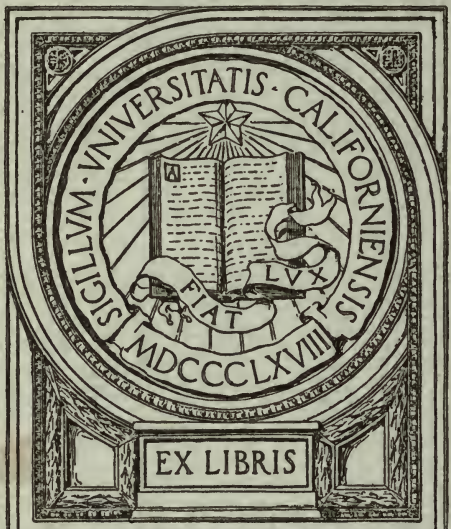

ADDRESS

ON THE

STUDY OF MATHEMATICS,

BY

ERASTUS EVERETT, A.M.,
Principal of the ORLEANS HIGH SCHOOL, New Orleans,

AT THE CLOSE OF THE ANNUAL EXAMINATION, AUGUST 18, 1852.

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CAJORI

ADDRESS.

LADIES AND GENTLEMEN:

It becomes my agreeable duty to thank you for the interest which you have taken in the exercises of this day. We were all once children, and we shall never forget how much the approbation of our seniors encouraged us in the career which we were just beginning, and how we then ventured for the first time to aspire to honors which merit only can win. I thank you, not only in my own behalf and that of the young gentlemen of the Institution who have appeared before you, but in behalf of my learned colleagues. They have faithfully and ably seconded me in my humble endeavors to impart to the students entrusted to my care, an accurate and extended knowledge of those branches of learning which will be found indispensable to their success and honorable standing in future life. And to you, young gentlemen, let me recommend not to forget the applause you have this day received. You perceive that your career is watched with solicitude by your parents, and, though the love which God has implanted in their bosoms would never be quite extinguished by your obscurity, it is increased ten fold and there is superadded to it an honest pride which parents only can feel, when they see that you will not only transmit their names to the next generation, but that

the honor of these names which they have rendered illustrious shall still be guarded when they shall sleep with their fathers, by you their sons, their joy, their pride, and, it may be, the hope of their declining years.

In accordance with ancient custom in Literary Institutions, we close our Annual Examination and our Academic Year with dramatic and oratorical exercises. We ought, however, in order that we may not be misunderstood, to remark, that in our daily instructions, we attach to these exercises a secondary importance. The useful rather than the agreeable occupies our chief attention, and the great secret of teaching is to invest the useful with a charm which shall cause the student to pursue it with eagerness and delight. We ever bear in mind the fact that these youths will soon be men; that they will be called upon to perform the responsible duties of life; and that in the performance of those duties, accurate knowledge will fit them for all emergencies, while the mere graces of elocution, without this knowledge, would only make their ignorance the more conspicuous, and expose to contempt such as might have dwelt in peaceful obscurity. In making these remarks, we must not be understood as undervaluing the power of true eloquence; but it is vain to cultivate this, to any great degree, till we have first subjected the mind to rigid discipline, and stored it with useful learning by years of arduous study. The caution of Quintilian, with regard to style, should be adopted as the motto of every teacher: "Curam verborum, rerum volo esse solicitudinem," says this great Master.

Among the branches of learning to which we attach

a primary importance, are Mathematics and the English, the French, and the Spanish language. Ours is essentially a commercial community, and the young men now in school will soon have to take a part in conducting the mercantile transactions of the world. It appears to us that this fact has too often been lost sight of, and that these branches, and particularly Mathematics, have not received that attention which their importance deserves. Fully impressed with the truth of this remark, we have endeavoured of late to raise the standard of merit in this department, and to impart a thorough knowledge of Mathematics and to elucidate its principles from its simplest elements to its most abstruse truths and most remote conclusions.

I have thought that I could not choose a more important theme, analogous to the occasion, than the study of this science. I am aware that some turn away from this subject as void of interest, but I have no fears of meeting with any such in the polite and intellectual assembly whom it is now my pleasure to address. And you will, I doubt not, accompany me while we devote a short time to the consideration of this profitable and interesting subject.

