred and fifty to an inch. Double the thickness of the letter paper, and it will contain the deep holes which are so unfathomed and mysterious, not to say bottomless, to the swimmers and fishermen.
Methinks the button-bushes about Fair Haven indicate a muddy but not deep pond.
The deepest reach of this twenty-five miles is from E. Davis Hill to Skelton Bend.
Methinks I saw some of the fresh-water sponge in the river in Framingham.
Undoubtedly, in the most stagnant parts of the river, when the wind blows hard up-stream, a chip will be drifted faster up-stream than ever it floats downward *there* in a calm.

P.M.– I see two or three birds which I take to be rose-breasted grosbeaks of this year. They are speckled brown and white (with considerable white) birds, and no rose on breast that I see. I hear them singing a little in a grosbeak-like strain, but a more partial warble. Heard one July 28th on an oak high up Assabet, and to-day on an apple tree near Brister's.
Warren Miles tells me that in mowing lately he cut in two a checkered "adder," –by his account it was the chicken snake,– and there was in its stomach a green snake, dead and partly digested, and he was surprised to find that they ate them.
Water-bugs are collected in dense swarms about my boat, at its stagnant harbor. They gyrate in a very leisurely manner under my face, occasionally touching one another by their edges a moment. When I move or disturb the water, they at once begin to gyrate rapidly. After the evening has set in, I perceive that these waterbugs, which all day were collected in dense swarms in the stagnant water amid the weeds at the sides, are dispersed over the river (quite across it here) and gyrating rapidly in the twilight.
The haymakers are quite busy on the Great Meadows, it being drier than usual. It being remote from public view, some of them work in their shirts or half naked.
As I wade through the middle of the meadows in sedge up to my middle and look afar over the waving and rustling bent tops of the sedge (all are bent northeast by the southwest wind) toward the distant mainland, I feel a little as if caught by a rising tide on flats far from the shore. I am, as it were, cast away in the midst of the sea. It is a level sea of waving and rustling sedge about me. The grassy sea. You feel somewhat as you would if you were standing in water at an equal distance from the shore. To-day I can walk dry over the greater part of the meadows, but not over the lower parts, where pipes, etc., grow; yet many think it has not been so dry for ten years! Goodwin is there after snipes. I scare up one in the wettest part.
High blackberries begin to be ripe.
A novel phenomenon of dry weather and a low stage of water is the sight of dense green beds of *Eleocharis acicularis*, still in bloom, which grows at the bottom of muddy pools, but now, they being dry, looks like a dense fine bed of green moss, denser than grass. I recline on such a bed, perfectly dry and clean, amid the flags and

pontederia, where lately was water and mud. It covers the mud with a short dense green mat of culms fine as a hair, quite agreeable to rest on and a rather novel sight.

1876

Henry Thoreau's question about the helicoidal flow of meandering Nut Meadow Brook in Concord had needed to wait, until in this year Professor James Thomson, LL.D., F.R.S.E. presented "On the Origin of Windings of Rivers in Alluvial Plains, with Remarks on the Flow of Water round Bends in Pipes" in Proceedings of the Royal Society of London. From May 4, 1876, to February 22, 1877. Volume XXV, pages 5-8.

ON THE ORIGIN OF WINDINGS

However, it would appear that the answer proposed by Professor Thomson would not prove to be adequate, because it would involve a mistaken theory advanced by Karl Ernest von Baer, according to which such streams meander in one type of spiral in the Northern Hemisphere, but in the opposite type of spiral in the Southern Hemisphere, due to the Coriollis effect of the rotation of the planet Earth. The problem with this is that as a matter of fact, there is no difference whatever in the manner in which streams meander, in the Northern versus in the Southern hemisphere. Although the Coriolis effect is strong enough to produce distinct ocean currents, it is nowhere near strong enough to produce any noticeable effect upon the flow of water of streams.

1901

"Dr." Samuel Arthur Jones (editor). PERTAINING TO THOREAU (Detroit, Michigan). XVIII, 171pp. Limited to 225 copies.

