Mathamerica

and key to

the American Dozen System of Mathematics

by

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http://www.dozenal.org

Dozenal numeration is a system of thinking of numbers in twelves, rather than tens. Twelve is much more versatile, having four even divisors—2, 3, 4, and 6—as opposed to only two for ten. This means that such hatefulness as "0.333. . . " for $^1/_3$ and "0.1666. . . " for $^1/_6$ are things of the past, replaced by easy "0;4" (four twelfths) and "0;2" (two twelfths).

In dozenal, counting goes "one, two, three, four, five, six, seven, eight, nine, ten, elv, dozen; dozen one, dozen two, dozen three, dozen four, dozen five, dozen six, dozen seven, dozen eight, dozen nine, dozen ten, dozen elv, two dozen, two dozen one. . . " It's written as such: 1, 2, 3, 4, 5, 6, 7, 8, 9, ↊, ↋, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 1↊, 1↋, 20, 21. . .

Dozenal counting is at once much more efficient and much easier than decimal counting, and takes only a little bit of time to get used to. Further information can be had from the dozenal societies (http://www.dozenal.org), as well as in many other places on the Internet.

Preface

The purpose of this work is to set forth a new theory and motive regarding numbers—to explain and demonstrate an improved process of calculation, and to point out some of the benefits and economies that follow the understanding and uses of this new discovery.

When the author first began the study of twelve as a possible basis for a number system, and after he had learned to perform simple problems in addition, subtraction, etc., his impression was that he had simply invented another way to handle numbers. It was not until after the new principles and methods were applied to everyday practice that the fuller scope and revolutionary character of the change became apparent.

Any proposal to change arithmetic and numbers from the accustomed decimal basis to that of another system meets with stubborn opposition in certain places. This is to be expected, for in our measured universe values have been learned by tens. Ten may be denominated the number of mankind, since the education and practice of the individual and the numerical foundation of organized society is built thereon.

But again there are others who are ready to break with past tradition, in order to be right with the present and future. To them such a change is welcomed.

If the facts as set forth warrant the conclusions, and the writer believes that they do, then these facts, to carry weight, must be easily understood by all, and not by just a favored few. With his present limited apprehension of the subject the author has endeavored to record, as simply as possible, some ascertained facts and some fundamental truths, which can hardly be disregarded by anyone professing to be in accord with a science as absolute and exacting as mathematics.

The higher and immensely valuable symbolism of mathematics has been lost in the confusion of a mis-fit number system. The mathematical interpretation of things has been merely mechanical in its significance. Its practical and symbolical meaning is not indicated in the disrupted and broken sphere of decimal operations. Let the beginner in the study of twelve, as herein treated, ponder the simple but universal lessons that this great number teaches, and mathematics will become to him a living subject, all-absorbing, interesting—full of useful lessons and indicative of good works.

Order is heaven's *first* law, says Pope, and if this be true then a lack of order is unlawful, and hardly of heavenly origin. Any institution that is disorderly is numbered for length of days; and the decimal system, judged by its own testimony, is such a system.

The modern world will not knowingly condone inefficiency and confusion; nor will the match of events long tolerate what is wrong in precept and practice. The circumstances of progress demand a better understanding and application of numbers than has heretofore been available.

Twelve, the base of the new system, is well established in the respect and customs of the people of all lands. The mathematics of the new system will grow and develop for it is not only demonstrative and symbolical as a theory, but more than adequate as a tool,—meet for this age of pioneering, engineering and general progress.

G. C. Perry

Chicago, U.S.A.
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Mathamerica: A Treatise on Number Twelve

Introduction

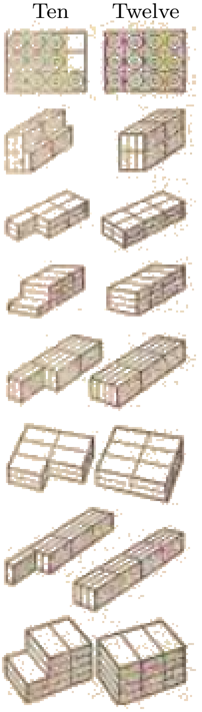
The American Dozen System of Mathematics, founded on the base twelve, provides a complete working system of numbers that can be handled by twelves in large and small denominations and computed in a manner that is as rapid, and more accurate and comprehensive than the well-known Arabic Decimal System of tens.

Twelve is the natural arithmetical and geometrical base for the use of numbers. It is the center of the perfect mathematical universe, in and around which all forms and numbers operate harmoniously. Twelve is the number of science and service complying with all mathematical law; while ten is the number of physical sense, having its origin as a base number in counting on the ten fingers and thumbs of the human hands.

The decimal system of tens is out of step with all natural law and order. It does not and cannot satisfy the numerical requirements of mankind. It is used, where used, not because of its superiority, but because it has been the only system with functions that made possible the handling of the larger amounts. Wherever real practical service is required, as in division of numbers, weights and measures, the handling of merchandise, etc., twelve is in every way preferable to ten. The only reason that twelve has not displaced the decimal ten completely is because there has been neither method, names, nor characters i.e., a system, for handling numbers by units, dozens, grosses, etc., as is done by units, tens, hundreds, and thousands.

Notwithstanding the fact that the current arithmetic and numbering system is on the basis of tens, decimal, the use of number twelve is, in some instances, universal and practically supreme. This is especially noticeable in the realm of merchandising where twelve, with its factors and multiples predominate. Hence the predominence of twelve is not the result of chance, nor a mere preference for one number over another, but has its sanction in geometrical law and order.

Twelve and Merchandising



In the handling of merchandise the manufacturer, the exporter and wholesaler must pack their articles, items, or units to square with geometrical principles. Twelve articles can be stacked in solid cubical form in many different styles; while ten can be packed or arranged in only a very limited number of forms without open spaces or fractional pieces remaining. Twelve, with its large range of even forms, permits the more economical cutting and fitting of materials for boxes and containers; and also insures solid, shapely, well-packed shipping cases. The same advantages are even more notably true of the multiples of twelve over the multiples of ten, for example, packing half a gross over half a hundred.

The wholesaler, dealer and jobber, buying boxes and cases of dozens, grosses, dozen grosses, etc., naturally finds them priced, not by decimals—tens and hundreds, but as they are put up—by dozens and grosses. Thus packed and priced they are passed on to the retailer. Finally, the purchaser, the ultimate consumer, which means almost every individual in the world, in buying, finds himself computing by twelves—buying articles by dozens and parts of dozens—and figuring prices on that basis.

In arithmetical law and order twelve again predominates. The number twelve has divisors 2, 3, 4 and 6, with 2 and 3 divisors of 4 and 6. Compare this divisibility with that of number ten which has factors 2 and 5 only, with 5 indivisible by other numbers.

In the countless number of small transactions, such as grocery and retail store purchases, the unit is usually a box, carton or case containing twelve smaller units. The purchaser finds that he can take the $\frac{1}{6}$, $\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$ or $\frac{5}{6}$ part of a dozen, which divisional signs represent and correspond to the numbers 2, 3, 4, 6, 8, 9 and T (ten). No complicated mental work is required in handling these numbers with their signs in dividing the unit of twelve parts. This is not the case with ten, for the numbers 3, 4, 6, 8 and 9 do not divide ten in an orderly manner; hence difficult fractions become involved.

If the purchaser of small items of merchandise is in a country using the decimal system of coinage he finds that the same divisors that give him the desired parts of a dozen do not always divide right to make the cents come out without a fraction. This is because the unit of money is a ten, instead of a twelve which it should be, for the same arithmetical reasons that facilitate the dividing of the dozen articles.

It can thus be seen that geometrical and arithmetical law concur to force the use of twelve in the world of merchandising. Ten does not qualify for service in either number or form, and it is here that we find the first great disparity between the decimal theory of numbers and the practical requirements of mankind.

In the multitudinous world of buying and selling the wonderful adaptability of twelve proves a constant blessing to both the great and the humble. The easy comprehension and application of the simple fractionless properties of twelve, to everyday affairs, simplifies and expedites the world's business, and offers a practical hint of the possibilities of a complete system of twelves. The new system could well replace the decimal ten system, since it can be used with greater accuracy, economy and efficiency in every department of activities where numbers are employed.

Twelve in Geometry and Arithmetic

It is not in the realm of trade alone that twelve furnishes the sphere of mathematical agreement between form and number—geometry and arithmetic; for in all natural forms and institutions (those which are not mere arbitrary devices) the geometrical divisions of the unit-form are the numerical divisors of number twelve. The divisional manifestations of ten and its half, five, are so rare in nature as to be negligible.

There is an everlasting, normal and harmonious mathematical coincidence between geometry and arithmetic which cannot be demonstrated with the decimal system of numbers. This lack of agreement, manifest as fractions, has been costly and confusing. It has troubled the users of mathematics since the decimal system was first applied to the solution of problems. The existence of fractions has been continuous and is today the greatest anomaly that we have in mathematics. The most deplorable aspect of the whole situation is that the farther we work in decimals—the more the decimal processes are applied to numbers—the worse the matter becomes.

In the geometry of life, in which all things seem to live, move, or have their being, are experienced the concepts form, number, spaces, time, place, quantity, quality, etc. It is in these concepts that the engineer and mechanic, the statesman, the lawyer, the writer, the preacher, the peasant, the captain and king—fashion into form and give expression to the things apprehended mentally. How well each can work his problem—apprehend the relation between its various elements or factors—depends on how clearly he sees where and how to divide and subdivide the problem into its elementary parts. All division is geometrical by nature: and we will attempt to show that these divisions are of the order of twelve, and that they cannot be made to co-incide with the decimal system of tens.

While number itself exists as a mental or spiritual fact, its exemplification is suggested by the form of the things surrounding the individual and dawns on consciousness very slowly. The primeval and elementary number-forms are symbolized by names: Two, Three, and Four, and also by figures 2, 3 and 4—all factors of twelve. These simple concepts are observable as objects about us. The divisions of 2 are seen in the horizon dividing earth and sky; a North and South line dividing the East from the West; the path or highway dividing the right from the left; day and night; up and down, and countless other divisions of 2. Number 3 is seen in earth, sea, and sky; the forked path; the confluence of two streams making a third. Number 4—in the cross-roads; the tree bisecting the horizon; the square plot of ground; the 4 cardinal points of the compass or circle. Numbers 6, 8, and 9 are seen in compound forms of 2, 3, and 4, and certain forms that are modifications of the circle and sphere.

As it is with numbers so it is in geometrical theory. The line, circle, or cycle divides: By 2—into the half or semi-circle: By 3—into the third, the Y, or triangle: By 4—into the cross, square or quadrant: By 6—into the hexagon. The cube has 6 sides and twelve edges. These forms and numbers are the factors of the twelve unit but not of the ten.

