RESEARCH

Principles of prime numbers - Part I-New definition of prime numbers with modNt number system & induction

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ABSTRACT

This is a treatise on Primal Numbers which results in the solution of long outstanding unsolved problems of the prime numbers. Primal numbers are Nature's Number System defined herein and are built with a completely new set of criteria. This work builds on and greatly expands the work presented in earlier texts [1]"Calculate Primes" 2007 and [3] "Breaking RSA Codes" 2014. The original release was in a paper submitted to a mathematics journal "Principles of Prime Numbers" 2006. A new number system is developed based on prime numbers and a new visual representation is presented in the form of "Spp_n and Rpp_n Tables". The understanding of Prime Numbers as a complete system of mathematics continues with visualizations of the results of using the "McCanney Generator Function" which directly calculates prime numbers in groups. The base N modulo number systems (e.g. the most common of which is base 10) are shown to be inadequate to understand the true nature of Prime Numbers, which are the building blocks of all of mathematics. It will be shown that trying to understand prime numbers using base 10 has been the hinderance that has kept solutions since the ancient Greeks first formulated the first unsolved problems (many which exist yet today). The solutions to outstanding unsolved problems have mainly been because the tools were not available to understand the prime numbers as a complete number system in their own right. The research originally intended and found the basis for proofs by Induction since the tables generate future tables. The result is that the prime numbers all belong to families with ancestors and offspring. This leads to the discovery (Calculate Primes 2007) that all prime numbers have an ancestry going back to 0 and 1 and the Peano postulates. They are not simply the numbers missing from the standard multiplication tables or numbers in a sieve process of elimination. They are not derived from brute force factorization calculations (as is done in traditional computer computational mathematics) but are directly calculated in groups from previous groups of Prime Numbers. The definition that prime numbers are those numbers divisible by only themselves and 1 is shown to be lacking in scope and gives no understanding of the true nature of prime numbers or natural occurring number systems. It also leads to ambiguous concepts regarding the numbers 0 and 1.

Key words: *Prime numbers; Number systems; Generator function; Nature's number system*

INTRODUCTION

This is Part I of a multiple series set of papers. This paper introduces the concepts presented in the book [2] "Principles of Prime Numbers – Volume I" 2010. Future papers will develop advanced topics from Volumes II and III. The current paper presents topics of Nature's Number System (modNt) but uses primarily base 10 (mod10) numbers while the reader is getting used to the concepts involved. The future papers will move to using primarily the modNt number system. This number system represents the numbers with each digit representing the ancestry of the prime number back to the original base prime numbers.

The newly developed methods break the problems into pieces that can be solved individually then combined to give a complete solution. Previously, primes were thought of as "random or pseudorandom numbers with no patterns". Trying to understand prime numbers as a linear progression has been partly at fault. Prime numbers are now organized and generate future prime numbers in groups and families with ancestors and descendants. This is key to create the organization to solve more complex problems.

The "Calculate Primes" Generator Function system of directly calculating prime numbers is made more understandable in the current text because of the visualization using tables defined as "Spp_n and Rpp_n Tables". It is the same prime number solution, but visual. By dividing the direct calculation of primes into small manageable groups which have well defined parameters and mathematical properties, one can now solve problems with understanding that were not available before. Each group generates the next group with known parameters giving rise to proofs by Induction. This is the "TOOL" that everyone has been looking for over the past 2500 years. The mathematical system, as explained in "Calculate Primes", involves such mathematical

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properties as Closure, Symmetry, Reciprocity, Completeness and a wave pattern that allows equations to be generated with wave lengths that extend to infinity. At last, a system exists to predict the future of prime numbers and solves the issue of density of primes as one moves out on the number line. It is proven that the equations for prime number generation are simply bounded. The concept of finding "rogue primes" and "rogue gaps" is finally solved, and it is shown that in the Generator Function structure, prime numbers are a monotonically decreasing density function that is important in understanding prime patterns. Theorems are developed proving that all prime numbers generate an infinite number of future prime numbers and likewise all have ancestral patterns in the primes going back to the alpha prime "0". These are used to understand and offer solutions to the Twin Prime Conjecture and Goldbach Conjecture unsolved problems. The prime numbers are generated in groups using the Generator Function by only addition and subtraction of previously discovered prime numbers (discovered in the prior iteration of the Generator Function).

Discussion of multiplication tables, sieves, wheels, formulas/categories of primes, the riemann hypothesis and computational methods

Before looking at the Generator Function and related solutions, it is important to define terms and identify prior methods of determining prime numbers so there is no confusion or false claims that the current work is one of these. These prior methods tend to work with small prime numbers but soon lose their ability to locate primes and one then has to revert to division by prime numbers (factorization) to determine primality.

Multiplication Tables: The most fundamental method of locating prime numbers is to create a multiplication table and note that all the numbers missing are the prime numbers. The draw back is that you have to write all the natural numbers to find a decreasing number or primes. Finding these missing numbers becomes increasingly difficult and time consuming as you grow to larger numbers. You also have to repeat many iterations (all multiples of 2, 3, 5, etc). Of all the primitive methods this is the least productive and as I recall was my first introduction to prime numbers in grade school. Unfortunately, that situation has not changed to this day.

Sieves: The next stage to streamlining the multiplication table process in locating primes is called a Sieve. There are numerous forms of Sieves, but all are basically variations on the same theme. You take a list of all natural numbers and begin crossing out the numbers that are multiples of known small prime numbers, leaving a very small select list of primes relative to the large number of numbers at the beginning of this process. The issues with a sieve are that 1) you need to know the prime numbers before you start the process, so it only is valid for small numbers for which you already have the prime number solutions and 2) you have to list all the natural numbers (as with the multiplication table method it is a process of elimination starting with all numbers) so it is not a number system based on just prime numbers but likewise an elimination from the entire list of natural numbers. Most importantly, it ultimately resorts to factorization to identify the prime numbers for more eliminations and lastly 5) IT HAS NO PREDICTIVE PROPERTIES. All of these issues are what separate the Sieves from the work presented in this paper. To be clear, in the current paper, we only use prime numbers to generate more prime numbers using just addition and subtraction, you do not use the non-prime numbers, you start with the smallest possible set (beginning with just 0 and 1) and build to larger groups (which grow very rapidly). Primes are discovered by direct calculation from prior known primes. The method works on patterns of prime numbers and predicts prime numbers to infinity including individual prime numbers, twin prime pairs, prime pairs of any gap size and creates an alternative proof to the prime counting function and additionally puts an upper limit on the counting function (something that had not existed previously). This is stressed here because the first utterance from some people too incumbered by sloth to read the entire paper would try to negate the current work as a Sieve prior to reading and understanding it. Then those who are even more incumbered by sloth would rely on those false claims to revert to their comfort zone. To be clear, *the current work is not a Sieve*.

Wheels: There are dozens of attempts to organize or predict prime numbers based on patterns that can be represented as consecutive squares, complex tables, multisided objects or concentric circles (usually based on basic number associations). They seem to work for small numbers but very soon break down or develop large numbers of false (non-prime) numbers. They generally are followed by long lists of "rules" that break down as numbers get larger. As a result, one has to resort to factorization to determine primality. Many amateurs have fallen into the traps of using such limited models. One such "wheel" depends on multiples of 6 and another recent attempt relied on prime numbers less than 210 with long lists of convoluted "rules". These arise from people noting nuances in the lists of small prime numbers but which fade quickly. One very interesting wheel or circle pattern involves making concentric circles with 24 divisions (the first inner circle numbered from 1 to 24). The next outer circle likewise has 24 divisions numbered from 25 to 48 with the next circle numbered from 49 to 72 and so on. This is not a new discovery but simply restating the long known fact that if you create a circle with 24 divisions, all of the squares of primes will be found on the radial line above the number 1. That is, the squares of prime numbers all differ by a multiple of 24. An equation can be written which is the opposite of this known fact of prime numbers and as you will see is not very useful in predicting prime numbers. It quickly fades to having many false predictions. It has some value in predicting the squares of primes which is related to certain analysis results. To create the circles ... draw a series of concentric circles. In the first circle divide the outer circumference into 24 divisions. Number these from 1 to 24 in the clockwise direction. On the next circle outwards (also divided into 24 sections), the numbers should be the number on the first circle +24. So the radial line extending out from 1 will have the values as follows: (notice that it skips 2^2 and 3^2) starting on the next page.

1 + 0x24 = 1 (the first circle)
1 + 1x24 = 25 = 5^2 (the second circle)
1 + 2x24 = 1 + 48 = 49 = 7^2
1 + 3x24 = 73 (prime)
1 + 4x24 = 97 (prime)
1 + 5x24 = 121 = 11^2
1 + 6x24 = 145 = 5x29 (composite of primes)
1 + 7x24 = 169 = 13^2 and so one.

All of the squares of primes fall on this radial line. By subtracting 1 you get an integer divisible by 24. The problem with this (or other "predictive" formulas such as 6n ± 1, n = 1,2,3...) is that they seem to work for small numbers but as the prime numbers become scarce, you are getting many more false outcomes than real primes and you must then resort to the old brute force method of factorization to see if the numbers are prime or not. It is really not very useful. On this theme I have proven that all squares of prime numbers in fact fall on this line using induction using the Generator Function (something that was conjectured before but not proven). Wheels with divisions of 6, 24, 30, 210 and others have been attempted and all fail.

Formulas and Categories of Primes: It would take pages to list all of the different small equations that have been presented over the centuries in attempts to predict prime numbers. Some of the more famous include the category of Mersenne Primes which was developed relative to the search for "Perfect Numbers". Volume II of the Principles of Prime Numbers (about to be released) covers these categories in detail, comparing them to the Generator Function presented in the current work to show their limitations. The simple result is that some equations work for small numbers but end up generating far more false solutions as the iterations become larger. Mersenne Primes are a primary example which has an extremely low success rate with increasing number size. Despite this, they are used as a basis for calculations using super computers and GIMP calculation networks. As with all the simple formulas, they work well for small numbers but immediately break down and start producing large quantities of false results. As a result, they are relatively useless in the understanding of prime numbers and one must then revert to factorization to determine if the number is truly prime or not. The current paper shows that the Generator Function becomes more accurate with larger numbers.

The Riemann Hypothesis: It is incorrectly assumed by many that the so called "solution" to the Riemann Hypothesis would solve the issues of understanding prime numbers. To this end, I refer to the seminal book on the subject by John Derbyshire "Prime Obsession" (written for the professional and layman alike) where he addresses this topic [2]. The proof that all Riemann Zeros lay on the vertical ½ line will not bring any additional understanding of locating prime numbers. The status is that if anyone discovers a large arbitrary prime number, mathematical methods can be employed to show that it in fact also creates a zero point on the ½ vertical line. It is the belief of this author that the Riemann Hypothesis solution exists and the methods being disclosed here provide the tools for a proof by induction. That was one of the primary motivators for developing the Generator Function in the first place, to create new tools that will allow proofs by induction relative to prime numbers, something that had not existed previously.

Computational Methods: Computer methods use short cuts in eliminating numbers as prime numbers but they generally begin with Mersenne's simple formula as a starting point because it is thought to produce a higher percentage of results than just picking odd numbers at random or in succession. Ultimately, it is brute force computing that will find a new large prime number. When the numbers are announced, they are generally given in relation to the nth Mersenne number related to the discovery. The numbers leave immense quantities of primes undiscovered, and the discovery does not provide any insight into where the next prime will be found. When the numbers are published in base 10 digit format, they truly are a list of meaningless digits and do in fact look like so many random lottery numbers hooked together.