Franklin Benjamin Sanborn's THE PERSONALITY OF THOREAU (Boston: Goodspeed):

VIEW THE PAGE IMAGES

> Sanborn recollected, on pages 5-6: When I first saw Thoreau, in the College yard at Cambridge, striding along the path, away from my room in Holworthy, where he had left a copy of Walden for me, I knew him not, but was struck with his short and rustic appearance, and that peculiar stride which all who have walked with him remember.
>
> Sanborn recollected, on pages 9-10: In a wing of this capacious dwelling was the shop where the Thoreau lead-pencils had been made, perhaps, in former years; but this room, which I never visited while John Thoreau, the father, lived, was devoted, in my time, to the storing and shipping of a fine-ground plumbago for electrotyping — a business that had been taken up when the pencil industry became unprofitable. It was the family bread-winner for years, and yielded a modest income, supplemented by Henry's receipts for land-surveying, lecturing, and writing magazine articles. As late as 1850 he was making pencils; for, in his Journal for November 20, 1853, he writes, of an earlier period: "I was obliged to manufacture $1,000 worth of pencils, and slowly dispose of, and finally sacrifice them, in order to pay an assumed debt of $100." The plumbago, both for pencils and for electrotyping, was ground at a small mill in Acton (the next town west of Concord), where the Thoreaus had the secret of obtaining the finest-ground mineral; sent to the two-story shop attached to the dwelling-house, and there prepared for the market and shipped. Little was said of this business, although its existence was generally known; and it would not have been good manners to make inquiries about it, though in course of time Sophia spoke of it to me and others. It passed from the Thoreaus to the brothers, Marshall and Warren Miles, and has been carried on by the latter in recent years, but with less profit than in the time of the Thoreaus, who finally gave it up about 1870. After Mrs. Thoreau's death a weird story was invented about her ghost being seen in the pencil-shop.
>
> Sanborn fabricated a tendentious recollection which could not have been true or believed by him to be true,[9] on pages 30-31: One day as I entered the front hall of the Thoreau house for my noonday dinner, I saw under the stairs a pile of books; and when we met at the table, Henry said, "I have added several hundred

9. Sanborn knew very well that he had not met Thoreau until 1855, while Thoreau had long since received these unsold copies and carried them up the steps and stored them in his room, on October 27, 1853.

volumes to my library lately, all of my own composition." In fact, he had received from his first publisher the last parcel of his unsold Week, and for a year or two afterwards he sold them himself upon orders through the mail.

Sanborn recollected, on pages 37-38: When I first heard Thoreau lecture, as he did every year at the Concord Lyceum, and frequently at Worcester and elsewhere, I did not find his spoken essays so interesting as his conversations. He had few of the arts of the orator, in which Emerson and Phillips excelled; his presence on the platform was not inspiring, nor was his voice specially musical, though he had a musical ear and a real love of melody. But for the thought and humor in his lectures they would have been reckoned dull, — and that was the impression often made. He appeared to best advantage reading them in a small room; or when, as with the John Brown Address, he was mightily stirred by the emotions that a life so heroic excited in his fearless heart. At the age of forty, or thereabout, I heard him sing his favorite song, Tom Bowline, by Didbin, which to Thoreau was a reminiscence of his brother John, so early lost and so dearly loved. The voice was unpractised and rather harsh, but the sentiment made the song interesting.

Ellery Channing recollected, on pages 66-67: His illness might be passed over by some persons, but not by me; it was most impressive. To see one in middle life, with nerves and muscles and will of iron, torn apart piecemeal by that which was stronger than all, were enough to be described, if pen had the power to do it. It was a saying of his, not unfrequent, that he had lived and written as if to live forty years longer; his work was laid out for a long life. Therefore his resignation was great, true, and consistent; great, too, was his suffering. "I have no wish to live, except for my mother and sister," was one of his conclusions. But still, as always, work, work, work! During his illness he enlarged his calendar, made a list of birds, drew greatly on his Journals; at the same time he was writing or correcting several articles for printing, till his strength was no longer sufficient even to move a pencil. Nevertheless, he did not relax, but had the papers still laid before him. I am not aware that anywhere in literature is a greater heroism; the motive, too, was sacred, for he was doing this that his family might reap the advantage. One of his noblest and ablest associates was a philosopher (Alcott) whose heart was like a land flowing with milk and honey; and it was affecting to see this venerable man kissing his brow, when the damps and sweat of death lay upon it, even if Henry knew it not. It seemed to me an extreme unction, in which a friend was the best priest.