The Ancients had but a limited knowledge of this science. The knowledge of the Egyptians, which was probably derived mostly from the Persians and the Hindoos, was confined almost exclusively to the elements of geometry. They applied this, however, to mechanics so far as to be able, by the application of them to huge engines, to rear those massive structures which are the wonder of the world. The Grecians, particularly Thales and Pythagoras, but, above all,

Euclid, carried geometry to such perfection that little remained to succeeding ages but to study the admirable analyses which they left behind them. But arithmetic, algebra and trigonometry were quite unknown to them. These sciences may be said to have had their birth among the Saracens, who have done more than any other people to extend the province of Mathematics.

The mission of the Saracens as propagators of learning, began about the middle of the eighth century; and into every part of their then extended empire they infused the love of learning that they owed to the Grecian authors with whom they then for the first time became acquainted by translations into the Arabic; and this love of learning, which with the Greeks was the offspring of reason, became with the Saracens a burning zeal, an inextinguishable enthusiasm. They carried the cultivation of letters with them in all their conquests, and at a period in which all the world was buried in darkness, and barbarism had taken the place of civilization, Science took refuge in the court of the Caliphs of Bagdad. Here she found protection, and here she made some of her most brilliant conquests. Not only did the people of this wonderful empire preserve to the world the learning which they had derived from Greece, but they enriched it with immense additions by their own researches.—Among them chemistry had its origin. And, though the glory of the most brilliant discoveries in this science was reserved for the English and French savans of our own days, the Saracens made some discoveries which are valuable. They first discovered by distillation, pure alcohol, a chemical agent

whose value can scarcely be overrated. By the invention of gunpowder they prepared the way for revolutionising the ancient mode of warfare and substituting one less destructive of human life. That they made many contributions to astronomy, is attested, not only by history, but by the names of numerous stars whose Arabic prefixes show that their places were either first noted by the Saracens or that they first made use of these stars as bases of astronomical calculations. The former is the case with many stars of the lesser magnitudes and the latter with such stars as Aldebaran, one of the Hyades in the constellation Taurus, and Alpheritz and Almaach in Andromeda. The heavens are "sowed with stars," "thick as a field," that first received their names from the Saracens. They have thus built monuments for themselves in the firmament "more durable than brass." But their greatest triumphs were in the science of algebra. True, we are told they were not the inventors of this science, though its etymology is a strong presumption in favor of this supposition, but certain it is, they were the first who introduced it into Europe. This was a gigantic step in the career of Mathematics. Algebra, in the hands of Descartes, Newton and Laplace led to those astonishing results in astronomy which illustrate the last century and the present. Besides this, to the same ingenious people, we owe the invention of the decimal system. From the time of this invention arithmetic first took its place among the sciences as an important branch of Mathematics. To the Ancients arithmetic was almost wholly unknown; and when we consider the difficulty of calculating by Roman letters we shall cease to wonder

that the arithmetical knowledge of the Ancients was quite elementary. The art of book-keeping, since invented by the Italians, would be quite impracticable without the decimal system. We are thus prepared to acknowledge the debt of gratitude which the commercial world owe to the Saracens.

Valuable additions have been made to arithmetic, algebra and trigonometry within the last two centuries. Arithmetic is receiving improvements almost every year, and America may justly claim the honor of having furnished some admirable treatises on this subject. Algebra has been greatly improved in the hands of the French, the English and the Germans. The method of differential calculus was discovered by Newton as early as 1669, and a few years after by Leibnitz. Such new applications of the binomial theorem were made by Newton as, joined with his other contributions to this science, have placed him above all other mathematicians both ancient and modern. Logarithmic tables, which shorten immeasurably the former tedious operations in trigonometry, were published by Lord Napier in 1614.

Having given a sketch of the history of this science, let us consider some of its advantages. And, first, it is a universal language. The proposition, for example, that *the sum of two quantities multiplied by their difference is equal to the difference of their squares*, is enunciated by means of a few characters extremely simple, known to all algebraists of every tongue all over the world. The same may be said of every proposition.