The base 10 number system is a hindrance when it comes to understanding prime numbers. The elegance that comes from the new modNt Nature's Number System is that every digit signifies the ancestry of the number. Every digit has meaning, and every digit relates the number back to its ancestry and is then used to build a future set of primes that are unique to infinity that have the same base digits. If new primes are discovered using the modNt system, they could be used to predict the location of larger or smaller primes (a field that some may pursue when computational methods are required to claim prize money).

In the development of the Generator Function, which directly calculates prime numbers with increasing accuracy, it was necessary to have all these failed systems in mind. It is important to repeat here that the Generator Function and the visualization of primes in what are known as the Spp_n Tables, one only deals with prime numbers as a complete and distinct number system and mathematical Algebraic Group structure. It has predictive abilities and sees prime numbers as a distinct class of numbers completely independent of the rest of the non-prime numbers. The prime numbers are generated in groups of ever-increasing size and use the new definition of prime numbers illustrated below. The traditional definition of prime numbers, that prime numbers are numbers only divisible by themselves and 1, as well as the base 10 number system are hinderances to understanding the true nature of prime numbers.

One last thought will be given before summarizing the Generator Function and its vast number of implications. Many will be caught up in the one aspect that this may allow solutions to unsolved problems, but the most important aspect is that this finally creates a sound mathematical structure for prime numbers in a pure mathematical sense. Similar previous works of this fundamental nature would be Peano's Postulates, George Cantor's work defining infinities, or Russel's work on logic. The idea that prime numbers form in groups that follow Algebraic Group theory is a fundamental discovery that has been missing since the inception of prime numbers. The fact that prime numbers have a different definition which leads to these results now augments the importance of relative primes. Previously, there were primes and non-primes only. The new definition shows the new understanding of relative primes (of which the prime numbers are a subset), in the generation of true prime numbers. The new structure shows the prime number Groups have properties of symmetry, reciprocity, closure, completeness and a wave nature that was never understood. Also recall that what is presented below is a limited summary of major points and the complete definition and explanations are found in references.

CHAPTER 1
WHAT THE ANCIENT GREEKS KNEW AND WHAT THEY DID NOT KNOW AND WHAT EVERY MATHEMATICIAN SINCE HAS FAILED TO REALIZE

This chapter is simple but has tremendous implications for the understanding of prime numbers. Please be patient with this discussion as it may seem a bit tedious but is essential before going to the visual and easier to understand next chapters. First one must understand what the ancient Greeks understood and what were the limitations regarding the prime numbers. They were able to prove (using acceptable modern mathematical proof techniques) that there is an infinite number of prime numbers. Once again, mathematicians have repeated (many times incorrectly) the original Euclid proof by the mathematical techniques of "contradiction" and "induction" proving that there is an infinite number of prime numbers.

A proof by contradiction first assumes (the opposite of what you wish to prove) and then you find a contradiction which in fact proves what you are trying to prove. The second technique called "induction" is so basic to mathematics that it is one of the very first logical steps in defining mathematics in what are known as the "Peano Postulates", the basis of all modern mathematics.

A proof by induction basically states that if you can prove a property for one "element" succeeds to a next element by some process or operation, then you can prove it for an infinite number of "successor elements". This is one of the most powerful proof tools in all of mathematics and one that I used to solve previously unsolved problems, using the new tools developed in my studies of prime numbers. Thus, you will see that the Greeks understood both the proofs by contradiction and induction and used these most fundamental of mathematical proofs 2500 years ago. As impressive as this may be, neither they nor anyone after them carried this proof to its logical conclusions. It was in this that sets my work apart in seeing through the many thin veils that have blocked the understanding of the prime numbers.

Clearly the need to understand the prime numbers was fundamental from the very beginning of the Greek's recognition of these somehow special numbers. Despite the many comments published by mathematicians that show their complete and utter lack of knowledge of prime numbers, there are those today (in light of my achievement of directly calculating prime numbers) that claim there is no such thing and never was any such thing as the "prime number problem". Clearly the ancient Greeks knew about it and made no mistake about their need to understand it. Very simply put … "how do you find future prime numbers? ". Modern mathematicians state it but just as quickly refer to non-solutions like the "Riemann Hypothesis" to raise a wall of defense as if it could somehow solve the issue (if the illusive Riemann Hypothesis were solved).

Let us be clear, the Riemann Hypothesis can in no way give understanding for determining or predicting future prime numbers and this is clearly stated in the final pages of the excellent John Derbyshire book "Prime Obsession". The unfortunate side road that Mathematical Analysis has taken over the past 150 years can only show that the mathematical world had given up long ago to directly conquering the "prime number problem". Now that the solution is here through my work and the McCanney Generator Function, it is rather odd to see where they now claim there was no such quandary in the first place. How ridiculously absurd.

First, I will detail the proof of the ancient Greeks in its incorrect form and then in the correct form, and then show some subtle examples that show the Greeks and every mathematician since has failed to extend this to its logical conclusions. This is just one aspect of my many pronged solutions to directly calculating prime numbers and the further visualization of these concepts contained in this subsequent book "Principles of Prime Numbers – Volume 1". The first question will arise, why did they Greeks understand the significance of the number "1" and why did they stop there?

The following two paragraphs are taken from the 2007 book "Calculate Primes" in the chapter on "The Riemann Hypothesis".

Many times, even amongst professional mathematicians I see this ancient proof misquoted. I will explain and then proceed with more on The Riemann Hypothesis. The Greeks, like modern men, tried to calculate the prime numbers by brute force factorization. But since they wanted to know where to find more, and if there were in fact anymore, they made the basic assumption that there were NOT an infinite number of primes. If you multiply all of the prime numbers together that you know about, and add 1, then this number would have to be a prime number right? Actually, the answer to this is NO, and this is how many people incorrectly repeat the proof used by the ancient Greeks.

The actual proof goes as follows. First assume there is a finite number of prime numbers and that you have found them all. Multiply all known primes together, then add 1 and we will call this number "A". Either the new number "A" is prime OR you are missing a prime number in the list you thought was a complete list of prime numbers, and that new prime number is a factor of "A". By either standard, you have found a new prime number, and your original "complete" list really was not complete. You can repeat this process forever, proving that there is an infinite number of primes. This result is paramount to the quest for an equation representing the "density of primes". Without a proof for the uncountable or infinite number of primes, there could be no quest for a density equation.

The above statement hopefully will make sense but now I am going to change it a bit to show what no one since the Greeks has done. Imagine you follow the incorrect logic of the first paragraph above. The reality is that your new number "A + 1" may in fact not be prime even if you had discovered all the prime numbers up to a certain point as I will explain. Let me give an example. Take the prime numbers 2, 3, 5 and 11. You are missing 7 from the complete list of prime numbers up to 11. So, like the Greeks multiple your partial list together (2x3x5x11 = 330) but pretend you think you have found all the prime numbers. Now add "1" to get 331. It in fact is a prime number so you did discover a new prime number. But now subtract "1" to get 329. The same should be true, right? Actually no, you will find that 329 has "7" as a factor.

But you did "discover" a new prime number that was not in your list. It in fact was an essential prime number that you missed right in the middle of your list. That number is 329/7 = 47. But as we will find out, using this method as we get out into larger and larger numbers, numbers found like 47 may in fact not be prime.

To be clear, the reason you are adding and subtracting "1" here is because the only numbers that could have factors (and therefore NOT be prime) included in your list would be the base number 330 plus or minus 2, 3, 5 or 11. OR any numbers with these as factors. So, you are "safe" in adding and subtracting "1" because it could not have 2 or 3 or 5 or 11 as factors. 330 plus or minus 1 is either itself prime OR it has another prime number not in your list as a factor which therefore discovers a "new" prime … that is … and here is the part they always leave out … "relative to your list of primes". The term "Relative" comes into play and is an essential part of the "McCanney Generator Function" defined in the book "Calculate Primes". It is of utmost importance in understanding what mathematicians have missed throughout all of these thousands of years.

But what if in fact you were diligent and had found 7 and included it in your original list of "all" discovered prime numbers (you would have 2, 3, 5, 7 and 11). With this complete list of primes up to 11, there is no way you are going to discover any new prime numbers here, or is there? Let's follow the original Greek proof again and see where it leads this time but for the partial list 2, 3, 5 and 7. Multiply your list of "known" primes (2 x 3 x 5 x 7 = 210). Now add and subtract "1" giving 211 and 209. 211 is prime but 209 is not. It turns out that 209 has factors of 11 and 19. So these factors are "relatively" prime to 210. They are not in our list so we in fact have discovered not one but two new primes that were not in the original list of 2, 3, 5 and 7. Since our original list was complete up to 7 (2, 3, 5 and 7), the factors of 209 could not be in that list. We found primes outside of the limits of the list we knew were "complete" and therefore they are "relative primes". We will find many "relative primes" that are not true primes but which create new prime numbers in our process. This subtle issue is one that took me some time to break through and understand relative to the generation of prime numbers from prior prime numbers.

Now let us take this to the logical conclusion. This is the heart of the McCanney Generator Function. Take a complete list of prime numbers up to a given point (up to the n^{th} prime number), multiply these together and we will call this number the "n^{th} magic number" and we will write it as Spp_n (the mathematical term is the "n^{th} sequential prime product"). **The only numbers that can be prime "relative" to this number are $Spp_n + 1$, $Spp_n - 1$ (for the same logical reasons as given above) and also Spp_n + all relative primes and Spp_n – all relative primes (relative primes with respect to Spp_n).**

When this process is begun starting at just the number "0", you generate using only addition and subtraction all the relative prime numbers in groups. You then use a "boundary condition" rule that states that all numbers discovered by this process less than p_n^2 (where p_n is the nth prime number) will be prime (there is a mathematical theorem and proof of this in the Calculate Primes book). The result is the Generator Function which directly calculates prime numbers ***in groups***. You begin with the number "0". Applying the Generator Function gives the first "set" of prime numbers. With this you calculate the next magic number because you have discovered more prime numbers ***in sequence*** (without missing any … the property of Completeness). This set of prime numbers is then inserted into the Generator Function to create the second group of prime numbers. This process continues with each successive group having more prime numbers than the previous group. At first this seems like a relatively minor function until you realize that the groups become larger and larger very quickly. Within a few iterations of the generator function you will be generating prime numbers that if the digits were placed in one-centimeter cubes, the number would stretch from earth to the sun. The issue with just looking at the Generator Function is that it is an equation and most people (even mathematicians) need to visualize the meaning. This is where the Spp_n and Rpp_n tables come in to use. One might imagine that these tables would be quite simple but in fact they have properties that are extremely complex. The prime numbers of themselves form a mathematical system that is very ordered. This is a totally unexpected result of the Calculate Primes process, and this book gives the visualization of that process.

In the process we will find many "false primes" but here again is one of the thin veils that no one saw through if they even ventured near this (as did the great F. Gauss but even he did not see the solution). The false primes are needed to generate the real primes if they are "relatively prime" to the current group of numbers being worked on. There are many more subtle aspects to the Generator Function which lead to the conclusion that the 1) prime numbers are a mathematical number system unto themselves, 2) they are symmetrical around the "magic numbers" and there are many other symmetries, 3) this mathematical system has the properties of Closure (the number sets are a closed Group … each set of relative primes in Spp_n is a closed system), Reciprocity (the operation works in the forward and reverse directions), Symmetry (as already noted), 4 you are discovering all prime numbers so the discovery has Completeness, 5) the solutions form standing wave patterns that extend to infinity that predict all future prime numbers and 6) creates a new number system called "Nature's Number System" that is based on the prime numbers and identifies numbers and their properties in the number itself. The prime numbers occur in infinitely many wave patterns that repeat to infinity and which "beat" against each other to create the patterns we observe. It relates primes to the world of "relative primes". This creates a new understanding of prime numbers in counting. The prime numbers form "waves" that extend to infinity predicting all the prime numbers that will ever be discovered using simple formulae. The major aspect is that the current book shows the visualization of the prime numbers with all of these properties and many more. Most people cannot visualize using equations so a new system of "tables" is presented so anyone can see these properties visually [2].