BRONSON ALCOTT

Sanborn has taken a detached scrap of paper out of a textbook allegedly owned by Thoreau, the 3d edition, the 1828 edition, of Professor John Farrar of Harvard College's brief 1818 knock-off of Euler's famous textbook, entitled AN INTRODUCTION TO THE ELEMENTS

OF ALGEBRA, DESIGNED FOR THE USE OF THOSE WHO ARE ACQUAINTED ONLY WITH THE FIRST PRINCIPLES OF ARITHMETIC / SELECTED FROM THE ALGEBRA OF EULER (Boston: Hilliard, Gray, Little, and Wilkins, 1828), and glued

ELEMENTS OF ALGEBRA

this scrap of paper into the front of copy #105 of his THE PERSONALITY OF THOREAU. (This volume with its holographic fragment is now copy #3 in the special collections of Brown University, at the John Hay Library.) The paper scrap contains a holograph algebraic proof written by Thoreau in Concord on January 10, 1840.[10] The problem he selected is to identify a four-number geometric progression series in which the 4th number of the series is 24 more than the 2d number of the series, and the sum of the 1st number and 4th number is to the sum of the 2d number and 3d number, in the ratio of 7 to 3.

Thoreau's first move was to identify the four numbers of the series as respectively x, xy, xy^2, and xy^3.

Then he stated the first of the constraints, that the 4th number of the series is 24 more than the 2d number of the series, as $xy^3 - xy = 24$.

Then he stated the second of the constraints, that the sum of the 1st number and 4th number is to the sum of the 2d number and 3d number in the ratio of 7 to 3, as $3x + 3xy^3 = 7xy + 7xy^2$. Not bothering to write down the steps of the transformation, this immediately became $y^3 = (7y + 7y^2)/3 - 1$.

Then, putting $y^3 = (7y + 7y^2)/3 - 1$ into $xy^3 - xy = 24$ and freeing the denominator and reducing immediately generated $7xy^2 + 4xy - 3x = 72$.

Then comparing $7xy^2 + 4xy - 3x = 72$ with $3x + 3xy^3 = 7xy + 7xy^2$ and eliminating xy and reducing $7xy^2 - 3x + 4xy^3 = 168$ on $xy^2 = 24 + (3x - 4xy^2)/7$ giving xy^3 its value obtained from $xy^3 - xy = 24$, putting the value of xy^2 as it then stands in the geometric progression series and taking the product of the means equal to that of the extremes x^2y [hole in the paper] $4x = 24xy + (3x^2y - 4x^2y^2 - 95xy)/7$.

Then finding by x, freeing of the denominator, and reducing, results in $xy + xy^2 = 18y - 42$.

Then putting the value of xy^2 obtained from this into $3x + 3xy^3 = 7xy + 7xy^2$ and reducing, results in $x + xy^3 = 42y - 98$.

Then putting the value of xy^3 obtained from this in $xy^3 - xy = 24$ and reducing, generates $x + xy = 42y - 122$.

This is followed by $xy + xy^2 = 18y - 42$.

10. We note that in this writing which is indisputably Thoreau's, he forms the numeral "2" by beginning his stroke at the top left with a minuscule complete circle.

This is followed by $18y - 42 = 42y^2 - 122y$.

This is followed, on the basis of $xy^3 - xy = 24$, by $x = 24/(y^3 - y)$

By comparing $xy + xy^2 = 18y - 42$ he obtained y=3, hence x=1, and so the geometric progression that solves these simultaneous equations would have to be "1 3 9 27."

Last Ques in Geom. Prog. in Day's Algebra.