Man began counting with these primary number concepts, but in recording or tabulating the amounts the digits or fingers of the hands were used. Very oddly these fingers do not correspond in number to anything in science or nature, but are manifest as 5 and ten. This counting gives us a system of tens, or decimals, on which our whole number scheme is founded. Ten is not, unfortunately a multiple of divisors other than 2 and 5.

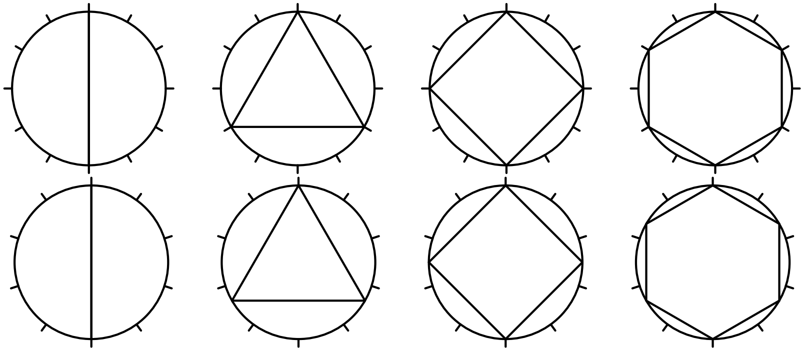
Number 1 can never be fully apprehended by human thought, for if number 1 is to represent the unit, then unity must be the individual ONE, beside which there can be no other. It must be All-in-all, unmultipliable, indivisible, and include both the infinite and the infinitesimal.

In lesser things, however, the unit may be considred as the sum total of the parts of any problem; and every problem must be treated as a unit before it can be solved. The first operation on the unit is usually to divide it by 2, 3, or 4, into halves, thirds, or quarters. The problem under consideration may be a planet or sphere to be divided by a circle or a plane; it may be a length, an area, or a solid, to be divided and subdivided into pieces, patterns, forms, quantities or qualities, as desired; or the problem may be wholly mental—an idea—requiring an act or thought, with a dividing line only (figuratively or literally) from which to calculate.

In the practice of dividing our work-a-day problems we are confronted with a natural unit (object) which must be divided by the small numbers 2, 3, 4, and often 6, which resulting divisions are parts of twelve; but with a decimal numbering system whose unit of ten parts does not divide evenly by these numbers. Here trouble begins, for in dividing the objects, the things themselves, the parts are not fractured or broken; but in dividing the numbers that represent these parts, a break or fracture is the result. Hence, *fractions*, in everything arithmetrical.

When arithmetic is applied to geometrical figures, to obtain their numerical values, it is found that the decimal unit of ten parts does not divide evenly by numbers 2, 3, 4, and 6; except in the case of 2 with a resulting 5. It might seem that factor 2, dividing both ten and twelve, has equal values as a factor in both cases. That this is not true can be seen if the circumference of a circle is divided into twelve equal parts. The first division of 2 gives two half-circles of 6 parts each. Another line drawn through the center at right angles to the first, results in 4 quarters of 3 divisions each. Now if the circumference be divided into ten parts, the first division of 2 results in 5 in each half, while the second division produces the fraction $2\frac{1}{2}$, or 2 *and* 1 divided by 2.

Division is the test of all things. The multiplication of forms and numbers is not difficult; after the problem or unit has been solved—its factors and parts divided and determined—or a model constructed. And it is just here that the decimal system reveals its disintegrating, schismatic nature. Any continued division of numbers by decimals breaks these numbers into prolonged and recurring fractions; which to reassemble requires the most complicated and drastic treatment in all arithmetic.



The unit of twelve parts can be divided and redivided, in any order, without a recurring fraction by the numbers 2, 3, 4, and 6, and also by 8 and 9, which divide 2 and 3 dozen respectively. The numbers 5, 7, T (ten), and L (eleven) do not represent regular geometrical forms, but are intermediate or fill-in numbers. They have their places and functions, but are divisible by themselves only; hence are not fit to serve as multiples or divisors of other numbers.

Twelve and National Measures

If further evidence is required to show the inherent superiority of twelve over ten it may be useful to observe how mankind has divided its units of measure when uninfluenced by decimal usage and practices.

National or natural measures, (as distinct from artificial measures, such as the decimal and Metric measures) were in existence centuries before the decimal ten system of numbers was in general use. Consequently these measures were not influenced by decimal calculation. Here we may expect to find, and do find, that the divisions of the unit are either factors of twelve, twelve itself or multiples of twelve. This unlabored selection would be enough of itself to prove that twelve is the logical base number for the divisions and subdivisions of the unit.

The English-American yard is a natural measure, and is the most wonderfully convenient and mathematically perfect measure in existence. The yard with its 3 dozen inches divides evenly (without a recurring fraction) by 2, 3, 4, 6, 8, and 9. Its one-third is the foot of twelve inches, divisible by 2, 3, 4, and 6. With the inch subdivided into twelfths—lines, (French lignes)—comes another unit divisible by the same divisors. This is the acme of mathematical perfection.

Other natural measures are notable for their divisibility. The gallon has 8 pints and 4 quarts. The bushel has 4 pecks each with 8 quarts. The pound has ounces twelve and four. The day 2 dozen hours. The Zodiac twelve signs or divisions. The year twelve months. In music and other forms of sound the meter, time, or rhythm automatically arranges itself into factors of twelve; while the full chromatic scale of tones is made up of twelve equal intervals within the octave, as of black and white keys on the piano keyboard. None of these divisions are normal factors of ten, but all are even divisors of the unit of twelve parts.

Ten Out of Step With Nature

The decimal system of tens is not only out of phase with the numbering and arithmetical solution of geometrical angles, forms, points, and divisions; but is also out of phase with the arithmetical order of numbers. The decimal system is out of phase with itself, a broken kingdom, since decimal division breaks its own numbers into myriads of fractions.

That the decimal ten system of numbers is inadequate to handle the problems of daily experience is proved:

1—By the almost exclusive use of dozens in the world of merchandising, which transactions probably out-number all other transactions combined.

2—By observing that forms and numbers, as instituted by natural law and human selection, do not fit into the decimal system of arithmetic.

3—By the impossibility of demonstrating the utilizing the full mathematical agreement between geometry and arithmetic, where ten is used as the basis of the numerical system.

4—By the necessity of such expedients in decimal arithmetic as "Fractions" which is one of the present numerical anomalies; impairing the efficiency of mathematics; and making this delightful science a task to the user, and an abomination to the teacher and learner.

Twelve Redemptive in Practice

The instances cited to prove the prerogative of number twelve are but a few of the many that exist. The total can be greatly enlarged. We will now mention a few of the advantages of the Dozen System over the decimal system in its aspects as a *system* of numbers. In arithmetic these advantages are broad and far-reaching in both theory and practice. Here are some of them:

1. Flexibility and breadth of factor and multiple relations of numbers to the base twelve, and resultant economy in mental effort over decimals; since numbers naturally yield themselves for solution more readily by twelves and twelfths.

2. Economy is the use of characters or figures in expressing equivalent amounts over decimals (about thirteen per cent). This means a substantial saving in labor, time, power and material in numbering, number plates, recording meters, serial printing, etc.

3. The multiples of twelve are larger and have more factors than the multiples of ten; while twelfths are smaller with more factors than the fractions tenths, in both cases a decided advantage. Common, decimal and binary fractions are abolished and less-than-unit parts are handled as whole numbers are handled.

4. When a like amount of calculating has been done with the American System a far greater mathematical value has been accomplished. This means from one-half to fives times as great a result or value for a given amount of work; or one-half to one-fifth as much work to get a like result.

5. The application of the American System, even in part, to the manufacturer and the wholesaler's problems is immediately beneficial. All calculations can be negotiated by twelves. There is no further need for mixed binary-decimal-dozen expressions, such as forty gross, or the eighth and sixteenth inch. Direct answers are obtained without the usual circumcalculation as formerly required.

6. Because it demonstrates the agreement between geometry and arithmetic, the Dozen System offers the only practical basis for the perfecting of American-English numbering, coinage, weights, and measures. Many of our weights and measures are founded on twelve and fit into this system of numbers perfectly. Those standards which have proved their worth through natural selection and centuries of use, namely—the foot, the pound, the gallon, the dollar, the clock, the compass, etc., require only sub-divisions of

twelfths to make them perfect for mathematical treatment. No change is required except improvement in mathematical thinking.

7. The mental discipline required to master this system of numbers is repaid many times over in the enlarged mathematical education of the individual—an enlarged and quickened sense of the meaning and application of numbers to the solution of problems.

8. The American Dozen System is the next logical step in the evolution of numbers. Being mathematical and demonstrable it is susceptible of immediate proof; therefore it is not merely a scheme or arbitrary proposal requiring legislative enactment for acceptance or use. The dozen and the foot, being universally used and understood, are the rocks on which this system can be adapted to the language and use of every nation.

9. Being simple, i.e., in conformity with natural mathematical law this system is without the inherent faults and limitations of decimals. It gives direct integral answers to problems, thereby simplifying the teaching and learning of mathematics.

T. An examination of the history of the evolution of arithmetic and its uses shows advancement to be slow and toilsome. Its footsteps and progress have not always been in accordance with science or consistency, but have been erroneously influenced by false appearances, trick problems and fanciful theories.

L. The American System being established on the universal number twelve is the final step in the evolution of numbers, predominating in every field where numbers are or can be used. It offers unlimited opportunity in mathematical research and revision.

10: Progress demands that mathematics be understood also in its spiritual import, and not be used merely as a method of naming, calculating or determining a human sense of objects or forces, and their relation to things and each other.

Mathematics and Metaphysics

Mathematics cannot be limited to a material objectification of forms and numbers. Every truth is mathematical in structure and form and can be so expressed. In mathematics is to be found the complete and exact counterpart of the eternal law which governs in the spiritual universe as well as in the so-called material world. Numbers and forms are but symbols of metaphysical or spiritual truths.

The postulates of Christ Jesus, the divine Mathematician, often take the form of equations. "As ye would that men should do unto you do ye likewise" and "with what measure ye mete it shall be measured unto you again," are exact statements of the operation of spiritual law. They are algebraic in character, and although numbers are not involved they are non-the-less mathematical, as is demonstrated by experience.

The law that Christ Jesus exemplified is not a theory of the relative, but the law of the absolute. There are few wonders wrought by present day inventions that this supreme Scientist did not demonstrate in a more scientific and miraculous manner. He not only controlled, but reversed and annulled the so-called forms, forces, and processes of nature—light, heat, gravitation, space, time, place, power, growth, and decay. He divided where humans multiply and multiplied where humans divide.