At this point I am going to make a brief segue specifically for professional mathematicians, but all readers should note this also. Fishermen have learned that to catch big fish you need what is known as a "stinger hook" as big fish have learned that you do not swallow the entire bait (in case it is bait and not regular wild food). The stinger hook is a small hook that is difficult to see and feel and a way for the fisherman to catch a wary big fish. So here is my "stinger hook" to keep the interest of professional mathematicians to read until the end of this book, hopefully catching their attention … hook, line and sinker.

Of the many new theorems and corollaries proven in this book, the following are the most unusual. Stinger hook #1) The highest local values of Goldbach pairs (the number of prime pairs that add to equal an even number N), occur at locations Spp_n because of the symmetry of prime numbers around the value of ½ Spp_n, while the minimum local values are related to the Maximal Gaps and/or large gaps that occur just beyond the sequential prime product values. For the following unusual result proven later in this book, one needs to have a good background in the work of George Cantor dealing with infinities. Stinger hook #2) Not only is the Twin Prime Conjecture proven, but additionally, every Twin Prime Pair generates an infinite number of future Twin Prime Pairs. For good measure Stinger hook #3) The application of the Generator Function proves that the density of primes is a strictly monotonically decreasing function as there is a limit put on the size of gaps (there are no rogue prime gaps that would cause the Goldbach conjecture to be false). Now if there are still any mathematicians uncertain about continuing, here is Stinger hook #4). Just as every integer has a unique set of prime factors (The Fundamental Theorem of Arithmetic), every prime number is generated by a unique previous "ancestral" prime number and has a unique ancestry of unique prime numbers leading back to the alpha prime number 0.

This last segue was necessary because at this point the next topic deals with the numbers 0 and 1 being prime numbers under the new definition of primes. In building the prime numbers using the Generator Function, the number 0 is called the "alpha" prime or the mother of all primes. All prime numbers have ancestries that lead uniquely back to "0". This is where many "traditional mathematicians" would slam this book shut in anger believing that this issue has been settled. Remember that we are working with a new definition of prime numbers that has as a subset the traditional definition of primes. The old definition will become obsolete as the new definition and the tools it brings with it are understood. It is in a sense that Tensor analysis and General Relativity did for Newtonian Mechanics. It did not disprove or nullify Newtonian Mechanics; it added another layer on top of it.

The new view of prime numbers allows one to look at the prime numbers in small groups and then generate the next group using standardized formulae. This allows one to structure proofs and equations that predict prime number behavior and thus allows proofs by induction. These are the tools that have been missing and this gives a firm understanding of the prime numbers and without considering any other numbers except the primes. They are now a number system all to themselves. Abstract Algebra, commonly used properties of Group Theory and other forms of analysis, can be applied to these small groups of primes. These generate patterns in the prime numbers never imagined before. These were described in the original text "Calculate Primes" but it appears that no one noticed this. These properties are expanded upon in this book with visuals so everyone will be able to readily see the results.

An additional issue is that with the new definition of prime numbers (all numbers generated by the Generator Function) we now conclusively include 0 and 1 as prime numbers. This provides the connection between positive and negative prime numbers and leads to the use of prime numbers as the basis for a more complete set of prime numbers in the form of complex prime numbers of the form $p_i + ip_j$ where $i = \sqrt{-1}$ (the square root of negative 1). Without 0 and 1 as essential pieces of the prime number set, the advancement to more complex number systems would not be possible (see the final chapter of the book "Calculate Primes" for further discussion of this topic). Of course, this was never an issue before since no one considered the prime numbers to be a closed number system. The issue is not to argue based on the standard definition of prime numbers; the issue is to understand that the standard definition is not complete.

It will be discovered also that the wave patterns of the prime numbers propagate both in the positive and negative directions (with symmetry) and cross from positive to negative numbers with 0, 1 and -1 being included in the patterns. The traditional arguments over whether 1 should be included as a prime number comes from the incompleteness of the standard definition of prime numbers. The new definition of prime numbers using the Generator Function begins with 0 and 1 and furthermore branches to negative numbers and then to complex numbers.

The standard reasons for 1 not being a prime are as follows and then I will comment on their viability. The first objection is that 1 is a simple factorization where 1 has factors of itself and 1. That in fact fits exactly the standard definition of a prime number. Per the Greek definition, it fits in exactly one row and one column and cannot be rebuilt in any other form. Therefore, it should be classified as a prime. The second and more often used argument against 1 being a prime is that if used in factoring would not comply with the Fundamental Theorem of Arithmetic. For example 12 factored could = 1 x 2 x 2 x 3 or could equal 1 x 1 x 2 x 2 x 3 OR could also equal this string of prime factors with any number of 1s. BUT my answer is that 1 x 1 x 1 x 1 = 1 and therefore no matter how many times you care to write 1 in the product, all the 1s can be written as just a single 1 and therefore this should not create a problem.

The inclusion of 0 as a prime will have many mathematicians ready to slam this book closed and begin to rant down the halls outside of their offices. Before you do, remember that this is a mathematical model of which the traditional definition of prime numbers is a limited subset. The benefit of including 0 as a prime as the "alpha" prime or "mother of all primes" will become clear in the application of the Generator Function. The necessity to include it as the "glue" between the negative and positive prime numbers and the center point for the complex primes is another valid reason.

More importantly in the pure mathematical sense, 0 is the beginning number as you will see the prime numbers are literally generated from the Peano Postulates, with 0 being the first element. This should give mathematicians pause to admit that the benefits of all of these reasons at long last gives the prime numbers their rightful place in mathematics. Not only are prime numbers the building blocks of products (the factors of all numbers), but they in fact are the building blocks of the prime numbers themselves. All prime numbers are generated from prior prime numbers starting at 0 and using only the operations of addition and subtraction. This topic is also covered in the last page of the book "Calculate Primes" and is restated later in this book. The generation of prime numbers starting from Peano´s Postulates should stand as a landmark achievement.

The greatest achievement of this work is the fact that the prime numbers generate other prime numbers using simple addition and subtraction and therefore are determined beginning with the prime number "0". Prime numbers are no longer seen as numbers that only have themselves and 1 as factors, they are now defined as the numbers uniquely determined directly by simple addition and subtraction of already discovered prime numbers to and from the magic numbers which are themselves the products of sequences of prime numbers. The following is one of the proofs found in this book.

The fundamental theorem of prime numbers: Every prime number has a unique set of ancestral prime numbers going back to the number "0" the alpha prime or mother of all primes

As an example, the number 41 has as its unique parent 11 (the sequential prime product 30 plus 11). 11 has as its unique parent 5 (the sequential prime product 6 plus 5). The number 5 has as its unique parent 1 (plus the sequential prime product 2 x 2 = 4 second row). And finally, the number 1 has as its unique parent 0 (the "alpha prime" or mother of all primes plus 1). All prime numbers have such an ancestry and it is unique when following the rules of the Generator Function. You will see that some of the ancestral primes may be relative primes (relative to the Spp_n value where they were generated). Relative primes have as much value as real primes in certain applications. One can also talk about "brothers" or "sisters" in that 37 (the sequential prime product 30 + 7) is a sister prime to 41 (the sequential prime product 30 + 11) since they are generated in the same group related to the sequential prime product 30. Likewise, one can discuss symmetries like 19 and 41 being symmetrical around the sequential prime product 30.

Where 30 - 11 = 19 & 30 + 11 = 41.

There is another set of symmetries that fall around the value of ½ Spp_n. For example, all the primes in the Spp_n = 30 group add to equal 30. 1 + 29, 7 + 23, 11 + 19, 13 + 17 are called "complement primes" since their sum is 30 plus, they are all symmetrical around the value of ½ Spp_n = 15. But you might add that 5 + 25 is missing since 25 is not prime. This is part of the prime discovery process in that that 5 and 25 are not included because 5 is a factor of 30. And finally, one can write an equation for all future primes based on the "wave" function discovered for Spp_n = 30 as follows (all future primes will have this form ... note not all of these will be prime but all true primes will be of this form):

$= n\,30 \pm (1, 7, 11, 13, 17, 19, 23, 29)$ where $n = -\infty \ldots -3, -2, -1, 0, 1, 2, 3 \ldots +\infty$

In this book we call this a "comb" to represent a series of select numbers in a sequence. A simple and partial form of this type of equation usually quoted by mathematicians noted is $6n \pm 1$. However, as you will see later in this book, this formula is a partial solution for the Sequential Prime Product 6. The equation for Spp_n = 30 will produce fewer predicted values that the equation for Spp_n = 6. The equation for Spp_n = 210 will produce fewer predicted values than the equation for Spp_n = 30 and so on. We will be able to write a similar set of equations for each subsequent value of Spp_n which will be a subset of values of the prior Spp_n equation, that is, every subsequent set of equations will further limit the predictive "comb" of the prior equation. This is the essence of the proof of the theorem discussed later that "the density of primes is a strictly monotonically decreasing function" since the equation for any sequential prime product contains fewer potential prime numbers than the prior sequential prime equation (for the previous sequential prime product). Now also note that as these tables grow, not all of the numbers in the "equation" will be true prime numbers, they will also include "relatively prime numbers" relative to the Spp_n value. The Generator Function boundary condition rules deal with this issue in a natural way since the relative primes are needed to generate future real prime numbers and when their usefulness has ended, they are eliminated by the selection rules (much like selection rules in nuclear and atomic quantum mechanics).

One last point is given. Since every prime number has a unique ancestry, then so does every twin prime pair. For example, the twin prime pair (41, 43) each prime 41 and 43 has a unique ancestry of but more importantly, the twin prime has an ancestry that goes back the the mother of all twin prime pairs. This twin prime pair in turn will generate an infinite number of future twin prime pairs using the Generator Function. These tools allow us to prove previously unsolved problems AND to easily understand why they are true. This will be the basis for the proof of the outstanding problem The Twin Prime Conjecture.

Besides twin primes (which are primes of "gap 2") this same process proceeds to all prime numbers and all gap sizes. This book develops not only the equations to predict the number of twin primes in future tables, but also can predict the prime pairs of all gap sizes showing that all gaps are "conserved". There is a "Law of Conservation of Gaps" theorem that is a core new discovery that shows that once a particular gap size is formed in the structure of the prime numbers, this gap will then continue to be generated to infinity just as are the primes. We will develop graphs of these.

Before starting the serious rigorous part of this book, I will also give a preview of the new number system which again has escaped everyone who have been fixated with the base 10 or other modulo number systems. The new number system which in this book is called "Nature's Number System" (because it is a natural extension of the prime numbers) is structured as follows. First look at the commonly used modulo 10 or base 10 number system. The first digit represents "1's". The second digit represents "10's". The third digit represents "100's" and so on. Each successive digit is another multiple of 10, thus the name "modulo 10". One could write this to remind us as 1000, 100,10,1 to note the value of each digit and typically putting a comma between every 3 digits to make them easier to read. We can define number systems with modulo "8" (hex numbers), "2" (the binary system) or even modulo "29" if we want. The great mathematician F. Gauss used these to try to understand prime numbers but never got past that point. The problem is that by the time you get to somewhere between 10 and 100, the prime numbers are lost in the maze. The prime numbers in all of the "modulo" systems of numbers are simply the numbers left out of the standard multiplication table. We memorize as children the common multiplication table for modulo 10 but we could just as easily learn the multiplication table for modulo 29 or any other base number system. The best thing you can say about any modulo 10 number is that if it ends in either 2 or 5 or 0 it is not prime. Now imagine a number system in which the successive digits are represented by the sequential prime product (or magic) numbers Spp_n. The digits would go as follows 510510, 30030, 2310, 210, 30, 6, 2, 1 where each successive number to the left is the next value of Spp_n.