(There is a Geom. Prog. of four numbers, such that the last is 24 more than the second, and the sum of the extremes is 9 times the means, as 1 to 3.) $x \quad xy \quad xy^2 \quad xy^3$ Then $(xy^3 - xy = 24)$ (1)

and $(3x + 3xy^3 = 7xy + 7xy^2)$ (2) From Relat $y^3 = \frac{7y + 7y^2}{3} - 1$

Putting this in N° 1, freeing of the denominator, and reducing-

$7xy^2 + 4xy - 3x = 72$ Comparing N° 2, eliminating xy,

and reducing $7xy^2 - 3x + 4xy^3 = 168$ or

$xy^2 = 24 + \frac{3x - 4xy^3}{7}$ Giving xy^3 its value obtained from N° 1,

putting the value of xy^2 as it then stands in the Prog.

and taking the product of the means equal to that

of the extremes. $x^2y + 4x = 24xy + \frac{3x^2y - 4x^2y^3 - 96xy}{7}$

Reducing by x, freeing of the denominator, and reducing-

$(xy + xy^2 = 18y - 42)$ (3) Putting the value of xy^2 obtained

from this in N° 2 and reducing. $x + xy^3 = 42y - 98$

Putting the value of xy^3 obtained from this in N° 1,

and reducing $x + xy = 42y - 122$ Comparing N° 3

$xy + xy^2 = 18y - 42$ we obtain

$18y - 42 = 42y^2 - 122y$ Hence $y = 3$

From N° 1 $x = \frac{24}{y^3 - y}$ Hence $x = 1$

Prog. = 1 3 9 27

Concord, Mass. 18th 1844

1914

Dr. Robert Edouard Moritz, Professor of Mathematics in the University of Washington, collected in the 383 pages of MEMORABILIA MATHEMATICA; OR, THE PHILOMATH'S QUOTATION-BOOK some 2,160 quotations from more than 300 authors. His Thoreau snippet is from A WEEK ON THE CONCORD AND MERRIMACK RIVERS:

"We have heard much about the poetry of mathematics, but very little of it has yet been sung. The ancients had a juster notion of their poetic value than we. The most distinct and beautiful statement of any truth must take at last the mathematical form. We might so simplify the rules of moral philosophy, as well as of arithmetic, that one formula would express them both."

— Henry Thoreau, A WEEK

THOREAUVIAN MATHEMATICS

A WEEK: We have heard much about the poetry of mathematics, but very little of it has yet been sung. The ancients had a juster notion of their poetic value than we. The most distinct and beautiful statement of any truth must take at last the mathematical form. We might so simplify the rules of moral philosophy, as well as of arithmetic, that one formula would express them both. All the moral laws are readily translated into natural philosophy, for often we have only to restore the primitive meaning of the words by which they are expressed, or to attend to their literal instead of their metaphorical sense. They are already **supernatural** philosophy. The whole body of what is now called moral or ethical truth existed in the golden age as abstract science. Or, if we prefer, we may say that the laws of Nature are the purest morality. The Tree of Knowledge is a Tree of Knowledge of good and evil. He is not a true man of science who does not bring some sympathy to his studies, and expect to learn something by behavior as well as by application. It is childish to rest in the discovery of mere coincidences, or of partial and extraneous laws. The study of geometry is a petty and idle exercise of the mind, if it is applied to no larger system than the starry one. Mathematics should be mixed not only with physics but with ethics, **that** is **mixed** mathematics. The fact which interests us most is the life of the naturalist. The purest science is still biographical. Nothing will dignify and elevate science while it is sundered so wholly from the moral life of its devotee, and he professes another religion than it teaches, and worships at a foreign shrine. Anciently the faith of a philosopher was identical with his system, or, in other words, his view of the universe.

1926

Albert Einstein had designed a refrigerator, and in this year it received its patent.

COOLNESS

In 1876 Professor James Thomson, LL.D., F.R.S.E. had proposed in the pages of the Proceedings of the Royal Society of London an explanation for meandering streams, such as Henry Thoreau's 1852/1853 question about the helicoidal flow of meandering Nut Meadow Brook in Concord, but his explanation had been found to lead to false predictions. In this year, therefore, Albert Einstein needed to revisit the matter in the journal *Die Naturwissenschaften*, in the article "*Die Ursache der Mäanderbildung der Flußläufe und des sogenannten Baerschen Gesetzes*," (11, S. 223-224), which would eventually be translated as "The cause of the Formation of Meanders in the Courses of Rivers and of the so-called Baer's Law," as pages 249-253 of IDEAS AND OPINIONS (New York: Bonanza Books, 1954).