He knew the name, place, number, and substance of all things, and therefore could state the truth concerning every idea. He stilled the storm, healed the sick, and raised the dead. He proved metaphysical law (Mind) to be the only law, and demonstrated this power with mathematical precision. So great were these wonders that his fame spread all over the world; and his influence is the most powerful, yet beneficent, force in the world today. So conscious was the Messiah of his dominion that he could say: "All power is given unto me in heaven and earth"; and, "I am the *light* of the world."

The kingdom of God is within. The astronomer who goes out to find God in bigger and brighter suns, or the physicist in smaller and livelier electrons comes back, saying, No God. He started with zero, nothing, and the last state of that man is worse than the first.

Twelve—One, and the Bible

The use of number 1 to represent or symbolize God, and of twelve to portray the perfect spiritual universe is marked throughout the whole Bible. This use begins in the first chapter of Genesis where the Creation—the beginning, the only, the first—is divided into 6 days of 2 intervals each, making twelve spaces, called evening and mornings. Man, "given dominion over the fish of the sea, over the fowl of the air and over all the earth" is the first-born of all creation. He is the product of all existence—the sum of all being. His interval or day is the first and the last—*and his number is twelve.*

This unique and exact employment of one and twelve continues until the final prophetic chapter of Revelation, where we are told that, after certain things occur, "the tree of life bears twelve manner of fruits, and yields monthly" or by twelves. There is hardly a page between these two books of the Bible that does not employ mathematics—arithmetic, algebra, geometry, weights and measures, etc., in one form or another to elucidate the thought.

The judgment of Belshazzar, who "lifted up" himself "against the Lord of heaven," as interpreted by the Prophet Daniel was: God hath *numbered* thy kingdom.... Thou art *weighed* in the balances.... Thy kingdom is *divided*... (Dan., 5th chapter). It is written that both king and kingdom perished, that night.

It is impossible to understand the fuller meaning of numbers, weights and measures as used in the Scriptures until some comprehension of the number twelve is attained. The current system of numbers based on ten (decimals) is to the mathematics of the Bible what a flat earth is to astronomy—a false basis. It is not for naught that the true Creation is recorded as being ONE, a unit, of twelve parts.

The first and great commandment is, Hear, O Israel; The Lord our God is one Lord. The Lord's portion is His people, says Moses, and he states that, When the Most High *divided* to the nations their inheritance... he set the bounds according to the *number* (twelve) of the children of Israel (Deut. xxxii, 8). Christ Jesus declared that he was *one* with the Father (John x, 30), and chose twelve disciples, and promised that those who followed him in the regeneration would be his spiritual heirs, and sit upon twelve thrones, judging the twelve tribes of Israel (Matt. xix, 28).

Ten is often used in Bible language to typify physical sense as opposed to scientific understanding. A more universal type of the disintegrating nature of evil does not exist. Having its origin, as the base of the decimal system, with the fingers and thumbs of the hands, it is another "temple made with hands."

"And he (the beast) causeth all, both small and great, rich and poor, free and bond, to receive a mark in their right hand, or in their foreheads: And that no man might buy or sell, save he that had the mark, or the name of the beast, or the number of his name." (Rev. xiii,16:17.) This describes, with startling accuracy, the condition of mankind today; since all business is transacted in whole or part, by decimal tens.

St. John, the Revelator, farther portrays the false creation, the beast, as a ten horned creature and identifies it and its progeny as number six hundred sixty-six. It is more than a coincidence that we find in the decimal system the unmanageable, undefinable 1/3 and 2/3 (of a unit or a thousand) which are written 333+ and 666+. These thirds can never be exactly defined by decimals since they produce a continuing fraction, symbolizing a kingdom divided against itself; dust returning to dust.

The destruction of the beast is prophesied in Revelation. What is the falling of the tenth part of the city (Rev. xi, 13) but the destruction of all evil, which is symbolized by the decimal practices of mankind.... "And the great city was divided into three parts, and the cities of the nations fell." (Rev. 16:19.) The decimal institution or city cannot be divided by three without destroying its unity; but twelve—the city foursquare, has 3 gates on each side.

St. John continues with a metaphorical picture of the celestial city, the new city, which abounds in twelve and twelves, thus: 1. The foundation, the line, is twelve. 2. It lieth foursquare, representing twelve times twelve. 3. It is a cube, with the length and the breadth and the height of it equal, or twelve ties twelve times twelve (Rev. xxi, 16). And he measured the wall thereof, an hundred and forty and four cubits, according to the measure of a MAN.

Mathematics and America

THIS HISTORY AND DESTINY of the United States of America is indissolubly connected with mathematics and numbers. What is erroneously called "thirteen" is a misapprehension and misstatement of the sacred number whose true significance is TWELVE and ONE. This number crowns Manasseh's Eagle in starry symbolism on the Great Seal of the United States. That mighty charter of spiritual liberty, the Declaration of Independence, was established by the representatives of the Dozen and One American Colonies. *Thirteen is decimal,—three and ten.*

The Constitution, the symbol of our national Unity (one-ness) was originally signed by twelve sovereign political divisions or states. Its full political power is now complete and represented by Four Dozen states. This Nation, and its mission, symbolizes the city that "lieth foursquare, which cometh down from God, out of heaven" and is "beautiful for situation, the joy of the whole earth."

It is written (1 Kings, 18th chapter) that the Prophet Elijah, in his awful conflict with the prophets of Baal, "took twelve stones…and built an altar in the name of the Lord." This was the altar on which "the first of the Lord descended" just prior to the destruction of the false prophets. An altar fit to stand before the Most High could not be built of ten stones; for either the foundation, or the sides, or the top, would be incomplete and therefore could not fulfill the structural requirements (described in Revelation) of the city foursquare, whose "length and the breath and height are…equal." Neither could such an altar be built of any other number of stones and retain its mathematical integrity.

The Declaration of Independence concludes with a prayer of affirmation, expressing "a firm reliance on the protection of Divine Providence." This is the new "altar and witness to the Lord of Hosts in the land of Egypt" (darkness and oppression).

The twelve stones comprise the altar, and the altar itself is one. A great civil war was fought to determine whether this Nation should remain ONE and *indivisible*, or become nations *many*. America was instituted by God to show science and salvation unto His people. The Truth, which this stone resembles (which the builders reject) will grind all other stones to powder; and above the ashes of discredited time-honored systems stands this temple dedicated to the fulfillment of the Creator's endowment,—"Life, Liberty and the pursuit of Happiness" to all mankind, according to the "Laws of Nature and Nature's God."

And there appeared a great wonder in heaven; a woman clothed with the sun, and the moon under her feet, and upon her head a crown of twelve stars. (Rev., xii. 1.)

The Dozen System Not "Duodecimals"

Contrary to a popular misapprehension there never has been a duodecimal system of numbers. The belief that there has been such a system possibly arises from the similarity of the words decimal and duodecimal. The use of the term "decimal system" may imply, apparently, that there has also existed concurrently a "duodecimal system"; but such is not the case.

Any system, in order to be a system, must have within itself the elements, mechanism, names, functions, or other properties which will permit its operation to the end of attaining an exact, uniform, and therefore dependable result.

Many early arithmetics give short treatises called "Duodecimals" or "Cross-multiplication." Most of these treatises consist of an endeavor to solve numbers, i.e., addition, subtraction, multiplication and division, etc., by twelves; but the logic invariably breaks down before a successful result is reached or a system perfected. In a majority of instances an author himself cannot negotiate a simple problem with his own "system." Some of the principal unsolved difficulties and deficiencies of these so-called systems are as follows:

1—A lack of suitable characters and names for the numbers ten, eleven, and twelve.

2—No names or values for the scale of twelves and twelfths.

3—The mental processes remain decimal; or translation from decimals to twelves is required.

4—The answers obtained are in decimal tens; and not twelves.

5—These so-called systems are without system in any effective sense, and are strained, artificial, undeveloped, wholly arbitrary, and incomprehensible.

6—None of these proposals are practical, for being without system they cannot be used.

The American Dozen System of Mathematics, founded on twelve, is the only true and workable *duodecimal* system, and is, in the belief of the author, the first and only successful effort to devise a system of twelves that is perfect, practical, and complete in its operation and results.

The word duodecimal is of Latin origin, being *duo* + *decime* (two plus ten), showing conclusively its decimal inception. The word *twelve* is Anglo-Saxon and is no more a combination of ten and two than it is of eleven and one, or any other group of numbers whose sum is twelve. Neither number twelve nor the American Dozen System can be understood from a "duodecimal" bias.

The American Dozen System

THE KEY TO ITS ARITHMETIC

The beginner in [the] Dozen System of numbers should remember that the mathematical habits of mankind are built up on the decimal method of thinking. He will constantly encounter the tendency to think a certain way and should not be discouraged if this age-long habit is not immediately overcome. No good thing is ever attained without some effort, and success can generally be measured by the amount of effort put forth; not only in attaining the new, but in overcoming the old, which in this case is the greater part of the required effort.

The *digits* or *figures* in the Dozen System are:—

1, 2, 3, 4, 5, 6, 7, 8, 9, T, L, 0

The character T is referred to as "figure ten" and L as "figure eleven". Their numerical values are the same as in the decimal system. Figure 0 represents zero: no value. Printers type or typewriter characters may be used for ten and eleven; letters T for the former and L for the latter.

The *columns* or *scale of values* ascend from left to right by twelves; as units, dozens, grosses (twelve dozens).

The following exercises should be read and pronounced aloud. All numbers must be read and thought of in the new system, until the old habits of reading and thinking in decimals is overcome. The reader can supply the missing numbers in these reading exercises.

The *first* column, right, is the *units* column; the *second*, to the left, the *dozens* column:

0	zero	10	one dozen
1	one	11	one dozen one
2	two	12	one dozen two
3	three	13	one dozen three
4	four	14	one dozen four
5	five	15	one dozen five
6	six	16	one dozen six
7	seven	17	one dozen seven
8	eight	18	one dozen eight
9	nine	19	one dozen nine
T	ten	1T	one dozen ten

L	eleven	1L	one dozen eleven
20	two dozen	5T	five dozen ten
21	two dozen one	5L	five dozen eleven
2T	two dozen ten	60	six dozen
2L	two dozen eleven	70	seven dozen
30	three dozen	80	eight dozen
31	three dozen one	90	nine dozen
3T	three dozen ten	T0	ten dozen
3L	three dozen eleven	T1	ten dozen one
40	four dozen	TT	ten dozen ten
4T	four dozen ten	TL	ten dozen eleven
4L	four dozen eleven	L0	eleven dozen
50	five dozen	LL	eleven dozen eleven

The *third* column to the left is the *gross* (twelve dozen) column.