To find these numbers multiply the prime numbers 2 x 3 = 6, 2 x 3 x 5 = 30, 2 x 3 x 5 x 7 = 210 and so on (all the way to infinity). That is the only hint I will give at this point but this number system has amazing properties not the least of which is that it is structured on the prime numbers. Some amazing properties of these numbers will become apparent when we begin building the visual tables of Spp_n and see how the numbers line up when compared to the modulo 10 numbers. We will also learn that once you get the "patterns" you will not have to use numbers at all but will build the properties of the prime numbers without using numbers per se. When you think about it, that is how the ancient Greeks started all of this by representing numbers in rows and columns, however that spiraled into the view of primes as numbers mixed into a sequence of all numbers. We will see in the tables that we will be dealing only with prime numbers, not all the "un-prime" numbers. This will greatly reduce the problem of dealing with large groups of numbers.

At this point we have seen just the very beginning of the properties of these tables which I guarantee you will stretch even seasoned mathematicians to grasp. But the journey will be worth the effort since these are the tools that have been missing since prime numbers were first noticed by the ancient Greeks.

It is further very interesting to note all the relationships between prime numbers in the many examples given in the book "Calculate Primes" showing how families of prime numbers are related to other families of prime numbers, since prime numbers are generated in groups (not one at a time). This is a topic that could take chapters but is best understood visually. A simple example is that when you start at any magic number subtracting the current set of relative primes (generated by a prior iteration of the Generator Function) from that magic number, it identifies the exact same set of numbers as are discovered by adding relative primes from any prior magic number and its relative prime group. That is, the wave patterns propagating in the positive direction match exactly the wave patterns or primes propagating in the negative direction NO MATTER WHERE YOU START. Additionally, if you continue the "wave" far into the negative numbers you similarly identify the negative prime numbers which exactly reflect all the properties of the positive prime numbers (we are not dealing with negative or complex prime numbers in Volume I of this book). The complexities of these patterns are more than amazing to see, especially in a group of numbers that were previously stated to have no patterns at all and were at most stated to be "random" or at best "pseudo-random" (meaning that they seem to be not random sometimes but in fact are random … this is the mathematical equivalent of the weather man stating that it may be rainy or may be sunny today). The prime numbers are not random and contain an infinite number of complex patterns. These will become obvious in the visualization tables in the following chapters.

By now you should have a better idea of what the ancient Greeks knew and what they did not know, and additionally, what standard mathematics did not recognize … and with these few initial brief samples … what my years of private studies are now revealing.

CHAPTER 2
CREATING Spp_n TABLES

This chapter sets the stage for very complex yet subtle properties of prime numbers. Previous efforts over the past 2500 years have used number systems that did not accommodate the prime numbers, in fact as you will see, they created a hindrance to understanding. Just as Roman Numerals were found to have inherent limitations, so to modern number systems have serious limitations. Along with the visual tables is the topic of "Nature's Number System" defined in this book which brings an entirely new light about prime numbers. The following is an example (Figure 1 - next page) of a completed primes only (red column only) table (for n = 5, using mod10 numbers) that we will be building and developing. Do not spend too much time on this we will develop all this in short order.

But first, the following is copied from the original Calculate Primes text defining the "Generator Function". It presents the mathematical expression outlined above in a simple format. It has one single boundary condition that defines prime numbers to be all numbers less than p_n^2 after each application of the Generator Function. There are no complicated rules. The process starts with the number 0 and the equation is applied which generates the second number 1 (as defined in Peano's Postulates). It is the operator that generates the first step of the process of Induction. These numbers are the first "groups" of prime numbers. These are then operated on by the Generator Function to create the next "group" and the process continues. As a numerical and physical representation, we will develop Nature's Number System based solely on prime numbers and the Spp_n Tables which contain only prime numbers developed by the Generator Function defined below.

******** THE GENERATOR FUNCTION *********

The notational representation for an "umbrella group" is as follows (the symbols ε and $\underline{\varepsilon}$ represent "are an element of " and "are not an element of" respectively):

$$U_{gn} = \Pi_1^n p_i \pm 1 \text{ and } \Pi_1^n p_i \pm p_{cm}$$

$$p_{cm} \ \varepsilon \ U_{g(n-1)} \text{ and } p_{cm} \ \underline{\varepsilon} \ R_{gn} \ \text{(for all } p_{cm} > 0)$$

Prime Number Selection Rule – $p_{real} < p_n^2$

(Where p_i is the ith prime number of the nth "sequential prime product" Spp_n and the Greek letter Π represents the operation of multiplying all terms defined after it).

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Each term will now be separated out and examined individually.

In this definition the "sequential prime product" is written by the following expression.

$Spp_n = \Pi_1^n p_i =$ "repetition group length" = wavelength

See the Figure 1 below for an example of a well developed Spp_n table for n = 5. As with the Generator Function, each successive table is constructed from the prior table.

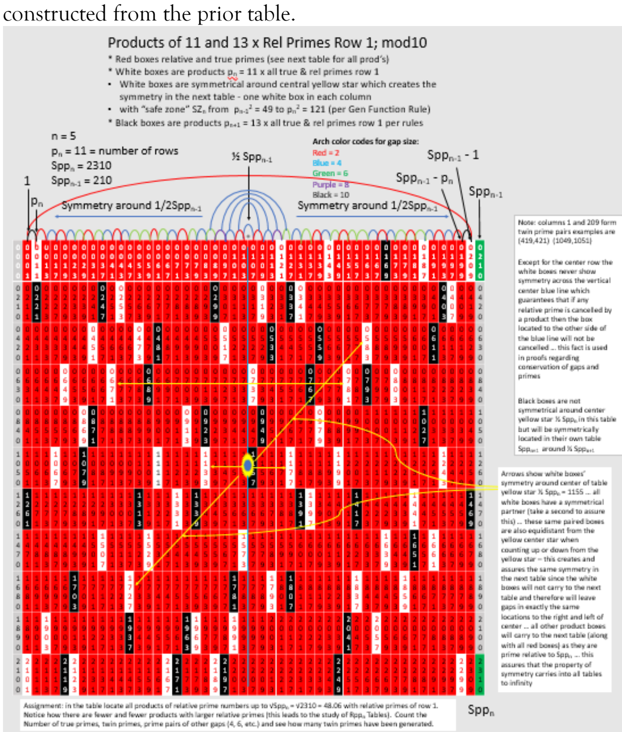

Figure 1) n = 5 with *Spp_5 = 2310 Table - 48 columns and 11 rows.*

Above is the "red column" table for n = 5, P_n = 11, Spp_n = 2310 and Spp_{n-1} = 210. This table contains all the relative primes (true primes and non- prime numbers that are relatively prime with respect to 2310) with the white cells removed (all multiples of p_n = 11 are the white cells). We are using mod10 numbers in the cell since you are familiar with base 10 numbers. All prime numbers less than 2310 are contained in this table (they are the red cells). How did they get there? This table was generated from the prior table Spp_{n-1} = 210. Row 1 of this table was constructed by linking all the rows of the prior table Spp_{n-1} in sequence. Then every cell in rows 2 to p_n is constructed by simply adding multiples of Spp_{n-1} (210, 420, 630, ... , 2100) to the parent or top cell value. This is the visualization of the McCanney Generator Function found in the first book of this series "Calculate Primes".

You will notice that there is one and only one white cell in every column. All the other numbers less than 2310 that are **not** relatively prime to 2310 are **not** in this table. Remember that only the prime numbers are used to create future prime numbers. This is the visualization of the **direct calculation of prime numbers** from the Calculate Primes book. To create the next table, all cells except the white cells are placed in sequence to create row 1 of the next table Spp_{n+1} = 30300 (the next sequential prime product after 2310). You should now take a quick look at the file accompanying this release entitled "Appendix - Parameters for Tables Spp_n and Rpp_n ". This Appendix defines a list of parameters relative to Volume I of this 3 volume set. As you will see there are many dozens of mathematical parameters defined which describe the attributes of the tables. There are similar lists for Volumes II and III. Also note that there are much better resolution photos in the accompanying files that go with this text so the above table is available in higher resolution ... some of the tables have a significant amount of detail that cannot be duplicated within this text.

Look again at the table above. Notice that in row 1 there is a symmetry around the ½ point (marked ½ Spp_{n-1} above the center of the table). All values in row 1 to the right are the same distance from the equivalent value to the left of this ½ point. The colored arcs above the columns represent gaps (differences between the prime numbers) and these also are symmetrical around this ½ point of row 1 (a gap to the left is found equidistant to the right of the ½ point).

When you then add the multiples of 210 to these cells to get the values in the cells below each parent top cell, this symmetry is preserved and therefore is transmitted to the next table. Symmetry is preserved from one table to the next to infinity. Looking into the table notice the center point of the table marked with a green dot (surrounded with yellow) with value 1155 (not listed in the table because it is not a relative prime number). Now pick any cell in the table and find its "complement" (the value symmetrically on the other side of the center point). A few points are marked (0583, 1727) and (1133, 1177). Every cell has a "complement" cell and these are located symmetrically around the ½ center point of the table. This should be true because this symmetry is a result of the table being constructed from a symmetrical row 1, which was Spp_{n-1} = 210. All red cells in this table have complement cells. This creates an organization of prime pairs that add to equal a single number (Spp_n). There is a bit of work to understand the following point fully, but this why in looking at the Goldbach prime pairs (pairs of primes that add to equal even integers), the local maximum values are always either sequential prime products OR multiples of sequential prime products. That is why I chose as one of my "stinger hook" points in the beginning of this text (to hold the professional mathematician's attention) until these points could be made. This is also relevant to the overall proof of the Goldbach Conjecture later in the next text. The tables which are visualizations of the Generator Function provide the tools for new understanding of the structure of prime numbers and unsolved problems. Many more examples are yet to come. There are dozens of other relationships hidden in these tables. Just a few examples are listed at this time.

Look at the values of the cells of the table. Notice the location of twin prime pairs (marked with red arcs above their locations). Now go down the columns below these parent cells. All the cells below are also twin prime pairs. We are generating twin prime pairs from parent twin prime pairs. Locate the top column cells 1 and 209. These also form twin primes (209, 211), (419, 421), etc. These are also generating twin prime pairs. You will find all the red cells (true twin prime pairs) in these columns that were generated in this table by applying the Generator Function. There are many more twin primes in table Spp_n = 2310 than found in the prior table Spp_{n-1} = 210 which in turn had more twin primes than the prior table Spp_{n-2} = 30. Future tables will all have more true twin prime pairs than the prior table. The generalization of this will be the basis for the proof of The Twin Prime Conjecture using Induction. This was an underlying effort in my studies to create a structure for the prime numbers that would allow Induction Proofs. An additional mathematical concept founded by mathematician George Cantor will also come into play where there will be many levels of infinity in the propagation of primes, twin primes, prime gaps, etc.

One additional structure is the formation of mathematical Groups based on the Spp_n tables. A closed Group is a mathematical system that uses a single operation for which all operations on the elements of the Group wrap back into the members of the Group. The tables constitute a closed Group based on the relative prime numbers. This will be discussed in detail later in the text and further mathematical structures are presented in Volumes II and III of this set of books including negative and complex prime numbers. Additionally classes of prime numbers such as Mersenne primes (numbers that are prime of the form $2^n - 1$ where n = 1, 2, 3, ... , ∞). One can see that this is a subset of the many equations that arrive naturally from the tables as discussed previously. The tables provide a far better set of equations for the identification of potential prime numbers. A later Appendix will discuss the dozens of specialty prime groups relative to the tables.

Throughout the history of mathematics, there have been many formulae and visual attempts at finding patterns in the prime numbers and all have failed for one very simple reason. They only saw part of the more complex system of relationships. The self generating Spp_n tables are the best representation of prime numbers. But first I want to recount how the “Spp_n Table” concept came to me.