But, second, not only is this a universal language, but, what is of far greater moment, it has to do with

general truths. It thus becomes the most beautiful example of pure intellection that can occupy the human mind. It seems to be the nearest approach that the mere intellect of man can make to the mind of the Infinite. The hypotheses of metaphysicians are nothing to it. They rest upon the shadowy foundations of theory, this upon the immovable foundations of demonstrated truth. The hypotheses of the metaphysician of yesterday are overthrown by the metaphysician of to-day, that he may substitute other hypotheses to be overthrown in their turn to-morrow. But the demonstrations of the mathematician will survive "the wreck of matter and the crush of worlds." Hence, there is a satisfaction in mathematical demonstration which the merely moral reasoner cannot conceive of. Pythagoras is said to have sacrificed a hecatomb of oxen when he discovered that the square of the hypothenuse is equal to the squares of the opposite sides. Archimedes discovered a new law in hydrostatics and, smit with divine enthusiasm, he ran through the streets of his native city shouting to all he met, "I have found it! I have found it!" Tradition relates that this devotee to the science of which we are treating fell a sacrifice to his enthusiasm. During the storming of Syracuse, he was sitting at the market-place considering the properties of the circle by means of a diagram which he had made in the sand, and when a Roman soldier approached, his entreaty was not "save my life," but "spare my circle." The ruthless soldier, heedless of the man of science, struck him down. Nor is there anything improbable in these traditions. Well attested examples have not been wanting

in modern times of men who held science dearer than life. The fate of the chemist Lavoisier is probably known to most of us. He fell a sacrifice to the violence of the times during the Reign of Terror in 1794, and when condemned to death, he plead for a reprieve of a few days till he should have time to complete some experiments upon which he was then engaged. The answer of his judges was, "The Republic has no need of chemists;" and he was compelled to leave his retorts upon the fire and go by the same road as Chenier, and Malesherbes, and Madame Roland, to that world where "there is no work, nor device, nor knowledge, nor wisdom."

Third: Another obvious advantage of the study of Mathematics is the mental discipline which it imparts. It does this in two ways: first, it fixes the attention; second, the premises being certain, the mind is freed from that doubt which too often attends moral reasoning.

It is manifest that without attention, the mind can not advance a single step; for, if an intermediate step is wanting, all the preceding conclusions are of no avail. The process of reasoning is a chain, and if one link is broken the entire chain is broken.

But attention would be of no avail as a means of mental discipline were it not for the fact that the mind being free from uncertainty with regard to the point of departure reasons with vigor and with that confidence in its own conclusions which cannot fail to strengthen the powers of the mind. For, let it be remarked that it is not every kind of mental exercise that serves as a mental discipline. On the contrary,

when we reason merely for the sake of argument, as in case of a debate in which we are chosen as champions of a proposition without regard to its merits, or when we take our departure from doubtful premises, as in points of scholastic theology, the mind instead of being invigorated becomes enfeebled. So far have some trifled with their powers of debate, that they have habitually played the hypocrite by defending what they knew to be wrong merely to show their skill; and God has inflicted upon them a punishment adequate to their offense. He has filled their minds with universal doubt; so that, having begun by pretending to be sceptics, they end in becoming such, and doubt everything, even the existence of a God, nay, even their own existence and the existence of matter. Our madhouses are filled with that other class who, sincere but too bold, have striven to attain objects beyond their reach, and have been overtaken by the just judgment of Heaven who has smitten their minds with hopeless impotency. And they furnish melancholly examples of the apophthegm of Pope:

Aspiring to be gods, if angels fell,
Aspiring to be angels, men rebel.

To be convinced of the vast superiority which mathematical reasoning possesses, as a means of mental discipline, over all methods of moral reasoning, let us glance at the peculiarities of the two most remarkable of these methods.—Aristotle's method consisted in discovering a new truth from the relation which exists between two known truths. But here arises a difficulty on our first setting out. What are known truths? What one receives as

truth, another considers as either doubtful or false. We hope we shall not be considered pedantic if we introduce, for the sake of illustration, a syllogism in form. Let us take for our major premise the proposition that *All republics are good governments;* and for our minor premise, *France and Mexico are republics.* The conclusion inevitably follows that France and Mexico are good governments. Now, this conclusion is erroneous because the major premise is false. It is not true that all republics are good governments. The same doubt, in many instances, attends the method of Lord Bacon. And here it is proper to remark, that, with respect to his philosophy, there has been a very general misapprehension. Because the philosophy of Aristotle accomplished little and that of Bacon accomplished much, it has been concluded that the philosophy of Bacon is opposed to that of Aristotle. But the truth is, Bacon came to Aristotle's assistance. He only completed what his predecessor had left unfinished. He did but consolidate the foundations which were too weak to support the noble structure that the Stagyrite had reared upon them. Why did the system of Aristotle fail in producing those results which followed the introduction of Bacon's method? It was not for want of acute minds, for there were among the schoolmen minds as acute as that of Blaise Pascal or Jonathan Edwards. It was not for want of attention to philosophical subjects; for the schoolmen attended to nothing else. It was simply because the Aristotelians took for granted what had never been proved, and hence, their whole system was but a tissue of argu-