100	one gross
101	one gross one
110	one gross one dozen
11T	one gross one dozen ten
11L	one gross one dozen eleven
1T0	one gross ten dozen
1TL	one gross ten dozen eleven
1LL	one gross eleven dozen eleven
200	two gross
20T	two gross ten
2LT	two gross eleven dozen ten
900	nine gross
T00	ten gross
TTT	ten gross ten dozen ten
TLL	ten gross eleven dozen eleven
L00	eleven gross
L0T	eleven gross ten
LL0	eleven gross eleven dozen
LLL	eleven gross eleven dozen eleven

The *fourth* column is the *grand* (dozen gross) column.

1,000	one grand
6,T00	six grand, ten gross
T,600	ten grand, six gross
L,6T5	eleven grand, six gross ten dozen five
L,TLT	eleven grand, ten gross eleven dozen ten
L,LLL	eleven grand, eleven gross eleven dozen eleven
2T,360	two dozen ten grand, three gross six dozen
358,T00	three gross five dozen eight grand, ten gross

The *seventh* position or place is called the *Americ.*

T,310,L24	ten Americ, three gross 1 dozen grand, eleven gross two dozen four
42L,5T0,397	four gross two dozen eleven Americ, five gross ten dozen grand, three gross nine dozen seven.

The *tenth* position is the *Brithain* (*Bre-thain*).

4T,50L,042,89T	four dozen ten Brithain, five gross eleven Americ, four dozen two grand, eight gross nine dozen ten

It will be noted in the American System that ten is a one column character, since it is represented by the figure T; which is likewise true of figure L for eleven. In the decimal system each of these numbers requires two characters, as 10 and 11. The new way effects an economy of characters or figures which amounts to about thirteen per cent over decimals. Write out the numerals from 1 to twelve decimally. Fifteen figures are required. Now write them by dozens. It will be seen that thirteen only are required. This economy in figures is noteworthy, amounting to about 2 million characters when writing or printing numbers from 1 to one and one-half million. In such matters as number plates this represents a great saving in labor and material.

The complete *scale of numbers*, up to 9 places on the units side and 5 places on the less-than-units side of the twelve-point, is shown herewith:

gross Brithain	dozen Brithain	BRITHAIN	gross Americ	dozen Americ	AMERIC	gross grand	dozen grand	GRAND	gross column	dozen column	units column	twelfth point	twelfths	gross parts	grand parts	twelfth-grand	gross-grand pts.
6	0	2	3	6	T	4	7	1	5	L	8	:	3	T	1	2	L

The above string of figures should be read as follows: Six gross two Brithain, three gross six dozen ten Americ, four gross seven dozen one grand, five gross eleven dozen eight *and* three twelfths, ten gross parts, one grant part, two dozen-grand parts, eleven gross-grand parts.

Because the order of numbers is somewhat different than with decimals the student should practice counting and numbering the dozen way until this can be done without confusion. Some difficulty may be experienced at first in the series beginning with ten dozen. For example count thus:

T (ten) dozen 1, T dozen 2,. . . T dozen T, T dozen L (eleven), L dozen,— L dozen 1, L dozen 2. . . L dozen 9, L dozen T, L dozen L, 1 gross. It is good practice to count one's steps in walking.

The language of the American Dozen System is the same as with decimals from 1 up to twelve. From twelve on the language is distinct from that of any other system.

When writing numbers a distinction between the decimal and dozen systems is sometimes required. Note the figures 315 for example. This number may be read as, Three gross one dozen five, or as three hundred fifteen. Whenever a page or form is used that embodies the numerals T and L then, of course, the context itself indicates that it belongs to the Dozen System. When an expression may be read either way, then the colon (:) should be affixed if the amount is in dozens and the decimal sign (.) if in decimals. Thus, 315: should be read by dozens—but 315. as a decimal expression. It is the same with less-than-unit parts, except that the sign precedes the number, as :4, meaning 4 twelfths and not as a decimal expression as .4 (four tenths).

The word "dozen" has a noun form that the word ten does not have. We can say, A dozen, half-dozen, quarter or third dozen; but similar expressions for ten do not seem to be used. Perhaps the fact that a half-ten would be a very unusual requirement; and that a quarter or third of ten does not exist (except in decimal arithmetic) accounts for the absence of such terms.

Addition by Dozens

Let the reader observe these simple signs and values in adding by dozens:

5 + 4 = 9	5 + 5 = T (ten)	6 + 4 = T
9 + 1 = T	6 + 5 = Ł (eleven)	7 + 4 = Ł
6 + 6 = 10: (1 dozen)	7 + 5 = 10:	Ł + 1 = 10:

Addition tables are given herewith. Be sure to read the values by dozens. Please note that 9 + 6 = 1 dozen 3, (written 13:) and not fifteen. Likewise 7 + T = 1 dozen 5—not seventeen. Note that the values are the same as with the decimal system but the manner of expression is different.

4 + 2 = 6	5 + 2 = 7	6 + 2 = 8	7 + 2 = 9
4 + 3 = 7	5 + 3 = 8	6 + 3 = 9	7 + 3 = T
4 + 4 = 8	5 + 4 = 9	6 + 4 = T	7 + 4 = Ł
4 + 5 = 9	5 + 5 = T	6 + 5 = Ł	7 + 5 = 10
4 + 6 = T	5 + 6 = Ł	6 + 6 = 10	7 + 6 = 11
4 + 7 = Ł	5 + 7 = 10	6 + 7 = 11	7 + 7 = 12
4 + 8 = 10	5 + 8 = 11	6 + 8 = 12	7 + 8 = 13
4 + 9 = 11	5 + 9 = 12	6 + 9 = 13	7 + 9 = 14
4 + T = 12	5 + T = 13	6 + T = 14	7 + T = 15
4 + Ł = 13	5 + Ł = 14	6 + Ł = 15	7 + Ł = 16
4 + 10 = 14	5 + 10 = 15	6 + 10 = 16	7 + 10 = 17
8 + 2 = T	9 + 2 = Ł	T + 2 = 10	Ł + 2 = 11
8 + 3 = Ł	9 + 3 = 10	T + 3 = 11	Ł + 3 = 12
8 + 4 = 10	9 + 4 = 11	T + 4 = 12	Ł + 4 = 13

$8+5=11$	$9+5=12$	T + 5 = 13	Ł + 5 = 14
$8+6=12$	$9+6=13$	T + 6 = 14	Ł + 6 = 15
$8+7=13$	$9+7=14$	T + 7 = 15	Ł + 7 = 16
$8+8=14$	$9+8=15$	T + 8 = 16	Ł + 8 = 17
$8+9=15$	$9+9=16$	T + 9 = 17	Ł + 9 = 18
8 + T = 16	9 + T = 17	T + T = 18	Ł + T = 19
8 + Ł = 17	9 + Ł = 18	T + Ł = 19	Ł + Ł = 1T
$8+10=18$	$9+10=19$	T + 10 = 1T	Ł + 10 = 1Ł

Consider these problems in addition:

51	5 dozen 1,	plus
39	3 dozen 9,	equals
8T	8 dozen T.	—Answer

1T7	1 gross T dozen 7,	plus
567	5 gross 6 dozen 7,	equals
752	7 gross 5 dozen 2.	—Answer

The process of the above problem is as follows:

First column, $7+7=1$ dozen 2, tabular the 2 and carry the 1 to the dozens column. Then 1 + 6 + T = 1 dozen 5, tabular 5 and carry 1 to the gross column. Then $1+5+1=7$.

```
  T 3 0 Ł;ŁŁ
    4 5 T 2
 ___________
1 2 8 Ł;ŁŁ1
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1 dozen 2 grand, 8 gross Ł dozen 1.—Answer.

The process is: Ł + 2 = 1 dozen 1, tabulate 1 carry 1 to dozen column. Then 1 + T + 0 = Ł, tabular Ł. $5+3=8$. Fourth column, T + 4 = 1 dozen 2, which tabulate as above.

Verify these problems with their answers:

```
   4 6 2 8        3 9 6 4 1       8 3 7 6
   1 T 3 9        7 2 3 8 6       4 0 T T
   5 6 2 7        5 T 4 2 T       6 5 Ł;ŁŁ2
 _________      ___________     _________
Ł;ŁŁT 9 0      1 4 T 2 3 5     1 6 T 5 6
```

Add the following by dozens:

3 8 6 4	1 4 6 9 2	6 7 3 T
2 5 7 2	6 8 3 7 T	T 4 2 Ł;ŁŁ
Ł;ŁŁ1 6 7	T 3 4 T 5	2 Ł;ŁŁ5 8

Subtraction by Dozens

Subtraction is the usual reverse of addition. The principal thing to remember is that in "borrowing" you take a dozen and not ten from the place to the left. Otherwise it is the same as decimal subtraction.

T − 1 = 9 Ł − 1 = T Ł − T = 1

Ł;ŁŁ3 Ł;ŁŁ	from Ł gross 3 dozen Ł
T 1 8	take T gross 1 dozen 8
1 2 3	1 gross 2 dozen 3. *Answer.*

T 3 6 Ł;ŁŁ	from T grand, 3 gross 6 dozen Ł
4 3 9 1	take 4 grand, 3 gross 9 dozen 1
5 Ł;ŁŁ9 T	5 grand, Ł gross 9 dozen T. *Answer.*

Process:—Ł − 1 = T 2d column—borrow 1 (dozen) from 3 and add to 6 = 16: −9 = 9. Borrow 1 (dozen) from T add to 2 = 12 − 3 = Ł. 9 − 4 = 5.

Multiplication by Dozens

It is absolutely necessary that the multiplication tables be memorized, if the user is to make headway with the American Dozen System of Mathematics. This is not difficult, since a large part of the tables is already known to the beginner. When you learn to "think" in dozens the tendency to translate will disappear. *These numbers must be read by dozens and units and not tens and units.*

2 × 1	=	2	3 × 1	=	3	4 × 1	=	4	5 × 1	=	5
2 × 2	=	4	3 × 2	=	6	4 × 2	=	8	5 × 2	=	T
2 × 3	=	6	3 × 3	=	9	4 × 3	=	10	5 × 3	=	13
2 × 4	=	8	3 × 4	=	10	4 × 4	=	14	5 × 4	=	18
2 × 5	=	T	3 × 5	=	13	4 × 5	=	18	5 × 5	=	21
2 × 6	=	10	3 × 6	=	16	4 × 6	=	20	5 × 6	=	26
2 × 7	=	12	3 × 7	=	19	4 × 7	=	24	5 × 7	=	2Ł
2 × 8	=	14	3 × 8	=	20	4 × 8	=	28	5 × 8	=	34
2 × 9	=	16	3 × 9	=	23	4 × 9	=	30	5 × 9	=	39
2 × T	=	18	3 × T	=	26	4 × T	=	34	5 × T	=	42
2 × Ł	=	1T	3 × Ł	=	29	4 × Ł	=	38	5 × Ł	=	47
2 × 10	=	20	3 × 10	=	30	4 × 10	=	40	5 × 10	=	50

6 × 1	=	6	7 × 1	=	7	8 × 1	=	8	9 × 1	=	9
6 × 2	=	10	7 × 2	=	12	8 × 2	=	14	9 × 2	=	16
6 × 3	=	16	7 × 3	=	19	8 × 3	=	20	9 × 3	=	23
6 × 4	=	20	7 × 4	=	24	8 × 4	=	28	9 × 4	=	30
6 × 5	=	26	7 × 5	=	2Ł	8 × 5	=	34	9 × 5	=	39
6 × 6	=	30	7 × 6	=	36	8 × 6	=	40	9 × 6	=	46
6 × 7	=	36	7 × 7	=	41	8 × 7	=	48	9 × 7	=	53
6 × 8	=	40	7 × 8	=	48	8 × 8	=	54	9 × 8	=	60
6 × 9	=	46	7 × 9	=	53	8 × 9	=	60	9 × 9	=	69
6 × T	=	50	7 × T	=	5T	8 × T	=	68	9 × T	=	76
6 × Ł	=	56	7 × Ł	=	65	8 × Ł	=	74	9 × Ł	=	83
6 × 10	=	60	7 × 10	=	70	8 × 10	=	80	9 × 10	=	90

T × 1	=	T	Ł × 1	=	Ł	10 × 1	=	10
T × 2	=	18	Ł × 2	=	1T	10 × 2	=	20
T × 3	=	26	Ł × 3	=	29	10 × 3	=	30
T × 4	=	34	Ł × 4	=	38	10 × 4	=	40
T × 5	=	42	Ł × 5	=	47	10 × 5	=	50
T × 6	=	50	Ł × 6	=	56	10 × 5	=	60
T × 7	=	5T	Ł × 7	=	65	10 × 7	=	70
T × 8	=	68	Ł × 8	=	74	10 × 8	=	80
T × 9	=	76	Ł × 9	=	83	10 × 9	=	90
T × T	=	84	Ł × T	=	92	10 × T	=	T0
T × Ł	=	92	Ł × Ł	=	T1	10 × Ł	=	Ł0

$$\mathrm{T} \times 10 = \mathrm{T}0 \quad Ł \times 10 = Ł0 \quad 10 \times 10 = 100$$

A good way to practice multiplication, without having to rewrite each problem anew, is to put down ay number, such as 3,T42 and multiply it by, for example, 23. Then use the product with a new multiplier, like 45. Continue until all numbers have been used as multipliers. This kind of multiplication gives good practice in addition also.

Note how these problems are solved:

5 2 4 3	3 3 5 T	1 4 2 6	2 3 , TŁ;ŁĮŁ1
2	3	4	6
T , 4 8 6	9 , T 5 6	5 , 4 T 0	1 1 Ł;ŁĮŁ, 5 6 6

3 T 4 2	3 grand, T gross 4 dozen 2
2 3	multiplied by 2 dozen 3
Ł;ŁĮ7 0 6	
7 8 8 4	
8 8 3 4 6 :	8 dozen 8 grand, 3 gross 4 dozen 6. *Answer.*

The process of the above problem is:—$3 \times 2 = 6$. $3 \times 4 = 10$: tabulate 0 carry 1. $3 \times \mathrm{T} = 26$:$+1 = 27$: tabular 7 carry 2. $3 \times 3 = 9 + 2 = Ł$. Second row:—$2 \times 2 = 4$. $2 \times 4 = 8$. $2 \times \mathrm{T} = 18$: tabular 8 carry 1. $2 \times 3 = 6 + 1 = 7$. Add the columns and read answer as above.

The economy, both mentally and manually, in the use of numbers in the Dozen System was pointed out in simple numbering. This economy increases in greater ratio in multiplication.

Take the following cases:

Ł;ŁĮŁ;ŁĮ	eleven dozen eleven, times
Ł;ŁĮŁ;ŁĮ	eleven dozen eleven, equals
TŁ;ŁĮ1	
TŁ;ŁĮ1	
Ł;ŁĮT 0 1	eleven grand, ten gross one. *Answer.*

The 2 largest decimal numbers of 2 columns each that can be multiplied are 99 × 99.

$$
\begin{array}{r l}
9\ 9 & \text{ninety-nine, times} \\
9\ 9 & \text{ninety-nine, equals} \\
\hline
8\ 9\ 1 & \\
8\ 9\ 1\ \ & \\
\hline
9\ 8\ 0\ 1 & \text{9 thousand, 8 hundred 1. } \textit{Answer.}
\end{array}
$$

But Ł,T01 expressed decimally is equal to 20,449. While exactly the same number of figures were used and the mental processes were equal, the value of the product in the Dozen System was more than twice that of [the] decimal answer.

Division by Dozens

Division is a try-and-fit process—the reverse of multiplication. Remember that you are handling dozens.

Note the following divisions:

1 ÷ 2 = :6	(6 twelfths)	1 ÷ 6 = :2	1 ÷ 3 = :4
2 ÷ 3 = :8	1 ÷ 4 = :3	3 ÷ 4 = :9	5 ÷ 6 = :7

Divide 123,564 by 4   4)123,564
36,T47 *Answer.*

Process: 4 into 12: = 3, with 2 remaining. 4 into 23: = 6, with 3 over. 4 into 35: = T, with 1 over. 4 into 16: = 4, with 2 over. 4 into 24: goes 7 times even.

Learn your multiplication and division will take care of itself.

Changing Decimals to Dozens

It is often necessary to convert values from one system to values of the other. It is done in both cases by the multiplication process.

*Change the Dozen expression 74*T *to decimal values:*

1 gross	=	(decimally)	144	×	7	=	1008.
1 dozen	=	(decimally)	12	×	4	=	48.
1 unit	=	(decimally)	1	×	10	=	10.
				Ans. (in decimals)			*1066.*

Change the decimal expression 5,926. to dozens:

1 thousand	=	(in dozens)	6Ł4	×	5	=	2,T88:
1 hundred	=	(in dozens)	84	×	9	=	630:
1 decims	=	(in dozens)	T	×	2	=	18:
1 unit	=		1	×	6	=	6:
				Ans. (in dozens)			*3,51*T*:*

Dozens		**and their equivalent values in**	**Decimals**
T	=	ten	10
Ł	=	eleven	11
10	=	1 dozen	12
100	=	1 gross	144
1,000	=	1 grand	1,728
10,000	=	1 dozen grand	20,736
100,000	=	1 gross grand	248,832
1,000,000	=	1 Americ	2,985,984
10,000,000	=	1 dozen Americ	35,831,808
100,000,000	=	1 gross Americ	429,981,696
1,000,000,000	=	1 Brithain	5,159,780,352

Decimals		**and their equivalent in**	**Dozens**
10	=	ten	T
11	=	eleven	Ł
100	=	1 hundred	84:
1,000	=	1 thousand	6Ł4:
10,000	=	ten thousand	5,954:
100,000	=	1 hundred thousand	49,T54:
1,000,000	=	1 million	402,854:
10,000,000	=	ten million	3,423,054:
100,000,000	=	1 hundred million	29,5T6,454:
1,000,000,000	=	1 billion	23T,T93,854:

Twelves, Cubes and Squares

Twelve is not a perfect square, neither is it a perfect cube; yet it is more useful in practice than either, as the following factors will show (the expressions are decimal):

As a square:		**Factors**
9	$= 3 \times 3$	3 only
16	$= 4 \times 4$	2, 4 and 8
25	$= 5 \times 5$	5 only
12	$= 2 \times 6, 3 \times 4$	2, 3, 4 and 6

As a cube:		**Factors**
8	$= 2 \times 2 \times 2$	2 and 4
27	$= 3 \times 3 \times 3, 1 \times 3 \times 9$	3 and 9
12	$= 1 \times 2 \times 6, 1 \times 3 \times 4, 2 \times 2 \times 3$	2, 3, 4 and 6

It will be noted that twelve is the only small number, as a square or a cube, that is divisible by the half, third, quarter and sixth. Those that divide into halves and quarters will not divide into thirds and *vice-versa.*

Fractions—What Are They? Why and When?

That branch of mathematics known as fractions has always been an enigma. What are fractions and from whence do they come? What are those peculiar expressions that indicate a disrupted, fractured, broken universe? And what strange thing has happened to numbers, that such involved and complicated processes are required in solving the problems of arithmetic?

Among objects there does not appear to be such a thing as a fraction; for no matter how small or numerous these objects may be, they still remain units. A drop of water; a grain of sand; a seed; or a star;—each is individually a unit and not a fraction. The novice in mathematics goes along very nicely in addition, subtraction and multiplication of numbers. He soon finds, however, that although he can multiply numbers without trouble, the moment he begins to reverse the process and divide, the resulting fractions quickly put an end to the application of the simple rules that he has learned up to this point.

Now numbers are supposed to represent things, yet according to decimal testimony they do not; for in decimal arithmetic we have an instance of a book full of numbers called fractions, but not a fraction anywhere outside of the book for these numbers to represent. Let us see if this great discrepancy between facts and figures can be explained.

In decimal arithmetic the word fraction is used as the name for two entirely different hings. Take, for example, the division sign $\frac{1}{2}$ or $1 \div 2$. According to decimal division 2 does divide 1, the unit, evenly into 2 parts, each of 5 tenths, represented as .5. Nothing is broken thus far, for the number .5 is whole and unfractured—a part, but not a broken part of a unit. Now let us consider the sign $\frac{1}{3}$, in decimal division. One cannot be divided by 3, but results in a continuing broken number, as $.333\frac{1}{3}$ which, when carried to any number of places still fails to find an abiding place; and we indicate this recurrance with a sign to continue, as $\frac{1}{3}$ or $+$. Here evidently is a fraction, since the integrity of the divided number is really fractured in the process of division.

Text-books ordinarily define fractions as “even parts of a unit”, but this definition will not hold, since even parts of a unit are whole and unfractured, therefore are not fractions. This indicates the need of a restriction of the application of the word fraction to numbers which really are broken in the process of division; and also the need of a new word for divisions of numbers which are not fractured when divided. In this work we have referred to unbroken divisions as parts-of-the-unit, unit-parts, or simply parts. These names will suffice, for the present, to differentiate between the two divisions of numbers which in decimal arithmetic have been called fractions.

It is by contrasting the decimal system with the Dozen System that we are enabled to analyze the fraction-making proclivities of the former, and to observe how the latter corrects this tendency. In decimal arithmetic units are grouped in tens, and the unit itself is assumed to contain ten parts. Now, as shown in the INTRODUCTION of this work, all natural divisions of objects are found to be the divisions of some unit. We may have 3, 4, 6, 8 or 9 objects, but they cannot be represented by tenths; for example, 3 is not a half, a third, a fourth, or any other even division of ten. Hence, a division of ten by these numbers must produce fractions, and continued division and subdivision of any quotient by these divisors results in what amounts of numerical chaos—the entire disintegration or dis-unity of numbers in the system of decimals.