FORMATION OF MEANDERS

The Scholastic Aptitude Test (SAT), developed by Professor Carl C. Brigham of Princeton University by making the US Army's "Alpha" test of WWI more and more difficult so that it would become more and more exclusive, rejecting higher and higher percentages of the testees, was administered experimentally to a few thousand high school students who were college applicants. Let's cull these people!

1943

J.L. Coolidge's "Three Hundred Years of Mathematics at Harvard" appeared in The American Mathematical Monthly, Volume 50, Issue #6.

MATHEMATICS AT HARVARD

From this year until 1946, J.C.R. Licklider would be a Research Fellow in the Psycho-Acoustics Laboratory at Harvard, advancing theories of pitch perception and the intelligibility of speech. He would become involved in efforts to improve communication at high altitudes, particularly in ways to compress or clip speech to increase the carrying power of radio.

A form of jelled gasoline that would be termed "napalm" was developed at Harvard by a team led by chemistry professor Louis F. Fieser (who is prouder of his synthesis of the hormone cortisone) to provide a stickier fuel for flamethrowers, more effective because it would tend not to drip off its target as it burned. Here is a Barbi

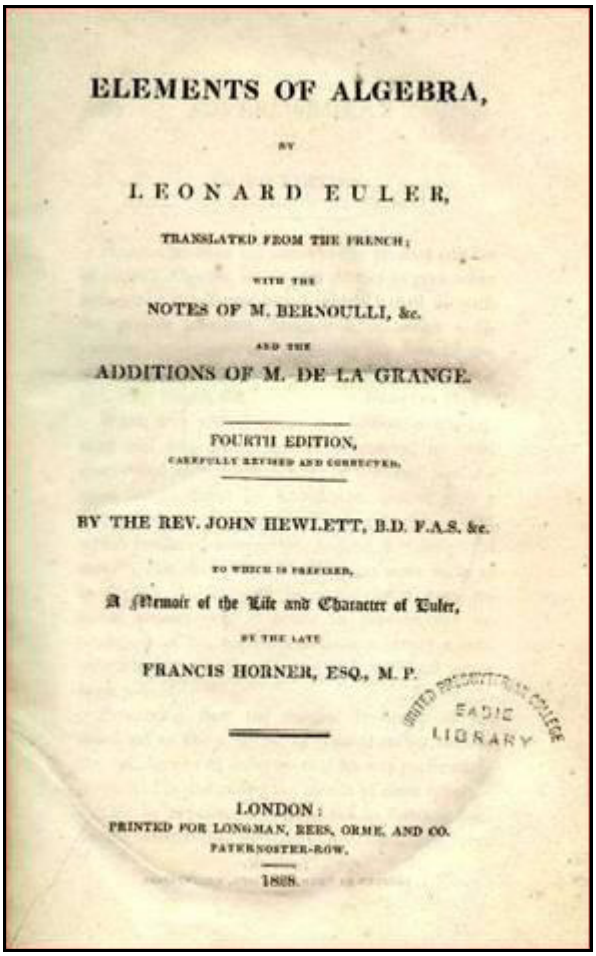
doll dipped in homemade napalm:

Professor Fieser made a gel out of gasoline with a powdered aluminum soap of naphthalene with palmitate, also known as napthenic and palmitic acids. The term “NA-PALM” thus originated an initialism standing for “NApthenic/PALMitic.” Greatly improved versions of napalm, known as “NP2” (a mixture of 21% benzene, 33% gasoline, and 46% polystyrene) and as the “MK-77 firebomb,” now make no use either of napthenic or of palmitic acid and thus the US military has been able to deny on appropriate occasions that it any longer makes any use whatever of “napalm.” The US Air Force has at one point, for instance, posted a “disinformation alert” on the internet asserting that the US in 2001 destroyed its entire stock of napalm bombs — and what it meant by that was merely that the US military had been moving along with more effective forms of incendiary gels. Disinformation indeed!

Nearly 400,000 tons of napalm would be dropped on targets in Vietnam, giving rise to an Army cadence chant wit the platoon response line, “Napalm sticks to kids!”