Many times during my education and professional life in physics and mathematics, I would become tired at the end of a long day and slip off to sleep. During the night on many occasions, my mind would continue to work and, in the morning, I would awake with the full solution including images and drawings in my head.

Creating the tables that are the true basis for the prime numbers is a simple application of the McCanney Generator Function described in “Calculate Primes”. One of the natural extensions of the Generator Function is that all multiples of the “magic numbers” have amazing properties relative to the prime numbers, as you will now be able to see and visualize. The idea for the tables came to me as I sat on an airliner on a long flight dozing off and falling into a deep sleep. As has happened many times in my life, my subconscious mind was busy working on the math problem that had occupied my mind for decades. As I awoke, I grabbed onto the solution that I conceived in my dream and started writing before the dream escaped the transition to my conscious mind. The tables were born in my subconscious mind. After working with the tables over past years, I have come to realize that they unlocked many of the secrets of the prime numbers. The tables provide a new tool with which to view the prime numbers and analyze them in small orderly groups. At first, they will seem simple and in fact, creating the tables is quite simple. They are very orderly and one table naturally generates the next table. What is not so simple is what happens once you begin to unlock the secrets of the prime numbers. Every day I discover new hidden properties of the prime numbers based on the tables. It is like having the Bohr model of the atom for the first time or the Schrödinger Equation. These are tools that have predictive values.

The tables are first created from the prior table. Then a series of operations are performed on the table which will produce dozens of parameters which tell us the progression of these parameters from all prior tables. Next we develop equations that generalize the development of tables from one table to the next and into the future. With these equations and relationships we develop the understanding necessary to create proofs by Induction that will prove previously unsolvable problems relative to the prime numbers. This is based on direct calculation of the primes not statistical Mathematical Analysis. We derive exact solutions not statistical solutions.

Essentially the prime numbers constitute a complete set of numbers unto themselves. They are not the errant left over numbers from a multiplication table. They are not the numbers that remain after a sieve is applied. And for sure they are not the numbers found by brute force calculations of super computers. These are all standard methods of locating a few prime numbers, but they give no understanding of the prime numbers at all. These methods of locating primes have convinced mathematicians that the prime numbers are random or at best pseudorandom but give no idea of relationships between the primes and certainly give no degree of knowledge of how to directly find or predict locations of primes (other than in vague generalized probabilistic equations that make General Relativity look like grade school math).

The Spp_n (Sequential Prime Product using counting integer “n”) and Rpp_n Tables bring the McCanney Generator Function to life and you will begin to visualize the power in its application. The current state of the math world would be like seeing the physics equations for a pulley system but without imaging a pulley system in a diagram. It is the relationship between the physical and mathematics that makes physics the science that it is. It would be like trying to describe a small single cell animal without powerful lenses of a microscope. So too it is with the prime numbers. Now you will have the physical visual descriptions of the prime numbers and will be able to view them with all their associated prime numbers without the cumbersome presence of all the other numbers. You will be viewing just the prime numbers as they were meant to be viewed but were never able to before because the tools to view them were never present. The number systems we were using could not open the door (Figure 2).

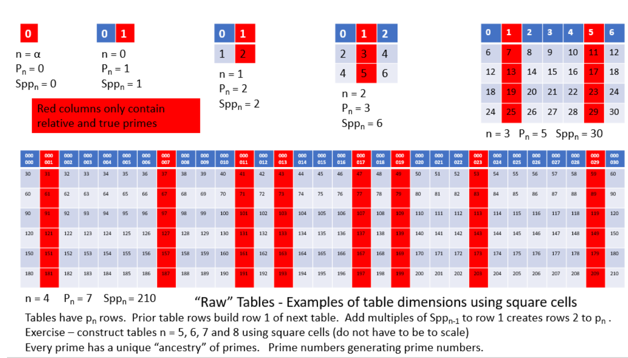

Figure 2) *Shows the first few Spp_n Tables that are generated from using the Generator Function as defined in the “Calculate Primes” book.*

You can see how one table is created from the prior table. This was one of my main goals as this then builds the structure for proofs by “induction”. If you can prove a property for one table for the prime numbers, then show how the next table is mathematically generated from the prior table with this property transferred to the new table, then you have created the scenario that will allow you to prove this property for the next table and therefore all tables to infinity. This is the basis of mathematical proof by induction which was first conceived of by the ancient Greeks, and later solidified into modern mathematics in its most basic form in what are known as the Peano Postulates.

In the tables observe that they begin with the alpha prime “0”. The table is a single “cell”. Observe how the basic table parameters progress from one table to the next and how the prime numbers occur in columns. Observe how there are some numbers eventually in the red columns that are not prime. We will show how the Generator Function operates visually within the table. Eventually there will be literally many dozens if not hundreds of properties and parameters associated with these tables that will allow us to build equations generating a future table from a prior table. This is just the basic beginning. The tables use the familiar modulo 10 number system to get the idea of the tables. We will translate these to use the Nature’s Number System and that is where you will begin to see the inherent power of these systems working together.

Soon after understanding the construction of the tables using standard base 10 numbers, we will convert to the new “Nature’s Number System” and you will see the amazing transformation of understanding.

To help put this into perspective we will take certain pieces from the chapter that defines the new “Nature’s Number System”.
In mathematics we have the following number systems that build one on the previous system. (the symbol ∞ means “to infinity”)

Roman Numerals using a complex system of I, X, L etc. were useless in commerce

Natural Numbers (1,2,3,4, ... ∞) Uses the symbol "N"

Integers (-∞, ... -4,-3,-2,-1,0,1,2,3,4...∞) Uses the symbol "I"

Rational Numbers = I_1/I_2 divide any integer by any other (cannot divide by 0)

Real Numbers = any number in the form xxxx.yyyy where x and y are digits 0 to 9

Complex Numbers = a + bi where "a" and "b" = real numbers & "i" = $\sqrt{-1} = (-1)^{1/2}$

Other forms of number systems are Matrices, Vectors, Tensors, etc. Algegras (define special groups of numbers or symbols having common properties).

Group Theory is a special form of mathematical structure will apply to prime numbers

There is a basic assumption in all of the above number systems that base 10 number system is universal and has no limitations. Some mathematicians tried to resolve certain limitations but never quite made it across the thin veil that separated them from the native number system of the prime numbers that I call "Nature's Number System". That assumption was that the way we represent the numbers was not important. Mathematicians have become diverted trying to determine if when observing prime numbers in modulo 10 if there might be a preference for primes to end in a particular digit or other. This is a non-question since the result would be different in every different number system of different modulo. This has nothing to do with the order or structure of the prime numbers but would be no more than a quirk of the number system. Furthermore, since this could all change with increasing prime numbers (and since computers can only calculate to limited ranges of prime numbers) we could never come to a definitive conclusion about this topic. It is something that literally could never be resolved. As it turns out in the "Nature´s Number System" all prime numbers will end with the same digit.

Throughout history, number systems have been assumed to be equivalent although we forget about the major step from Roman Numerals to Arabic numbers and base 10 which allow for ease of adding, subtracting, multiplying, dividing and doing all sorts of other higher levels of math. We typically use the modulo 10 numbers which repeat in powers of 10. 10, 100, 1000, 10000 etc. All of the great mathematical developments have been based on this number system including the specification of constants like "π" or "e". But the modulo 10 system is inherently faulty when it comes to understanding prime numbers. Let us imagine that we had been limited to using Roman Numerals ... where would mathematics be today? Imagine trying some standard math operations with Roman Numerals. For example, there is a system of "logarithms" that defines a relation between any real number and "10" the "base". That relation is written as $10^{\log x} = x$.

Every real number x has an associated "$\log_{10}$". We can define these in terms of any other "base" but 10 is the most commonly used "base". There is a natural base of logs known as "natural logs" and written as ln x based not on the base 10 but on base "e" with e = 2.718281828459...

This is known as "Euler's number" after the mathematician Euler. So $e^{\ln x} = x$ relates every real number x with its "Natural Logarithm" ln x.

One of the most famous math "identities" is $e^{i\pi} = -1$ which again assumes base 10 in the minds of most mathematicians.

In working with the Generator Function a new number system came forward that was new to mathematics and allowed for very easy use of prime numbers as the basis of all numbers (their rightful place in mathematics). Within this new numbers system, the prime numbers are NOT the errant numbers left out of the multiplication table and are NOT the numbers left after removing other numbers in a sieve and lastly, are NOT just numbers with 1 and themselves as factors (only to be found by brute force super computer calculations). Nature's Number System (notation is modNt) is based on the prime numbers. We can now determine prime numbers in the distant future based on this number system and more importantly tell many properties of a number just by looking at it, unlike base 10 (mod10) numbers which according to one mathematician when commenting on the prime numbers, "they appear to be no more than so many random lottery numbers".

Nature's Number System is based on increasingly large growth of prime numbers and their associated magic numbers instead of powers of 10 or some other artificially created modulo. The sequence is as follows: the first digit is 0 or 1 (base 2 or modulo 2 or mod 2) ... the next digit is based on modulo 6 (mod 6) ... the next digit is based on base 30 ... the next digit is based on base 210 and so on. 1, 2, 6, 30, 210, 2310 and so on are successive Sequential Prime products. Each successive "digit" represents the next value of Spp_n (the product of all prime numbers up to the nth prime) and so on to infinity. The power of this number system will become obvious with use. But its initial major achievement is that it is based on the prime numbers, not the number of fingers and toes we have. Within this number system the primes grow and are determined without the need of the rest of the numbers. Another property of the Generator Function is that it discovers prime numbers in groups staring with the alpha prime 0. It is a recursive process by which new prime numbers are discovered which are then fed into creating the next sequential prime product along with its newly discovered larger set of prime numbers. It is a system that naturally grows without any other input or help. It is a self generating process.

That is why I have called it "Nature's Number System". It is the number system that would also be discovered on the far side of the universe although they may use different symbols than ours. We will find that in dealing with the prime numbers, eventually we will no longer even write the numbers as they will simply become place holders in the table patterns and we will only write the major "mile marker" numbers to indicate locations in the tables. It is interesting to note that the famed mathematician F. Gauss worked with various modulo systems to try to interpret the prime numbers but failed to see through this thin veil. He noticed that base 10 numbers made it easy to recognize multiples of 2 and 5 (both prime numbers) but left us clueless regarding large numbers with any other primes as a factors. Gauss explored other modulo based number systems but never cracked the code of "Nature's Number System" which uses all of the prime numbers as a base. I often joke that if aliens ever do discover our society, they will find it humorous that our number system is based on the number of toes we have and that it took 2500 years to discover the true nature of numbers.

In the new number system, multiplication is replaced by a new process and factorization is also replaced by a new process. With this in mind, begin to create the additional tables in the above photo, using the Generator Function and the simple rules noted in the photo to build each table from the prior table. This is the baby step that will eventually bring this to the level where seasoned mathematicians will have a difficult time following all the properties that arise from these seemingly simple tables. We will also see that the numbers 0 and 1 are prime numbers and we will find that there is an equivalent group of negative and complex prime numbers. The numbers 0 and 1 are intermediate primes between the positive and negative prime numbers. Also note that the process begins slowly but within a few iterations of applying the Generator Function we will soon be generating millions and trillions of prime numbers within successive iterations of applying the Generator Function. To be very clear however, the goal is not to generate huge tables of prime numbers (although that is easily done), the goal is to bring understanding to the prime numbers as they extend to infinity. Managing large numbers and their relationships to smaller numbers is the goal that will finally make the prime numbers manageable to infinity. The ability to create subsequent tables "n + 1" from the prior table "n" gives the power of understanding previously missing from the mathematical tool box. This is the fundamental building block of proofs by induction. As I was building this mathematical structure I always had as my goal the use of building blocks that would facilitate proofs by induction.