The ragged-edged fractions that result from decimal division make endless trouble. Constant confusion, inaccuracy, and despair has followed in the wake of decimal practice. About a third of decimal arithmetic and two-thirds of our mathematical grief comes of fractions; and fractions come with decimals,—and they come in swarms, always with us, reproducing their kind,—generating continuing, recurring, jagged-edged quotients, *ad infinitum.* Fractions are outlaws,—little devils of the decimal kingdom: That they have been controlled at all is a miracle attesting the great perseverance and ingenuity of mankind.

Twelve is the natural base for the division of the unit as it is for the multiplication of units. In the American System numbers may be likened to a train of gears, with twelve the main wheel and all gears and sub-gears meshing perfectly. Twelve, or the unit of twelve parts, can be divided evenly by all the digits (except 5, 7, T and Ł) without a recurring fraction; and any resulting quotient can likewise be re-divided, continually, with an even remainder. The quotients divide out in one or 2 places; that is, the divisors 2, 3, 4, and 6 fit into twelve evenly; number 8 into 2 dozen, and 9 into three dozen. The numbers 5, 7, T and Ł function perfectly as numbers *per se*, in their respective order and places, but in their relation to other numbers they are erratic—like comets—with orbits that do not synchronize with the movement of the other numbers. They are seldom used as divisors, therefore they make no trouble in arithmetic.

The *thirds* have never been expressed in decimal arithmetic. The expression $\frac{1}{3}$ is not decimal and the indicated operation cannot be performed; hence, it is necessary to indicate these divisions in a non-decimal manner, as $\frac{1}{3}$, $\frac{1}{6}$, $\frac{2}{3}$, etc.

With unity based on twelve—that is, assumed to have twelve parts—these unnatural divisions disappear and $\frac{1}{3}$ becomes :4 (4 twelfths) and not the decimal $.333\frac{1}{3}$. Liekwise $\frac{1}{6}$ = :2 (2 twelfths) not $.166\frac{2}{3}$; and $\frac{2}{3}$ becomes :8 (eight twelfths) instead of $.666\frac{2}{3}$. It will thus be seen that these inexact, awkward, but much used decimal forms have no existence in the American System. In their places are less-than-unit-parts, expressed exactly and conveniently in twelfths, without prolonged or recurring values.

Such expressions as $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, etc., are known in decimal arithmetic as common or vulgar fractions. They may or may not be really fractional depending on whether they divide with or without a fracture in their quotients. In the Dozen System they are not fractions.

The sign $\frac{1}{3}$ merely indicates that 1 is to be divided into 3 parts. It is algebraic rather than arithmetical. Representing simple parts of a unit such divisions are not hard to comprehend; but as the parts diminish in size, as represented by the denominator, and increase in number, as represented by the numerator, they become more difficult to visualize. Thus the sign $\frac{1}{2}$ is easily visualized, since it means that 1 thing is to be divided into 2 parts; but $\frac{9}{32}$ means that the object is to be divided into 32 parts and that we are considering 9 of these parts. The chief difficulty in comprehending such values is that the size of the parts (denominator) changes with each new expression, given a continually changing scale of sizes. This demands a new mental readjustment and calculation with each new sign or division.

It is not only confusing to try to visualize such number forms, but it requires great skill to handle them arithmetically—to find their sums, products, etc.,—as must be done in decimal arithmetic. They are useful as signs of simple divisions, but farther than that their use should be avoided.

Since so many required divisions do not reduce to tenths it becomes necessary to employ these common fractional forms, or signs. The indivisibility of decimals causes these fractions, so it is found necessary to continue teaching the *solution of fractions* in order to handle the fractions incidental to the practice of decimal arithmetic.

The remedy for the situation is to assume the unit and groups of units as of twelve parts, as in the Dozen System. In the arithmetic of dozens, twelve or its multiples becomes the base or denominator for every divisional representation, when less than a unit in value; as well as for every number or group of numbers when considered as more than a unit. The *place* where the whole number *ends* and the unit-parts *begin* is purely theoretical and the processes or arithmetic apply to both in exactly the same manner. The twelfth point (:) is inserted between the whole number and its parts, but the entire number is never separated for treatment. The accompanying arbitrary table will illustrate:

10:	(1 dozen)	pieces	=	1	package
10:	(1 dozen)	packages	=	1	box
10:	(1 dozen)	boxes	=	1	crate
10:	(1 dozen)	crates	=	1	car
10:	(1 dozen)	cars	=	1	cargo

A *crate* of the above will be seen to contain twelve *boxes*, each a *twelfth* of a crate. Each box in turn contains twelve *packages*, the package being a *gross-part* of a crate. The packages each contain twelve pieces, each piece a *grand-part* of a crate.

No fraction or break would result in dividing the contents of these containers, unless a unit (full container) were divided into 5, 7, T or Ł parts. If they were packaged with tens the resulting divisions would be another matter. It will farther be seen that what has been called a fraction (in this sense a part) is an assumption only; having but a relative value. What is accepted as a unit in one instance may be less-than-a-unit in another. For example, a crate is a unit containing twelve boxes and a gross of packages; but a carload will contain many crates. Here in one instance the crate is a large unit, but in another it is but part-of-a-unit.

In the American System parts-of-the-unit are read in a different manner than decimal fractions are read. A *gross-part is a twelfth of a twelfth*, as a hundredth is a tenth of a tenth. A *grand-part is a twelfth of a gross-part.* Note these values:

:100	1	twelfths				
:T00	T	twelfths				
:3Ł0	3	twelfths	Ł	gross parts		
:060	0	twelfths	6	gross parts		
:43T	4	twelfths	3	gross parts	T	grand parts
:306	3	twelfths	0	gross parts	6	grand parts

The decimal number .35 is commonly read thirty-five hundredths. Twelfths are not so read. The sign :2T is read 2 twelfths and ten gross parts, not 2 dozen ten, gross parts.

Since all integers (except 5, 7, T and Ł) will divide twelve or any of its factors or multiples evenly we can express twelfths, as follows:

Common Fractions	**Dozenal Equivalents Expressed in Twelfths**			**Decimal Equivalents**
$\frac{1}{2}$	:60	6	twelfths	.5
$\frac{1}{3}$	:40	4	twelfths	.333+
$\frac{2}{3}$	:80	8	twelfths	.666+
$\frac{1}{4}$	:30	3	twelfths	.250

$\frac{3}{4}$	:90	9	twelfths			.750
$\frac{1}{6}$	:20	2	twelfths			.166+
$\frac{5}{6}$	:T0	T	twelfths			.833+
$\frac{1}{8}$	:16	1	twelfth	6	gross parts	.125
$\frac{3}{8}$	:46	4	twelfths	6	gross parts	.375
$\frac{5}{8}$	:76	5	twelfths	6	gross parts	.625
$\frac{1}{9}$	:14	1	twelfth	4	gross parts	.111+
$\frac{2}{9}$	:28	2	twelfths	8	gross parts	.222+
$\frac{4}{9}$	:54	5	twelfths	4	gross parts	.444+
$\frac{5}{9}$	:68	6	twelfths	8	gross parts	.555+
$\frac{7}{9}$	:94	9	twelfths	4	gross parts	.777+
$\frac{8}{9}$	:T8	T	twelfths	8	gross parts	.888+

Out of the above sixteen divisions, expressed in twelfths, all divide out evenly. Expressed decimally, however, ten of them have recurring fractions, with half of the even quotients requiring 3 places to complete the division.

The divisions halves, quarters, eighths, sixteenths, thirty-seconds, etc., are known as binary fractions and represent continual bisecting of the unit. Tenths, hundredths, and thousandths are decimal. Binary and decimal fractions do not work with the American System unless changed to the values of twelfths. It is done as follows:

To change common and decimal fractions to twelfths:

Express the numerator and the deominator in dozenal values and divide the numerator by the denominator, by twelves.

Example:

Change the common fraction $\frac{5}{9}$ to twelfths. *Divide the numerator by the denominator:*

$$\frac{5}{9} = 9\overline{)5{:}00}$$

:68 *Answer.* 6 twelfths, 8 gross parts.

If the expression is decimal as .3 (three-tenths), then $.3 = \frac{3}{10} = 3/\mathrm{T}$ or

T)3:000
    :372+   *Ans.* 3 twlfths, 7 gross parts, 2 grand parts.

Dozen System Needed in Practice

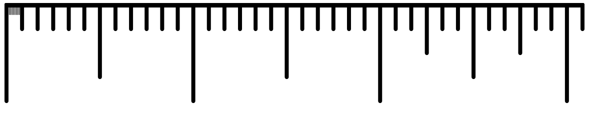
In billing a purchaser for merchandise it is common to indicate items in parts of a dozen as follows: $\frac{1}{12}$ dozen, $\frac{5}{12}$ dozen, $\frac{10}{12}$ dozen, $\frac{11}{12}$ dozen, etc. These expressions, while decimal in form, clearly indicate the desire to handle numbers by dozens. The American System provides a language and number-sign for the expression of all numbers by twelves. The above numbers would be expressed thus:

:1 (1 twelfth), :5 (5 twelfths), :T (ten-twelfths), :Ł (eleven-twelfths) of a dozen; or as units 1, 5, T and Ł.

The American Dozen System of Mathematics and the Anglo-Saxon Foot Rule

It is in its application to actual problems that the full beauty and utility of the Dozen System is seen. Authorities state that the twelve-inch foot rule has been used as far back as history can be traced. It is a singular thing that our Anglo-Saxon measurements are founded on twelve, contrary to all decimal theory and practice. It seems like one of those strange decrees of Wisdom, a sign, the meaning of which is revealed only in process of time and growth. The Ameican System comes not to destroy, but to extend, maintain, and fulfil the high destiny of Anglo-Saxon weights and measures.

Note the cut below which shows 3 inches of our every day foot-rule.



The inches, halves, and quarter-inches are unchanged. The smaller subdivisions, however, are twelfths instead of the usual eighths and sixteenths. Note that there are twelve of these divisions per inch, 6 per half-inch, and

3 per quarter-inch. These twelfths are named LINES as they are used and called in the printing trades of the United States and Great Britain.