2007

January/February: An article "Thoreau's Math" by Lawrence Goodman appeared in the Brown Alumni Magazine, after Assistant Professor Steven J. Miller of Brown University took a look at a textbook that Franklin Benjamin Sanborn claimed had belonged to Henry Thoreau, in the special collections of Brown University. On the basis of the remark "called Euler's Algebra after the famed eighteenth-century Swiss mathematician who wrote it," in the magazine article below, I at first presumed this volume would turn out to be the 1828 English edition of Leonard Euler's ELEMENTS OF ALGEBRA:



ELEMENTS OF ALGEBRA,

BY

LEONARD EULER,

TRANSLATED FROM THE FRENCH;

WITH THE

NOTES OF M. BERNOULLI, &c.

AND THE

ADDITIONS OF M. DE LA GRANGE.

FOURTH EDITION,

CAREFULLY REVISED AND CORRECTED.

BY THE REV. JOHN HEWLETT, B.D. F.A.S. &c.

TO WHICH IS PREFIXED,

A Memoir of the Life and Character of Euler,

BY THE LATE

FRANCIS HORNER, ESQ., M. P.

LONDON:
PRINTED FOR LONGMAN, REES, ORME, AND CO.
PATERNOSTER-ROW.
1828.

But, no, upon investigation, it wasn't that volume at all. Instead it turns out that this volume in Brown University's special collections is merely a Boston-printed copy of the 3d edition, the 1828 edition, of Professor John Farrar of Harvard College's brief 1818 knock-off of Euler's famous textbook, and is entitled AN INTRODUCTION TO THE ELEMENTS OF ALGEBRA, DESIGNED FOR THE USE OF THOSE WHO ARE ACQUAINTED ONLY WITH THE FIRST PRINCIPLES OF ARITHMETIC / SELECTED FROM THE ALGEBRA OF EULER (Boston:

Hilliard, Gray, Little, and Wilkins, 1828).

ELEMENTS OF ALGEBRA

Except for a long division done inside the rear cover, there are not a whole lot of scribbles. Exceedingly few of the pages have any number/variable jottings at all. This is not a rich source of information. The volume appears to have something like, as a best guess, the words "H Thoreau lunar mon," written in ink inside its back cover. Inside the front cover has been placed a Sanborn scrawl alleging this to be "a college textbook of H D Thoreau / F B S" and someone has added "[anborn]" after the "S" to make it clear that this notation was Sanborn's. Although this article in the alumni rag presents a photograph of a mathematical calculation, upon inspection of the numbers in the photo, the mathematical calculation turns out to be merely a neat jotting of a long division — which is to say, mere arithmetic rather than any sort of algebra. This calculation jotting was made by Thoreau or someone (since the handwriting of the integers has not been analyzed, who knows?) in pencil on a blank spot in this volume. It is abundantly clear, however, that the author of this Brown University article, Lawrence Goodman, has no clue that our guy Thoreau, whom he opinions was "not exactly known for his mathematical prowess," had begun the study of Euler's algebra not as a young adult at Harvard College, but at the Concord Academy at the tender age of ten or eleven — for in the article Assistant Professor Miller is quoted as remarking that this algebra topic "would most likely be taught today in high school, not college":

> Henry David Thoreau is not exactly known for his mathematical prowess. But while an undergraduate at Harvard in the 1830s, the famed Transcendentalist thinker studied algebra, and assistant mathematics professor Steven Miller recently took an interest in his textbook, which is in the Brown archives. On this page, Thoreau worked through one of the exercises in the book, which is called EULER'S ALGEBRA after the famed eighteenth-century Swiss mathematician who wrote it.
>
> The exercise is fairly simple, Miller says, and would most likely be taught today in high school, not college. An example: "Here is a geometric progression of four numbers such that the last is 24 more than the second, and the sum of the extremes is to that of the middles as 7 is to 3." The student is then asked to identify the four numbers (Answer: 1, 3, 9, and 27).
>
> Miller says Thoreau's jottings demonstrate a firm command of the material: "He was very thorough, pun intended." Miller found no errors in the book except in one exercise where Thoreau failed to show all his work. But he got the question right. Miller says he became fascinated by the textbook because he wanted to "put himself in Thoreau's shoes. Did he actually enjoy math classes or did he just grin and bear it?"
>
> Unfortunately, Miller says, "I can't tell one way or the other."