One last point regarding Nature's Number System is that in the first few iterations it grows at less than the modulo 10 number system (it takes more digits to express a given number than with modulo 10 for small numbers). But after n= 5 for Spp_5 = 2310 & p_5 = 11, Nature's Number System begins to pull ahead and eventually will grow by staggering amounts for each progressive value of "n". It very soon will use far fewer digits to specify a given number than the modulo 10 representation and these digits also will have meaning relative to the number. Unlike the base 10 number system in which large numbers are described by some mathematicians as "seeming to resemble random lottery numbers", Nature's Number System representations have real meaning. By simply looking at the number you will be able to trace the number's history back to the "alpha" prime 0.

This is also reflected in the tables which will grow to huge sizes very quickly. These properties are essential in proving outstanding problems such as The Twin Prime Conjecture and related problems. Managing large numbers has always been the bane of mathematicians which is directly a result of the base 10 number system's inability to give meaning to large numbers. The benefit is that Nature's Number System numbers have fewer digits for very large numbers and this becomes increasingly so the larger the number. This is a topic in another part of this book, but for example, using one centimeter cubes to contain the numbers of the tables, the table for the 9^{th} magic number Spp_9 = 1,000,000,000 modNt = 223,092,870 mod10

The "modNt" or Nature's Number System representation takes 10 digits. The base 10 "mod 10" representation takes 9 digits but is already almost as large as the modNt representation. The corresponding table (using one centimeter cells) will stretch to more than 96 kilometers (9,699,690 + 1 columns) and will have p_9 = 23 rows (the table will be 23 centimeters high). The beauty of the Generator Function and tables is that it will now be able to manage these large numbers and the relationships between them. The table for Spp_{13} will stretch for more than 3 billion kilometers (or 20 times the distance to the Sun). The numbers will be represented by
Spp_{13} = 10,000,000,000,000 modNt = 304,250,263,527,210 mod10.

Clearly the mod10 base 10 number is becoming much larger than the modNt Nature's Number System representation.

The huge advantage of the tables will become immediately obvious in that all the numbers that will ever be prime numbers are contained in the "red" columns. So we can immediately do away with the "white" or non-prime columns. We will only be dealing with prime numbers and relatively prime numbers from now on. The numbers that are not primes that exist in the "red" columns are relative primes (relative to Spp_n). The concept of relative primes will become obvious as these are needed to discover the true primes and as noted in the Calculate Primes book, in directly calculating prime numbers, they are naturally eliminated by the boundary conditions and selection rules of the Generator Function.

Most mathematicians should be realizing that this greater than exponential growth of the Spp_n values and the ability of the tables to find prime numbers (and gaps between prime numbers) means that the growth is larger than the logarithmic decline in density of the prime numbers themselves (known from the "Prime Number Theorem" and also proven in this text). This means that there are more prime numbers in each successive table than in the prior table, and it will be shown that this is true for twin primes and other patterns of prime numbers (there will be more twin prime pairs in each subsequent table). This provides a tool which was not available previously to understand prime numbers and their progressions. It is not just a game of numbers, but the predictability of location of all prime numbers using formulae will hopefully bring solutions closer to resolution. Whereas previously prime numbers, twin primes and other patterns were seen to diminish in occurrence as you get to larger and larger numbers, in the current system they become more plentiful. This is a direct result of the new number system. Additionally, the future prime numbers, twin primes and other patterns are generated from existing primes, twin primes and other patterns so we now have an understanding of how many there will be and where to look for these previously misunderstood entities.

Using the photo of the first 6 tables above starting with the number "0" the α prime we next create the first table and see the properties. The result is the "alpha" (n = α) or beginning table. It has prime number 0 with Spp_n = 0. All prime numbers are descendants of this number. This is step one of Peano´s Postulates. Add and subtract 1 from 0. You find 0 - 1 = -1 and 0 + 1 = 1. We will not deal with the negative prime numbers in this book (nor complex prime numbers) as these are advanced topics beyond the scope of Volume I. It turns out that the negative primes have the same symmetrical structure as the positive prime numbers and amazingly enough, if you find patterns from any positive Spp_n value, the patterns of primes subtracted from this number extend to negative infinity in the negative direction. All of this is beyond the scope of this book. So the first prime number to be generated is 1. It has the following values n = 0, p_0= 1 & Spp_0 = 1. This is where the "Nature's Number System begins. Spp_0 is the product of all the "generated prime numbers" and in this case 1 is the only member. In the Generator Function you also add and subtract all the relative prime numbers that have been discovered to date to Spp_n but since there are none we have to wait until there are some generated in future tables.

Add and subtract 1 from Spp_0 = 1. You find 1 – 1 = 0 (already know to be prime) and 1 + 1 = 2. Since 1 was a generated prime (but just happens to be the same as 1 from the other Generator Function rule), we do not have to add it again since it will only find the same new prime numbers. So 2 is a newly discovered prime number. As you watch this process you will find that the process finds all the prime numbers by simply adding and subtracting already found prime numbers to the magic number. This table is built from the prior table and has values n = 1, p_1 = 2, Spp_1 = 2. These first two tables will be the only times that p_n = Spp_n… all future values will be different. The fact that 2 is "even" is not an issue and as you will see (using Nature's Number System) all discovered prime numbers will appear to have the "only even number conundrum".

It turns out that every discovered prime number will eventually be retired from use so to speak so in this respect, the fact that 2 is even, makes it like other primes, not unlike other primes, this is a subtle concept

If you are a novice or a hardened mathematician you have to realize that building a firm foundation is key to success later in the process. We are now building that foundation so that when you eventually have very large prime numbers, or twin prime pairs, or any other pattern of prime numbers or any patterns of prime gaps that you can imagine, that you will be able to find their ancestry back to these primitive beginnings. All future prime numbers will be built on a unique ancestry leading back to the number "0" the "alpha prime". Twin primes (primes of gap = 2) for example will have an ancestry back to the original twin prime that created that particular lineage.

Moving to create the next table (n = 2), we begin by finding the next prime number. Add and subtract 1 from Spp_1 = 2. You will find 2 – 1 = 1 (which we already know is prime) and 2 + 1 = p_2 = 3. Multiply the known primes to date to find the next magic number = 1 x 2 x 3 = Spp_2 = 6. You will observe something unique by this time. If you take the rows of the prior table, they are transposed in order to create the first row (row 1) of the following table. Then you add the prior table value of the magic number 2 = Spp_{n-1} to the "parent" numbers in cells of the top row to create the values in the columns. This is a visualization of one of the main properties of the Generator Function as explained in the "Calculate Primes" book and accompanying DVD lecture. Each table has Spp_{n-1} + 1 columns (the extra column is for the "0^{th}" column which maintains symmetry - an essential part of the Generator Function remembering that the number 0 is part of the group) and each table has p_n rows (equal to the nth prime number associated with the n^{th} table).

Now take a second to look at the tables we are generating above. The first row of every table is simply the rows transposed from the prior table. Notice in the tables the symmetry around the center points of row 1 and of the center of the table. All the future prime numbers fall in the red columns. We will eventually create tables that eliminate all the other non-prime columns and will no longer see or need them. Only the prime numbers will be used to create new prime numbers. Every prime number will have a "parent" and ancestry chain leading back to the "alpha prime" = 0.

As an example, take the seemingly heretofore unrelated prime numbers 5, 29, 59, 89 and 149. Do you think these have any relationships at all or should I ask, prior to looking at these tables would you have suspected that these numbers were "related" in any way? The fact is that 29 is the parent of 59, 89 and 149. They are "Generated" from 29 using the Generator Function. 5 is the parent of 29 (from the prior table) and 1 is the parent of 5 with 0 being the parent of 1. Confirm this by following all back to their top row values in the table where they were "generated". In turn when we get to the next larger table (which you are to create as an assignment but are created later in the book) you will find all of these generating more prime numbers. As with any complex problem, there are "boundary conditions" that must be followed so be careful there are many pitfalls along the way that are resolved by following simple rules of algebra.

You may be wondering at this point why we are finding "non-primes" and what is their roll in all of this? This is where most mathematicians would cease to look and this is why I discovered this (I had complete faith that the designer of what we call "Nature" had a system and I was pursuant to find it). The "false primes" are actually "relative primes" with respect the table in which they are found. With respect to a given table, and in terms of Group Theory, the relative primes are every bit as valid as the real primes (relative to this table). For example, the number 209 is in the red column of "parent" 29 (209 = 29 + 6 Spp_3 = 29 + 6 x 30 = 209).

To understand the roll of "false primes" return to the "Calculate Primes" book to understand the roll of these numbers. 209 = 11 x 19 both of which are primes "yet to be discovered" by the Generator Function process and both are "relatively prime" to Spp_4 = 210. Only 2, 3, 5 and 7 are factors of 210. 11 will be a prime factor in the next table Spp_5 = 2310 so it is relatively prime to 210. In terms of our table Spp_4 , 209 is as valid a prime number as any "real prime". 209 is in fact needed to generate future real prime numbers and will be a viable column "parent" in the next table Spp_5 = 2310 (= 2 x 3 x 5 x 7 x 11). It will generate the true prime numbers (remembering that Spp_4 = 210) … 209 + 1 Spp_4 = 419, 209 + 3 Spp_4 = 839, 209 + 4 Spp_4 = 1049, 209 + 5 Spp_4 = 1259, 209 + 8 Spp_4 = 1889, 209 + 9 Spp_4 = 2099 and 209 + 10 Spp_4 = 2309. So "false primes" are needed to generate future real prime numbers and as described in "Calculate Primes" when their "usefulness" is completed they are eliminated in the natural progression of the Generator Function. Make sure you understand this concept … that adding relative prime numbers (which includes real prime numbers) to a multiple of Spp_{n-1} are the only numbers than can be prime. This is not a sieve of eliminating unwanted numbers but the direct calculation of prime numbers using only the relative prime and real prime numbers generated in the prior iteration of the Generator Function which is the same process as building the Spp_n Tables. That is, the tables reflect the rules and boundary conditions expressed in the Calculate Primes book but in a visual form.

Like any process, at first it may seem cumbersome. I always marveled at the effort put into building roads or an airport. That seems like an awful amount of work just to have a few people move around. But the effort of building the basis allows future generations to build on the efforts of the past. It is more than worth the effort. Mathematicians of all groups are more than parsimonious about such things.

There is a subtly fine point here. Remember that 7 is NOT relatively prime to Spp_4 = 210 (7 is a member of the prime number group used to generate 210 (210 = 2 x 3 x 5 x 7), so we have to mark and remove all the multiples of 7 from the table since adding any multiple of 210 to and multiple of 7 in the next table will not result in a prime number. The reason is basic algebra (for 210 plus any number containing 7 as a factor you can factor out 7 and the number will not be prime … this is the simple distributive property of arithmetic). We are only dealing with prime and relatively prime numbers which are the "parent" numbers in the top row red boxes (not any other numbers). This is not a sieve or elimination process it is direct calculation of the primes using only prime numbers while remembering that relative prime numbers in a table are as much "prime" as real prime numbers. The products of 7 are 7 x 1 = 7, 7 x 11 = 77, 7 x 13 = 91, 7 x 17 = 119, 7 x 23 = 161, 7 x 29 = 203. All other cells of this table will carry to generate row 1 of the next table Spp_5 = 2310 = 2 x 3 x 5 x 7 x 11. The multiples of 7 are the ONLY cells from the red columns that will NOT carry to create row 1 of the next table.