In the extreme left of the cut, in the first subdivision or LINE, there are twelve smaller divisions called POINTS. There are twelve points per line, and twelve lines per inch—so there are twelve times twelve, or a gross of POINTS per inch. (Expressed decimally each point is 1/144th of an inch.) The points are not drawn in in each division of the lines for they tend to blur the eye and it is easier and more accurate to work without them.

The foot-rule is now reduced to units of twelfths and we are ready to handle its divisions according to the American Dozen System.

Reading and Writing Dimensions in Dozens

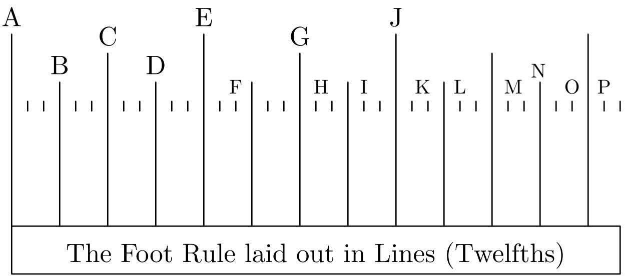
The unit of linear measure is the *foot.* The sign (′) indicates feet, multiples, and subdivisions of the foot.

Numbers to the left of the twelve point are feet, in units, dozens, grosses, etc.

1:000	=				1	foot	
1T:000	=			1	dozen T	”	
6Ł2:000	=	6	gross	Ł	dozen	2	”

Numbers to the right of the twelve point are subdivisions of the foot.
The first place or twelfth is the inch.
The second place or twelfth is the line.
The third place or twelfth is the point.
The fourth place or twelfth is the twelfth-point.
Read these combined feet, inches, lines, and points.

3:261			3	feet	2	inches	6	lines	1	point
1T:546	1	dozen	T	feet	5	inches	4	lines	6	points
32;Ł20	3	dozen	2	feet	Ł	inches	2	lines	0	points



The Foot Rule laid out in Lines (Twelfths)

The above measurements are read as follows:

A	to	B	:030			3	lines			($\frac{1}{4}$ inch)
	to	C	:060			6	lines			($\frac{1}{2}$ inch)
	to	D	:090			9	lines			($\frac{3}{4}$ inch)
	to	E	:100	1	inch	0	lines			(1 inch)
	to	F	:120	1	inch	2	lines			($1\frac{1}{6}$ inch)
	to	G	:160	1	inch	6	lines			($1\frac{1}{2}$ inch)
	to	H	:174	1	inch	7	lines	4	points	
	to	I	:1T0	1	inch	T	lines	0	points	($1\frac{5}{6}$ inch)
	to	J	:200	2	inch	0	lines	0	points	
	to	K	:219	2	inch	1	lines	9	points	
	to	L	:240	2	inch	4	lines	0	points	($2\frac{1}{3}$ inch)
	to	M	:274	2	inch	7	lines	4	points	
	to	N	:28T	2	inch	8	lines	T	points	
	to	O	:2Ł0	2	inch	Ł	lines	0	points	
	to	P	:30Ł	3	inch	0	lines	Ł	points	

Note the ease, the accuracy, and the minuteness (down to the one hundred forty-fourth of the inch) with which measurements can be read or laid off with this rule,—and how the units of ten and eleven are of 1 column figures. Also that we have the thirds, sixths and ninths as well as the quarters and half of the inch. One single notation expresses the dimension regardless of its size, or which parts of the rule are involved. This is quite unlike the unusual fractional measurements such as:

$$6 \text{ feet, } 5\tfrac{2}{3} \text{ inches}$$

a form which is badly broken and unfit for arithmetical treatment until reduced to a common denomination, treated fractionally, and resolved back into feet, inches, etc.

Now that the foot-rule is reduced to numerical order, and divisions of the foot have become entities with real names and places, we are ready to do, in a simple intelligible manner, things that have always been difficult for even the best of calculators.

Foot-Rule Tables in Twelfths

10	(one dozen)	twelfth-points	=	1	point
10	(one dozen)	points	=	1	line
10	(one dozen)	lines	=	1	inch
10	(one dozen)	inches	=	1	foot
100	(one gross)	sq. twelfth-points	=	1	sq. point
100	(one gross)	sq. points	=	1	sq. line
100	(one gross)	sq. lines	=	1	sq. inch
100	(one gross)	sq. inches	=	1	sq. foot
1000	(one grand)	cu. twelfth-points	=	1	cu. point
1000	(one grand)	cu. points	=	1	cu. line
1000	(one grand)	cu. lines	=	1	cu. inch
1000	(one grand)	cu. inches	=	1	cu. foot

Addition of Measurements in Dozens

Let us add some dimensions in length by the American System method:

Abbreviations will be as follows: feet = ft., inches = in., lines = ln., points = pt., twelfth-points = tpt., etc.

3:420		3 ft., 4 in., 2 ln.
5:835		5 ft., 8 in., 3 ln., 5 pt.
Ł:2TŁ		Ł ft., 2 in., T ln., Ł pt.
1T:542	1 dozen	T ft., 5 in., 4 ln., 2 pt.
′36:886		3 dozen, 6 ft., 8 in., 8 ln., 6 pt.

In the above problem the feet, inches, lines, etc., all being in multiples of twelves, automatically take care of themselves in the process of addition.

This is true in all arithmetical processes in The American System. Reductions and translations, as required by the old methods are eliminated and the answers are read in units of feet, inches, lines, etc., as they exist on the rule.

Subtraction of Measurements in Dozens

From	′3Ł:4T8	3	dozen	Ł	ft.,	4	in.,	T	ln.,	8	pt.
take	18:641	1	dozen	8	ft.,	6	in.,	4	ln.,	1	pt.
	′22:T67	*Answer.*									

Linear Multiplication in Dozens

Since dimensions and numbers are both expressed in twelves, we can multiply any dimension by any number and the answer will be in units of the foot rule.

Multiply ′14:3T1 by $3\frac{1}{2}$ ($3\frac{1}{2} = 3{:}6$).
′14:3T1 × 3:6 = ′49:1536 *Answer*

The above answer is read thus: 4 dozen 9 feet, 1 inch, 5 lines, 3 points, 6 twelfth-points.

Division of Measurements in Dozens

Divide ′49:1536 by 3.

3)′49:1536
′17:0592 *Answer*

This problem also shows the reduction of feet and its parts to yards. The whole number in the quotient becomes yards but the divisions are in inches, lines, etc.

The Square and the Cube in Dozens

Thus far linear, or one dimension measurements only, have been considered. The reader is earnestly requested to pay particular attention to what follows, as the results and the methods of attaining them, as shown, are unprecedented in arithmetic. The simplicity and great utility of all this will appeal to everyone who uses measures in any of the mecanical or engineering arts.

The Square (Area)

A square is as an area bounded by four straight lines and four right angles. A perfect square has four equal straight lines and four right angles.

The area of a square is equal to the product of the length of one side multiplied by the length of one other side.

Find area of a square $'3{:}5 \times {'2{:}3}$.

$$'3{:}5 \times 2{:}3 \quad '7{:}83'$$

7 sq. ft., 8 dozen 3 sq. in. *Answer*

In the above answer the whole number 7 is the number of square feet in the area,—the 8 dozen 3, are the square inches.

In squares the whole number is the number of square feet. The subdivisions, pointed off by twos to the right from the twelve point, are first the square inches, followed by square lines, then square points, etc., always read in pairs and by dozens.

Find area of a square $'12{:}43 \times {'24{:}13}$.

Multiply these 2 dimensions:

$$'12{:}43 \times {'24{:}13} = {'297{:}4Ł39} \quad \textit{Answer}$$

The square units are read as follows: 2 gross 9 doz 7 sq. ft., 4 doz Ł sq. in, 3 doz 9 sq. lines.

The Cube (Volume)

A cube is a volume bounded by six squares. A perfect cube is a volume with six equal squares.

The volume of a cube is equal to the product of the length times the height times the breadth.

Find the volume of a cube $'3{:}5 \times {'4{:}6} \times {'5{:}2}$.

Here we multiply the three dimensions,

$$'3{:}5 \times '4{:}6 \times '5{:}2 = '67{:}530' \quad \textit{Answer}$$

In the above answer the volume is in cubic units, hence, the whole number is cu. ft. The sub-divisions are pointed off in periods of three figures each, for each unit of the rule. The answer is read: 6 dozen 7 cu. ft., 5 gross 5 dozen cu. in.

A Common Problem

Let the reader find the area of this square in common dimensions and by the common process:

$$3 \text{ ft., } 5\tfrac{3}{8} \text{ in.} \times 5 \text{ ft., } 2\ \tfrac{1}{16} \text{ in.}$$

and after he has solved the problem examine the answer very carefully. We would be interested to know how it is done and just what the answer means, in its relation to units of measurement.

This same problem solved the American System way, after the fractions are unscrambled, and changed to twelfths becomes:

	3 ft. 5 in. are unchanged	=	′3:500
plus	$\frac{1}{8}$ in. = :016 $\quad \frac{3}{8}$ = 3×:016	=	:046
			′3:546
	5 ft., 2 in. are unchanged	=	′5:200
plus	$\frac{1}{16}$ in. = :009	=	′5:200
			′5:209

Hence the dimensions in twelfths are:

′3:546 × 5:209 = ′15:9Ł′T0′46 *Answer*

In other words, the answer is 1 dozen 5 sq. ft., 9 dozen Ł sq. in., ten dozen sq. lines, 4 dozen 6 sq. points.

The Circle and Sphere

In the calculations of the circle and sphere we get the same remarkable results that are had when doing problems of length, area, and contents,—straight line dimensions.

Expressed in twelfths, the ratio of the circumference of a circle to the diameter (pi), is expressed numerically as 3:1848—where 3 is the unit, 1 is the twelfths, 8 the gross part, etc. This gives a valuation that can be handled with dimensions of The American System foot-rule. Of course we must continue to do all problems by the law of twelfths and not by decimal arithmetic.

The Circle (Circumference)

The circumference of a circle is equal to the diameter multiplied by the ratio 3:1848.

Find the circumference of a circle whose diameter is ′4:35 (4 ft., 3 in., 5 lns.).

Multiply the diameter of the ratio 3:1848 thus:

$$'4{:}35 \times 3{:}1848 = '11{:}5643\text{Ł}4 \quad \textit{Answer}$$

One process of multiplication gives the answer in feet, inches, lines, etc., which is 1 dozen 1 ft., 5 in., 6 in., 4 pt., 3 twp., and smaller dimensions far beyond any practical requirements. Since the above dimension in linear only, the subdivisions are not pointed off by twos, as with the square, or by threes as if the answer was a cube.

The Circle (Area)

The area of a circle equals the product of the square of the radius multplied by 3:1848.

Find the area of a circle whose radius is ′4:26. ′4:26 × 4:26 = ′15:86′30 × 3:1848 = ′47:77′T0′92.

The above answer being in square units must be read in squares as explained in problems treating of the square.

The Sphere (Area)

The area of the surface of a sphere is equal to the square of the diameter multiplied by 3:1848.

Find the area of a sphere ′2:64 in diameter. ′2:64 × ′2:64 = ′6:48′14 × 3:1848 = ′18:0T′74′06′28.

The answer being pointed off in pairs indicates that the subdivisions are squares.

The Sphere (Volume)

The volume of a sphere is equal to the cube of the diameter multiplied by :6349 *that is* ($\frac{1}{6}\times$ 3:1848).

Find the volume of a sphere ′2:41 in diameter.

$$′2{:}41 \times ′2{:}41 \times ′2{:}41 = ′10{:}988′701$$
$$′10{:}998′701 \times {:}6349 = ′6{:}864′72Ł′364′900$$

The above answer is read as follows: 6 cu. ft., 8 gross 6 dozen 4 cu. in., 7 gross 2 dozen Ł cu. in., 3 gross 6 dozen 4 cu. pt., 9 gross cu. twp.

Mixed Subdivisions Gone