mentative romance. They reasoned and reasoned till their brains were turned, upon subjects which it is utterly impossible to decide and the decision of which, even though it were possible, would be of no use either practically or philosophically. And why all this? Why, simply because the great Master had left his major premise unproved. Bacon taught us to establish this by experiment. It is for that reason that his method has been called the inductive method. Though not the first, as has been remarked by the ingenious Mr. Macaulay, to make use of this method, he was the first who insisted on it as essential to the establishment of any new truth. Having furnished a method by which to prove the major premise of Aristotle, he has laid the syllogistic method in foundations that can never be moved, and hence the triumphs of his system. We have, then, distinctly before us the peculiar merit of both these great masters. The former, taking certain truths for granted, pointed out the process of ratiocination by which to arrive at other truths, and showed that, without this process, no conclusion could be satisfactory. The latter has furnished us a method by which to prove what the other had taken for granted, and has supplied the link which was wanting to make the chain of reasoning complete. Well may we exclaim, "Par nobile fratrum." You have done all that human genius could do to avoid error and to arrive at truth. But you have, with all your wisdom, failed to establish many truths on which depends the happiness of millions. In some kinds of moral reasoning your methods have the certainty of mathematical demonstration. In others, your united efforts have not been able to save us from painful

doubt. On the great question of the truth of Revelation, proved as it is by the united testimony of disinterested witnesses, and by an immense amount of internal evidence consisting of the Divine nature of the truths revealed, the fulfilment of the prophecies with regard to ancient cities, and the oriental cast of the scenery, imagery, manners and customs, with which the Holy Scriptures abound, we cannot entertain the shadow of a doubt. Indeed, the making of an apocryphal book like the Bible would be a greater miracle than any which it records in proof of the mission of the Messiah. And the proofs of the incidents of our Saviour's life and death are as well established as those of the life and death of Julius Cæsar. They both rest upon the basis of history. Nor must it be supposed that all truth is to be doubted because it cannot be proved mathematically. It would be just as absurd to apply the process of algebraic equations to prove the truth of a historical fact as it would to attempt to measure Mont Blanc by means of a syllogism. The two systems of proof have nothing in common with each other. But on many points of history the world is still divided in opinion. The question is not yet settled whether Mary Queen of Scots was guilty of the murder of her husband. The same may be said of the justice of the death of Charles I, the justifiableness of the Crusades, and a thousand other questions which your own familiarity with history will suggest to you. So, in questions of law and ethics. Our most learned jurisconsults are retained to maintain opposite sides of disputed points, and so difficult is it to arrive at truth, that the decisions of our courts are often inconsistent with each

other. Questions of casuistry encounter us everywhere, and few are wiser after having been tossed upon the ocean of life for years than when they first launched their frail bark upon the stream of childhood. Philosophers have been reasoning about fatality and free-will for more than two thousands years, and it is doubtful whether we have advanced or retrograded. These subjects are involved in mystery from their very nature, and any attempts to elucidate them must end in contradiction and obscurity. Man's will, they tell us, is free, because he wills what he chooses to will; but they tell us further, that he always chooses and always must choose according to the strongest motive, and the motive is what moves. In other words, causing the technicalities to disappear, man's will is free because he acts as he is acted upon. This, it must be acknowledged, is pretty nearly the freedom of the magnetic needle.

Now, in mathematical reasoning there is none of this doubt. Hence, its superiority as a means of mental discipline over moral reasoning. We here begin with axioms self-evident to every intellect, and arrive at the most important conclusions, and all along the whole ascent, not a doubt springs up in the mind lest the outset may have been wrong. We rise by a series of equations or ratios, which follow each other necessarily, to the sublime discoveries which occupied the attention of a Descartes or a Newton. We begin by measuring the lot on which we build our cottage and ascend till we seat ourselves among the stars and contemplate the mechanism of the heavens.