(Note the shape of the numeral "2" below. In the document known to be by Thoreau, he very often begins this numeral with a complete tiny circle at the top left of the stroke.)

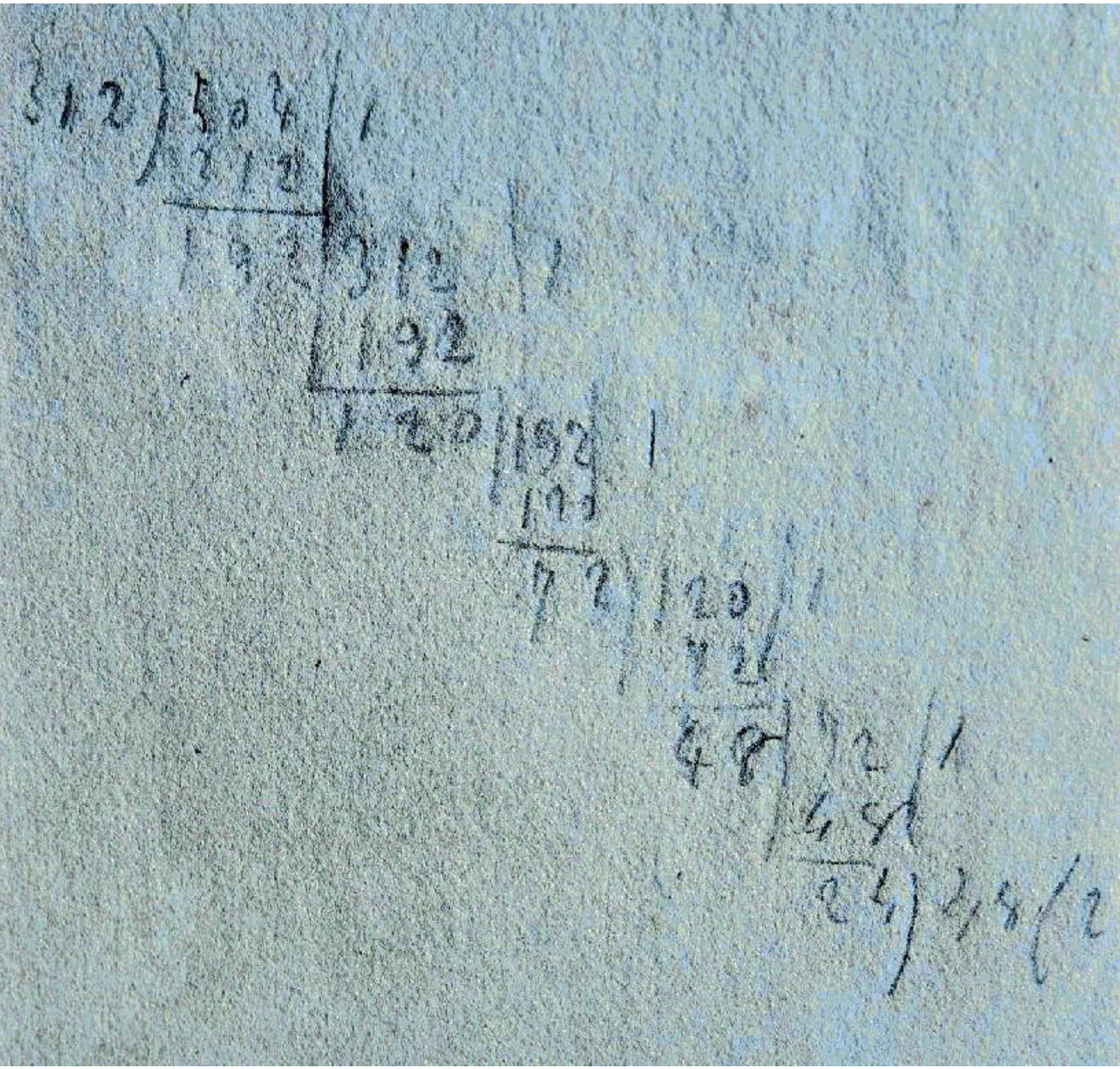
Jeffrey S. Cramer points out that when, on December 31, 1837, Thoreau wrote in his journal that:

> "As the least drop of wine tinges the whole goblet, so the least particle of truth colors our whole life. It is never isolated, or simply added as treasures to our stock. When any real progress is made, we unlearn and learn anew what we thought we knew before. We go picking up from year to year and laying side by side the disjecta membra of truth, as he who picked up one by one a row of a hundred stones, and returned with each separately to his basket."

this is an allusion to one of the algebraic problems on page 208 of this truncated 1828 Boston edition put out by the Harvard professor, John Farrar: "74. One hundred stones being placed on the ground, in a straight line, at the distance of a yard from each other, how far will a person travel who shall bring them one by one to a basket, which is placed one yard from the first stone. *Ans*. 5 *miles* and 1300 *yards*."