The foot rule and its divisions, as commonly used, are a strange mixture of "systems." First comes the unit—the foot. The inch is a twelfth, which is duodecimal. The fractions $\frac{1}{4}$, $\frac{1}{8}$, etc., are binary—neither decimal or duodecimal. Then the very small calibrations are hundredths and thousandths—decimal. Here are 3 systems of numbers. The American System rectifies these irregularities and gives us a rule and a system of numbers for handling it, which proves to be in reality that which false systems merely claim to be. Mechanical apparatus (slide rules, calculating machines, etc.), can never be made to work properly with mixed systems of numbers. The American System makes possible the use of mechanical calculators that give direct answers with less labor.

Weights and Other Measures

The natural measure of volume (liquid and dry) is the cubic yard, the cubic foot, and their cubic subdivisions. These units are gradually establishing themselves and it is possible that the gallon, quart, etc., will eventually disappear. The cubic yard volume, has all the advantages of both container or linear calculations and with the cubic foot, the cubic inch, and cubic line, as in the Dozen System, offers all the variations in size that are required in general practice and laboratory work. With the cubic foot weight (1 cu. ft. of water) used as the standard weight with its natural cubic subdivisions we have prophetic fulfillment of the great Magna Charta:

"There shall be one measure throughout our whole realm; and it shall be of weights as it is of measures."

Algebra

Algebra is but the handmaid and signal system indicating processes, related values, etc., for arithmetic. A complicated arithmetic requires a complicated algebra. When the crooked is made straight fewer signals are required. For example: Finding the area of a square, in feet and inches, in decimal arithmetic, is a compound operation, and cannot be done in one process of multiplication, hence, the process is indicated algebraically somewhat like this:

$$a^2 + 2ab + b^2$$

where a = feet, and b = inches. In the American System a^2 alone is sufficient to indicate the operation, since one process of multiplication only is required.

Much that now passes for algebra might better be dropped for it has no practical meaning. A great portion of it is positively erroneous and misleading.

Twelve vs. Decimal-Metric Systems

The decimal propaganda (Metric measures and decimal coinage) has troubled the English-speaking peoples for more than a century. It will continue to trouble them until they perfect their own Systems or else yield to the greater error of the various systems founded on decimals. As the decimal theory has spread over the world, gradually embracing one after another of countries, the fuller force of the decimal assault has been directed at the United States and Great Britain.

The United States uses the decimal currency, and some have inquired of the writer if he would be willing to go back to the old English system of pounds, shillings, and pence, as was used by the American Colonies, and is current today in Great Britain.

There are 2 important factors in the consideration of this subject. They are: (1) the respective merits of ten *versus* twelve for the base or unit of the currency; and (2) the advantages that would accrue to the institutions of large finances *versus* the advantages to the individual of small means. It is not, fundamentally, a matter of weights, measures, nor coinage; but appertains to mathematics and numbers. Progress is the law of life, and our apprehension of mathematics cannot escape or evade the law of progress.

Previously to the invention of the American Dozen System the decimal system was the only method by which numbers could be handled conveniently in columns, with a fixed value between each group or column. The decimal system was a great improvement over the old Roman system of notation, and has been very convenient for Banks, Insurance Corporations, and in fact all business institutions that use the larger sums of money. Amounts do not necessarily have to be handled that way, as the English non-decimal system well proves; but that the regular order of columnar calculation is the easier in adding, subtracting, and multiplying is conceded.

We in America have the decimal system of coinage and along with it all its limitations; chiefly, its lack of divisibility into aliquot parts. So if Congress, in making the dollar with its disme (tenth) the legal unit of coinage, gave us a system that could be added and multiplied readily; the same act deprived us of the divisibility that was inherent in the shilling of twelve pence. The Parliament of Great Britain has steadfastly refused to change their system to decimals.

Everything that goes up in multiplication, it is said, must finally come down in division. Banks may add, multiply, and compound their amounts, but eventually every pound and dollar of it must be spent (divided) into pennies and cents. For every Accountant and Bank Clerk figuring in large amounts, there are dozens of citizens spending dimes and cents, shillings and pennies. They are the ones who must divide the unit of currency in paying for small retail purchases. The English coinage has wonderful factors and multiples; the American decimal coinage does not have.

Now we do not wish to go over our thesis again in discussion of the merits of twelve and the de-merits of ten; but mean if possible, to throw just a little more light on this perennial-blooming question.

There is good reason why England has never changed its money system to decimals, and there is also good reason why the American people would disapprove of changing back to the English System. There is no good reason, however, why each country should not improve its coinage, which could be done by using the Dozen System of calculation instead of the decimal. The changes required would be slight, and assuming the shilling as the unit for Great Britain, and the Dollar for America, it would work out after this manner:

The English shilling consists of twelve pense. The pound now consists of twenty shillings. Let a new value of twelve shillings be coined which could be known as a twelve-shilling or short-pound or something else. The new denomination would then represent $\frac{3}{5}$ of a pound, or 1 pound would be to the value of $\frac{5}{3}$ short-pounds. The scale would then read: four farthings = 1 penny, twelve pence = 1 shilling, twelve shilling = 1 short-pound. The farthing remains $\frac{1}{4}$ pence, as at present, and would be written :003, or 3 twelfth-pence. Such a sum as £1:8Ł would be read: 1 short-pound, 8 shillings, eleven pence. Here we have the coinage adapted to the Dozen System of Mathematics with but one change, and no change in the standard of value.

American coinage could also be made perfect with slight change. Let the dollar remain as is, also the half and quarter-dollar. The dime (tenth) would be dropped for the twelfth dollar (silver). Each twelfth-dollar would in turn be coined into twelfths (copper), similar to the decimal cents but of smaller size and value. Then such an amount as \$21:3Ł would be read, 2 dozen 1 dollars, 3 twelfths and eleven gross-parts of a dollar. Appropriate names could be given these 2 new coins. Multiples of the dollar would be the \$6:00 piece, instead of the \$5.00; the \$10:00 (twelve dollar) instead of the ten; the 2 dozen, the half-gross, and the gross of dollars, instead of the twenty, the fifty, and hundred dollar notes. They are perfect multiples of all other divisions, and would represent enormous economy in coinage.

The factors of the dollar would then be: the gross part of a dollar; the twelfth dollar; the $\frac{1}{9}$, $\frac{1}{8}$, $\frac{1}{6}$, $\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, and $\frac{5}{6}$ dollar. Every division is represented except the 5th, 7th, Tth, and Łth. The twelfth-dollar piece would contain the same divisions. The new coins could circulate with the present coinage with no confusion. Two cents would be equal, very nearly, to 3 gross-parts of the dollar. The twelfth-dollar would equal $8\frac{1}{3}$ cents. Great advantages, in the form of better multiples and factors, would immediately be in evidence.

We are glad to communicate with anyone interested in this system of numbers and will co-operate with those desiring to install it in their institutions and practices. All communications will receive courteous reply whether they be pro or con. We would be especially glad to receive press clippings or written citations that are in any way related to this subject.

Many correspondents use the typewriter, which does not have certain mathematical characters. If characters are used as follows we will understand them:—

Character (&) for plus in addition; dash (—) for minus in subtraction; (×) for times in multiplication; (/) for division; (__) for equality; the colon (:) for twelfths. Thus:

5 & 5 __ T   8 — 5 __ 3   4 × 2 __ 8
T/ 2 __ 5   :3 __ three twelfths, etc.

Metal and wooden rules with inches and twelfths (line) scale can be purchased at Hardware and Draughting Supply Stores. We furnish a cardboard foot-rule, fairly accurate, in scale of twelfths, 5¢ for post charge only.

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The so-called "Oxford" comma has been added throughout. Also throughout, inconsistent numbers of periods in ellipses were made consistently three dots, unless immediately following a period, when they are four. Finally, the original work made rather free use of boldface; this has been removed in almost all cases, either absolutely or by changing it to the more typographically sound italics. Otherwise, the following specific changes have been made. On page 16, the original had the word "word" as "world." This has been corrected. On page 19, five columns out of all ended in periods; these were removed for consistency. On page 27, after the phrase "cannot be represented by tenths", a comma was changed to a semicolon, as a comma does not properly divide the clauses. On page 27, the all-capital italic word "introduction" was rendered instead in upright small capitals. In the tables on pages 2Ɛ and 2Ɛ, unnecessary punctuation was removed, and ditto marks were replaced with complete words and phrases. On page 31 and following, the all-capital words were changed to small-capitals. On page 30, a short "joke" was included which contained what we today would consider racist undertones. It has therefore been omitted. On page 31, superfluous commas were removed from the table showing feet, inches, lines, and points. "Ditto marks" were also removed. On page 32, superfluous commas were removed from the table showing feet, inches, lines, and points. "Ditto marks" were also removed. On page 36, there was an inconsistently-placed period in the table; this has been removed.