Again: Another obvious advantage of the study of Mathematics is, that it serves to check the

vagaries of the imagination. This is especially beneficial to the young student. The imagination, if allowed to wander at will, strays into forbidden paths, and often betrays its victim into fatal snares. We have only to compare the lives of the Mathematicians with the lives of the Poets, and we shall find that while the former have rarely forgotten that they were men destined to a high rank in the scale of intellectual beings, the latter have sacrificed at the shrine of pleasure till life became a burden, and have then sought to drown a troubled conscience in the intoxicating bowl.

We now come to the practical advantages of this study. And here the prospect opens upon us so vast, that we are in danger of being lost in the boundless field. This science is capable of being applied to an indefinite extent. Whether in calculating the price of a yard of cloth, or the length of a degree of longitude, whether in measuring the declivity of a roof or the height of a mountain, the width of a river, or the distance of a planet, Mathematics are always brought into requisition. All the interesting phenomena in Optics may be accounted for by a simple law which geometry enables us to verify. We wonder that the puny arm of man should have been able to build the pyramids. Let us wonder rather at the science which enabled man to invent the machines that raised those massive blocks to such a height, and laid them all in their proper places. Without this science, that puny arm would have been powerless.

To the daily applications which the different branches of Mathematics are receiving we owe, chiefly,

the various improvements in the arts which distinguish the present age. The engineer has spanned our rivers by bridges—some of solid masonry, reposing securely upon semi-circular arches, some upon attenuated threads of steel, and in one instance, he has crossed a strait more than five hundred feet in width by an eliptical tube of iron eighteen feet by thirty, and this raised so high that the largest ships pass beneath it, and so strong that the longest trains of cars pass through it without causing it to settle a single half inch.* He has caused his railroads to cross our mountains or to pass beneath them, and thus to make neighbors of people remote from each other. He has connected distant waters by canals, thereby opening new markets to the agriculturist and giving an increased impetus to trade. He has launched the steamship upon the ocean, and commanded it, regardless of wind or tide, to plough distant seas till now undisturbed but by the monsters of the deep, and has there made a highway for the nations. Communicating, by means of a modification of the telescope, from the top of one high mountain with a fellow laborer upon the top of another high mountain many leagues distant, he fixes the latitude and longitude of every important point upon our extended coast, and is enabled by this means to construct charts, which shall be safe guides to the mariner. In a more humble sphere, he lays out our streets or surveys our lands, and fixes their limits. And for all these labors we are indebted to formulas

* Allusion is here made to the iron bridge lately constructed over the Menai Straits by Mr. Stevenson. This is, without doubt, the greatest triumph that engineering has yet achieved.

depending upon calculations more or less complicated.

Architecture, in its more imposing displays, would never have had an existence but for geometry. From the staircase to the arch and the dome, all is constructed according to rules furnished by geometry. All the complicated varieties of machinery, from the watch to the spinning jenny and the steam engine, depend upon mathematical proportion.

But in no art or science have Mathematics made more brilliant triumphs than in astronomy. Planets whose rays are lost before they reach our unaided vision, are brought near by the aid of glasses, and not only their distances, but their motions are calculated with precision. We have been so long accustomed to look in the calendar for the phases of the moon, the position of the planets, the length of the day, and indeed, for all the information we desire with regard to the heavenly bodies, that we neither appreciate the labors of those men to whose indefatigable researches we are indebted for all we know, nor do we place an adequate estimate upon our knowledge as compared with that of the Ancients who considered the earth as a flat surface of indefinite extent, and the sun, moon and stars as pretty nearly equidistant from the earth, around which they were supposed daily to revolve. It is only three centuries since Tycho Brahe, a Danish astronomer who enriched the science by the number and exactness of his observations, maintained this ancient hypothesis in opposition to Copernicus; and it was not till Newton appeared and, by the light of his powerful mind, scattered the clouds which had hitherto hung over this subject, as the sun scatters the mists

of the morning, that all the civilized world adopted the system of Copernicus. And what is true of the Ancients is also true of the less enlightened nations of our day. In not a few instances, our Christian missionaries have won respect for the great cause to which they have consecrated their lives, by contrasting the accuracy of our almanacs with the erroneous calendars of the people of India. To such exactness has this science arrived with us, that the astronomer shall predict to a second the commencement of an eclipse one hundred years in advance, and at the precise point of time indicated the sun,

> "In dim eclipse, disastrous twilight sheds
> O'er half the nations, and with fear of change
> Perplexes monarchs."

Truly, O God, "Thou hast made man a little lower than the angels, and hast crowned him with glory and honor."