To this I can add that when Euler had originally published this heavily used textbook in two volumes in German in 1770, as *Vollständige Anleitung zur Algebra* (Kays. Acad. der Wiss., St.-Petersburg), he had made little attempt to be original in the problems that he presented for solution but had simply incorporated many of his problems practically verbatim from a famous textbook published some two and a half centuries earlier, Christoff Rudolff's *Behend vnnd Hubsch Rechnung durch die kunstreichen regeln Algebre so gemeinlicklich die Coss genent werden. Darinnen alles so treülich an tag gegeben, das auch allein auss vleissigem lesen on allen mündtliche vnterricht mag begriffen werden, etc*. (Jung, Strassburg, 1525).

And, it seems to me, the extent of the holograph calculations and notations in the Farrar volume can only be described as exceedingly slight. It seems to me that the article in the Brown alumni mag has puffed the stuff



quite a lot. The example problem it cites, for instance (the one about discovering the geometric progression 1, 3, 9, 27 on the basis of clues), was not an example problem out of Euler's Algebra at all, but instead is to be found only on a piece of unattached scrap paper and happens to be an example taken from President Jeremiah Day of Yale College's AN INTRODUCTION TO ALGEBRA, BEING THE FIRST PART OF A COURSE OF MATHEMATICS ADAPTED TO THE METHOD OF INSTRUCTION IN THE AMERICAN COLLEGES (New-Haven, 1814) — an entirely different volume that has not been examined.[11]

Brown has prepared for us an electronic image of the Thoreau solution to the 1, 3, 9, 27 problem. The scrap of paper bears the place/date identification at the bottom "Concord Me Jan 10th 1840". (Sanborn has taken that scrap of paper out of the Farrar volume and glued it into the front of copy #105 of his THE PERSONALITY OF THOREAU, printed by Goodspeed in Boston in 1901.)

"MAGISTERIAL HISTORY" IS FANTASIZING, HISTORY IS CHRONOLOGY

11. The Reverend Day also published treatises on trigonometry, geometry, and the mathematical principles of navigation and surveying which Thoreau may very well have studied. Not only Thoreau, but also Emily Dickinson while she was at Mount Holyoke, studied from his treatise on Algebra.

"It's all now you see. Yesterday won't be over until tomorrow and tomorrow began ten thousand years ago."

– Remark by character "Garin Stevens"
in William Faulkner's INTRUDER IN THE DUST

Prepared: April 8, 2018

ARRGH AUTOMATED RESEARCH REPORT

GENERATION HOTLINE

This stuff presumably looks to you as if it were generated by a human. Such is not the case. Instead, someone has requested that we pull it out of the hat of a pirate who has grown out of the shoulder of our pet parrot "Laura" (as above). What these chronological lists are: they are research reports compiled by ARRGH algorithms out of a database of modules which we term the Kouroo Contexture (this is data mining). To respond to such a request for information we merely push a button.

Commonly, the first output of the algorithm has obvious deficiencies and we need to go back into the modules stored in the contexture and do a minor amount of tweaking, and then we need to punch that button again and recompile the chronology — but there is nothing here that remotely resembles the ordinary "writerly" process you know and love. As the contents of this originating contexture improve, and as the programming improves, and as funding becomes available (to date no funding whatever has been needed in the creation of this facility, the entire operation being run out of pocket change) we expect a diminished need to do such tweaking and recompiling, and we fully expect to achieve a simulation of a generous and untiring robotic research librarian. Onward and upward in this brave new world.

First come first serve. There is no charge.
Place requests with <Kouroo@kouroo.info>. Arrgh.