Notice as you eliminate the multiples of 7 from this table, that of the cells eliminated, ONE AND ONLY ONE cell is eliminated in each red column. These eliminated cells are located symmetrically around the ½ point of the table (= 105) leaving all the remaining red cells (that carry to create row 1 of the subsequent table) to be symmetrical around this same ½ point. The end result is that this symmetry carries from one table to the next and to infinity. The prime numbers exhibit symmetry on this local level and this has huge ramifications in proofs. For example, in solving Goldbach's conjecture, it will be shown that this symmetry is essential in explaining why the large local values of Golbach Prime Pairs is maximum at vales of m Spp_n (m = 1, 2, 3, … ∞) where the incrementing variable "m" is multiplied with any sequential prime product Spp_n.

At this point in this table we can also eliminate all of the relative primes of this table by multiplying the prime numbers and relative prime numbers of row 1. These product numbers appear to be out of any symmetrical pattern in the table BUT they in fact will have symmetry if we extend the table downwards to the next sequential prime product (an advanced topic not covered in this book Volume I).

This carries with it some extremely important properties. All the twin primes, all the symmetries, all the prime pairs of gaps = 2, 4, 6 … will carry to the next table AND BE PARENTS of new primes and relative primes of the following tables. This is the fundamental property which leads to the "Law of Conservation of Gaps" that is essential in the proof of the Twin Prime Conjecture and the extended Prime Gap conjecture, the Goldbach Conjecture and leads to our understanding of primes in general. It will allow equations to be created which predict many new properties of prime numbers to infinity.

Notice the following (these properties will carry through to all future generated tables and will be very useful). The numbers 1 & 29, 7 & 23, 11 & 19, 17 & 13 are symmetrical around the ½ point of row 1 which is = 15 (Spp_3 = 30 the top right corner box … the ½ point in row 1 is 15). The ½ points will become "critical" in our construction of solutions of unsolved problems dealing with prime numbers (this is a play on words that some may catch and the future topic of another chapter). The products of 7 listed above are symmetrical around the ½ point of Spp_4 which is 105. This is understandable since all we did was multiply the first row by p_4 =7 (this symmetry was carried over from the prior table). Thus the symmetry we find in row 1 that was carried over from the prior table is now reflected in the products of 7 removed from the table, therefore all the remaining "relative primes" (some true primes and some "false" primes but none the less all relatively prime to Spp_n) will be symmetrical around the ½ point also. Since all the relative primes will be transposed to form row 1 of the next table, the symmetry will be carried over. Symmetry is an essential property of the prime numbers when working with the tables. Notice also that if you add these number pairs they all add to be the prior table value Spp_3 = 30 which is the top row carried over from the prior table.

Regarding the issue of "random" and "pseudorandom" primes, the interesting point is that the products of 7 listed above will (as already noted) "eliminate" one and only one element from each of the red columns and remember that these eliminated elements (cells) will be symmetrical around the ½ point = 105 in the Spp_4= 210 table. The process is not "random" nor is it "pseudo-random". The remaining elements after removing the products of 7 have perfect symmetry and if one subtracts the values left in the table from Spp_4 = 210 you will find the same numbers ascending as descending. Another way of saying this is that every remaining relative prime number p_i in the table has a corresponding "partner" p_j for which $p_i + p_j = Spp_4 = 210$. What you are seeing here is the beginning of a tool that will be valuable in working on the Goldbach Conjecture which asserts that every even number is the sum of at least 2 prime numbers. Another very interesting aspect is that there is never any symmetry across the vertical central line of the table (except for the center row). This will have important ramifications in the "Law of Conservation of Gaps" proof since if one cell is eliminated on one side of the table it will not be eliminated on the other, and since the columns are symmetrical, it is guaranteed that at least one of the cell patterns will not be affected by cell elimination by products of p_n.

Another important observation is that the prime "gaps" or spaces between prime numbers found in the tables are generated in the same manner as the prime numbers themselves. Look on the top row 1 of table Spp_4= 210 and observe the gaps between successive parent prime numbers. Find all the gaps of size "2" where the difference between successive row 1 numbers is 2. These are (11,13), (17,19) …(we will deal with the gap (29,31) shortly as part of table Spp_4). Notice that they are also symmetrical around the center point 15. Now observe all of the twin prime pairs that were "generated" below each pair in the red columns. There are more pairs generated in the Spp_4 table than in the prior Spp_3 table. The power of generating tables based on the faster than exponentially growing values of Nature's Number System will now give the tools necessary to understand and move towards a mathematical proof by induction for the Twin Prime Conjecture as noted earlier. There will be more twin prime pairs in each subsequent table. This is contrary to the traditional belief that there are fewer and fewer primes and therefore twin primes as you go to higher and higher numbers. The opposite is true using the Nature's Number System. This carries also for gaps of any size.

Take any other "false prime" left in the table of n = 4 where Spp_4 = 210 (after removing the multiples of 7 as noted above) and you will find that all will generate prime numbers in the following table Spp_5 = 2310. After eliminating the multiples of 7, discover all the "gaps" between the remaining relative prime numbers. These will all carry to the next table Spp_5 as the row 1 members to create new columns of potential prime numbers.

One of the amazing properties of "gaps" when viewed from the table construction is that there is a "Conservation of Gaps" which is a theorem proven in this book. Once a gap of any given size is formed it will be propagated and conserved to infinity and will additionally generate an infinite number of decedent gaps of equal size. You will not understand the full implications of this at first but it is very important to comprehend that it is the relative primes (both real and false) which will carry to the next table. Unusual "rogue gaps" or "rogue primes" do not carry to the next table and are generally lost in the progression to the next table. This has implications in proofs dealing with the question of infinite numbers of gaps of a given measure.

An early large "rogue" gap in the prime number table is the seemingly out of place very much larger than average gap = 34 between prime numbers 1327 and 1361. If prime numbers and gaps generate future primes and gaps, does this rogue gap then propagate into future tables? The clear answer is NO. Because of the method of future table construction, using all relative and true primes, all of the cells that were eliminated in the creation of this rogue gap ARE RELATIVE PRIMES and thusly carry forward to the next table. Explaining further, look at the table Spp_5 = 2310 where this large gap occurs. The products of row 1 that create this gap are all due to RELATIVE PRIMES found in row 1 of this table. The rogue gap DOES NOT carry to the next table. This is important in understanding the Goldbach Conjecture, the Maximal Gaps structure and the Twin Prime Conjecture all of which depend on the orderly structure of building the tables to infinity. This is just one of dozens of subtle aspects of building tables.

Complete the process of discovering all the true prime numbers in the table n = 4 by eliminating all multiples of 11 and 13 (multiplied by members of the top row red boxes). You stop at 13 because it is the largest prime number less than the square root of 210 ($\sqrt{210}$ =14.49). Observe the gaps between all the real prime numbers. As the tables are developed, the values of many parameters are recorded and eventually you will discover that generalized formulae can be derived to give the value of a given parameter in one table based on the parameter value in the prior table. This is the essential benefit of the tables in generalizing proofs by induction, for example as already noted, the number of twin prime pairs grows greatly with each new larger table.

Another minor point here raises the question "what if we run out of new prime numbers to generate new tables?". The answer is found in the next and subsequent tables Spp_5 Spp_6 etc and is again a result of the Generator Function in general which guarantees that we will find more primes in every iteration than the prior table. We will always have more than sufficient primes to continue the generation of the next table and on to infinity. The process is self generating. The tables may seem simple at this point and possibly hardly worth the effort. Believe me when I say that even trained seasoned mathematicians will eventually be struggling to comprehend the complexities that emerge from these seemingly primitive simple tables.

One last minor but very important point. Note that the second column always has 1 as parent (upper cell value). The second to last column always has (Spp_{n-1} – 1) from the prior table as parent (upper cell value that carries over from the prior table). Look at the values of the cells in these two columns. These columns always will create potential twin prime pairs as they always differ by 2 (e.g. (29,31), (59,61), (89,91) etc). It is true that this will always be the case for any table Spp_n . The logical argument is as follows. In any Spp_n Table there is the possibility that Spp_n - 1 could be prime but it may not be prime (it in fact is one of the richest areas to find prime numbers) per the Generator Function boundary conditions rules. Spp_n - 1 can either be a true prime or a relative non-prime … but note !!! if a non-prime it will always be a relative prime with respect to the Spp_n table and therefore carry to form row 1 of the next table. The logic follows. Since the only numbers that ***cannot*** carry to form row 1 of the next table are multiples of p_n , and since p_n is a factor or Spp_n , then Spp_n - 1 cannot have p_n as a factor and therefore Spp_n - 1 will always carry to form row 1 of the next table. **At any rate, this assures that the number Spp_n - 1 will always carry over to create row 1 of the next table even if it is not prime.** This assures that every Spp_n table will have these columns and they will always produce real twin prime pairs. There are multiple ways of proving the Twin Prime Conjecture using these tables. Be clear that all real and relative prime numbers which are parents (top cells in columns of a given table) will produce real prime numbers in their columns.

The factors of Spp_n – 1 (if it is not prime) can be discovered by multiplication of members of row 1 of the table, but what about Spp_n + 1 ? This is resolved by the same method because the magic number plus 1 cannot have any factors that are not contained in the Spp_n table. This is important in identifying whether Spp_n ± 1 is a twin prime pair or not as it belongs to both the present table and the next table also. But as noted, no matter whether Spp_n ± 1 are both prime, one is prime but the other is not or both are not prime is irrelevant to carrying both to the next table. They are both relatively prime to Spp_n and therefore both will always be carried into the next table to generate more twin primes. Thus columns 1 and the top right cell of the next table will ALWAYS continue to generate primes and many will be twin primes. The level of complexity of the tables is just beginning. They become very complicated when the structure of one table is seen working into many future tables (its patterns will be present in all future tables to infinity). The prime numbers have an infinite number of patterns working in harmony and you are just beginning to see the smallest part of these patterns and their implications.

There is a fundamental property from the Generator Function that states that a magic number Spp_n generates prime numbers in its respective table but any multiple of Spp_n also will have the same properties since the list of numbers that are relatively prime to Spp_n will also be relatively prime to multiples of Spp_n. This is the reason why all prime numbers greater than 5 can be written in the following form (an often quoted "fun fact" about prime numbers) n6 ± 1 (where n = 1,2,3,4 … ∞). The work in this text resulting from the new definition of prime numbers using the Generator Function will alter this to a different more complete form. It actually should read m6 + (1,5) ; m = 1,2,3,… ∞. That is, you add any multiple of 6 to 1 and 5 alternating. This gives the same result and comes from table n = 2 with Spp_n = 6. We will show that there is an infinite number of similar equations … the second being as follows m 30 + (1,7,11,13,17,19,23,29) for table n = 3 for Spp_n = 30. This equation gives fewer results **for all primes greater than 30**. In general the following holds true for all Spp_n tables of which there is an infinite number. Note these values are symmetrical around the ½ point 15 and add to equal 30 (e.g. (1,29), (7,23), (11,19) and (13,17)).

We first define the term (first used in the Calculate Primes book) called a "comb". Like a comb that you use to comb your hair, the prime number prediction comb has teeth that match the prime number patterns shown in the table Spp_n as defined by the boundary conditions of the Generator Function. A "$comb_{n-1}$" defined for table Spp_n is the first row of table Spp_n . The comb is defined for the previous table (n-1) since row 1 of table Spp_n is built from connecting all the rows of the prior table (n-1) in sequential order (less the multiples of the prime number related to the prior table p_{n-1}).

$comb_{n-1}$ = (1, p_n , p_{n+1} , … , Spp_{n-1} – p_{n+1} , Spp_{n-1} – p_n ,Spp_{n-1} – 1) or all the elements of row 1 of table n (note the symmetry). This is the wave pattern to infinity **starting at Spp_{n-1}.**

This is the set of ***relative*** prime numbers of row 1 of table Spp_n (before removing multiples of p_n) carried from combining in sequence all rows of table Spp_{n-1} … these are used to create the repeating wave of potential prime values to infinity with Spp_{n-1} as the wavelength. In general m Spp_{n-1} ± $comb_{n-1}$; (m = 1, 2, 3, …, ∞) = pattern for all ***future*** primes (the patterns are symmetrical around the mid point of row 1 of table Spp_n = ½ Spp_{n-1} and the repeating wave extends to positive and negative infinity).
Three examples of combs are given below. Note the complex subscript notation that is consistent with the definition given above. One of the skills of using the Generator Function and all of its implications is the correct use of subscripts. It has been years of using this notation that has brought me to the point of publishing this work. Note that the counting subscript "n" is always viewed from the table that you are working with. Future and prior tables are noted with subscripts "n + 1", "n + 2", "n + 3" … and "n – 1", "n – 2", "n – 3" … respectively. In viewing the three example "combs" below, imagine taking row 1 (including all prime and relatively prime numbers) from the table you are viewing. All the numbers in the top row then constitute the comb values. There are some other details that will be clarified in the future but this is a lot of information for this point in the book.

1. m6 + $comb_2$ (n-1 = 2 for Spp_{n-1} = 6) where $comb_2$ = (1,5) ; (m = 1, 2, 3, …, ∞) … row 1 of table Spp_3 =30 is symmetrical around the ½ point of row 1 of table n = 3 which is 3.
2. m30 + $comb_3$ (n-1 = 3 for Spp_{n-1} = 30) where $comb_3$ = (1,7,11,13,17,19,23,29) ; (m = 1, 2, 3, …, ∞) … row 1 of table Spp_4 =210 is symmetrical around the ½ point of row 1 of table n = 4 which is 15.
3. m210 + $comb_4$ (n-1 = 4 for Spp_{n-1} = 210) where $comb_4$ = (1,11,13,17,… ,209) ; (m = 1, 2, 3, …, ∞) …row 1 of table Spp_5 =2310 is symmetrical around the ½ point of row 1 of table n = 5 which is 105 (as an exercise complete $comb_4$ **remembering to include all relative prime numbers** from row 1).

Each table n has a $comb_{n-1}$ found in row 1 which predicts fewer potential primes than the prior $comb_{n-2}$ of the previous table. This is essential in creating the McCanney Prime Density Function. Note that the traditional way mathematicians state the n = 2 equation is m6 ± 1 which one can show easily is the same as m6 ± (1, 5) where m = 1,2,3…. This is where modern mathematical attempts at organizing or predicting the prime numbers with analytic equations ends. The current work shows that there are an infinite number of such equations (one for each table Spp_n). There are similarly an infinite number of equations for prediction of twin primes. The first example from table n = 3 is as follows: (5 + (m – 1)6, 1 + m6); (m = 1,2,3..., ∞). All twin primes meet these criteria. This first equation soon breaks down creating false solutions, but future equations are more accurate.

Every table Spp_n will have many such equations to predict twin primes (more than one for each table) that will refine the predictions of prior table equations to identify all future twin primes to infinity. One result of these equations is that there will be more primes, more twin primes, more primes of all gap sizes in every subsequent table. The proof of this is essential to understanding the growth of prime structures in future tables. Similar equations will be presented in a future Volume of this series showing how to predict patterns of primes or gaps or gap patterns of any size or dimension (this is an advanced topic).

The Spp_2 = 6 table is a parent of all future prime numbers when using the Generator Function. All prime numbers will have this form because 6 is a magic number and the Generator Function states that all future primes will be descendants of this number. Likewise, the so called "Mersenne Primes" of the form 2^n – 1 are an extension of the Spp_1 = 2 magic number (the first significant sequential prime product) and again the Generator Function predicts that all future prime numbers will be of the form 2n ± 1 which any mathematician can convert into the official "Mersenne" form (we also include +1 as an alternative form). The problem with these very primitive forms of "prediction of primes" formulae will become evident when the Generator Function begins generating very large much more complicated equations based on very long Spp_n "wavelengths". These will equally be predicting prime numbers but with much greater accuracy and with many fewer "false" primes. This is the basis for easily breaking the RSA codes as described in the second book of this series "Breaking RSA Codes for Fun and Profit". One goal in a later chapter will be to take the many different "prime types" and examine them in light of the Generator Function as was just done with some basic traditional prime "prediction" equations. It will be shown also that some of the types of primes do not have a basis and can be shown to be simply novelties that find a few early primes or prime patterns but which will fail (with the reasons given for such failures). These are advanced topics.

Begin to notice some of the other features of the tables as they grow. The basic discussion of constructing tables will end here and continue in later chapters that deal with proofs on theorems such as the "Law of Conservation of Gaps", "The Twin Prime Conjecture", the "Goldbach Conjecture", a topic "In Search of the Rogue Prime" dealing with Maximal Prime Gaps, the proof that "The Density of Primes is Monotonically Decreasing" relative to the Generator Function wave lengths giving an upper bound on prime numbers which can be used with traditional density equations and will make some related observations regarding the Riemann Hypothesis.

Before leaving, see the next diagram showing an example of the table n = 4 modified with more information to give you an inkling of what is to come. The red arcs above the table indicate twin prime pairs with all the twin prime pairs below the "parent" pairs. See how the 1 and 29 columns generate twin prime pairs along with their "children" below them. This occurs in all tables because the value of Spp_{n-1} – 1 (in this case 29) will always be relatively prime to Spp_{n-1} and will ALWAYS carry to the next table to generate more twin primes. NOTE that we will create a much simpler table by eliminating all the gray columns. The large tables become more complicated for many reasons not the least of which is keeping track of all the gaps, the symmetries, the many parameters, etc (Figure 3).

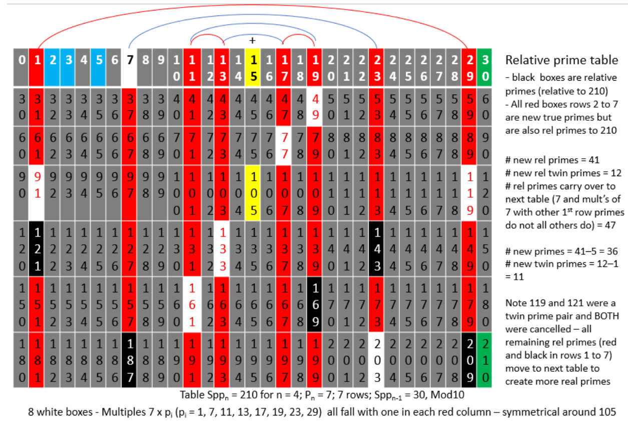

Figure 3) *Represent twin primes.*

The red arcs above the table represent twin primes in the top row cells and their respective children in the columns below that were calculated from the top cells. The blue arcs represent symmetry of gaps = 4 and other gaps are not marked. Note that the symmetry spans the top row with 15 being the center point (this was the table center point of the prior table n = 3) and this symmetry carries into this table. Since only the white cells of the table do not carry to create the next table (all other cells from the red columns DO carry to the next table), and since these white cells are symmetrical around the table ½ point, the symmetry of both primes and gaps is preserved from table to table around the ½ point. This fact allows a necessary concept in solving the Goldbach Conjecture.

The tables are reciprocal in that one table generates the next table, but that table in turn can generate or illustrate the properties of the prior table. The structure of gaps and their symmetry around the ½ point is also preserved from one table to the next. In other words, not only are the tables directly calculating prime numbers and maintaining their symmetries from one table to the next, but they are preserving the gap structure also. For example, every relative prime twin prime gap in the above table carries to the next table and these and all of their children twin prime pair gaps will also carry to all future tables with all of the symmetries around the ½ point.

We will show in more advanced chapters that this table in fact forms a Group using the traditional mathematical definition with the sums of primes wrapping back into the table and with (1,29) forming a twin prime within the Group. These Groups have very important properties from a pure mathematical perspective and should open many new avenues of inquiry. None of this would be expected in the traditional view of prime numbers. The study of these tables becomes far more complex. This is a simple beginning.

One last point is regarding the region between red columns 1 and p_{n-1} = 7 in row 1 and Spp_{n-1} - 1 = 30 – 1 = 29 and Spp_{n-1} – 7 = 30 – 7 = 23 also in row 1 (e.g the gap regions (1,7) and (23,29) which are grey or non-prime columns). These are defined as "Dead Zones of table n" = DZ_n and are symmetrically located around the ½ point of row 1 = 15.

Real primes 2, 3 and 5 are noted in blue. All cells below them will never be primes or even relative primes since these are all factors of the sequential prime products of this table and all future tables. None of the numbers in the right hand Dead Zone are prime nor relative primes including the top row cells. In prior tables 2, 3 and 5 have generated primes that will continue to generate primes, relative primes, twin primes and all other structures to infinity. Once a prime number p_n enters the n + 1 table it will forever be left in the Dead Zone from that point onward. This is just one of the dozens of aspects of tables that will be discussed in future chapters and is critical in understanding prime gap structures. **These gaps will carry into future tables to infinity.** As each new table is formed stringing together the rows of the prior table, all of this structure carries forward from every prior table and very importantly, with the symmetries carried with them around their respective ½ points. There is structure in every table with substructures of every prior table going back to the alpha table. This structure created by waves of combs adding together is what gives the prime numbers and the related gaps their structure. It is very recognizable once you see it in what used to be a seemingly random set of numbers we call the primes.

Additionally, note that since the white cells fall with one and only one in each column (these will not carry to create the next table), the patterns that these create in the rows carries forward to the next table (as you string together the rows of one table to form row 1 of the next table). This sub-structure gives the primes their overall structure which only appears to be random. Every row has a slightly different pattern (each differs by just one cell) although the underlying structure is exactly the same. This gives the "wave" patterns a unique fine structure that varies on a small scale. This structure can be uniquely expressed in the form of an equation for each table n. Each table will have a unique equation that expresses this "comb" or pattern which when added to any multiple of Spp_n will predict all prime numbers to infinity. All prime numbers will be of this form and all other numbers will be non-prime. Each successive table's equation will modify the prior table's equation and will create a "comb" which will eliminate more non-primes. This leads to the concepts necessary to create a "Prime Density Function" and also determine that there are not only an infinite number of twin primes, but also shows **that every twin prime will generate an infinite number of twin primes**. All of these twin primes will have ancestry back to the originating twin prime and ultimately to the alpha prime 0.

This is not a sieve nor any other form of random search for prime numbers. This results from directly calculating prime numbers using only prime numbers within tables which are using red columns only (no non-prime numbers are used). The predictions of primes using the analytical equations is to infinity with the repetitive wavelength equal to the value of Spp_n . One never considers the non-red columns, which would be the case of a Sieve or other traditional method of determining prime numbers (e.g. all numbers not found in the multiplication table or random searches using computers testing Mersenne primes of the form $2^n - 1$ with near infinite amounts of super computing time). As the Spp_n tables get larger, the near range prediction of prime numbers becomes very accurate using the predictive equations that are naturally derived from the "combs" which are added in wavelengths of Spp_n to the value of Spp_n . This is the direct calculation of prime numbers using the Generator Function with the boundary conditions and selection rules.

As an example shown later in this book, the largest RSA Factoring Challenge numbers are easily contained in Spp_n tables with predictive equations that can target the factors without the need for even an average home computer although that is not the goal of this work. What previously seemed to be large numbers are now well within the reach of simple calculations using analytic equations (without the use of computers at all). The next chapters detail the new modNt number system which will make the entire process much more natural along with the identification of prime numbers. Large numbers will no longer be just unrecognizable strings of digits. Each digit will have significance relative to the ancestry of the numbers for both relative prime numbers (including true primes and non-primes which are relatively prime to Spp_n) as well as non-prime numbers. Then in the subsequent chapter there is a simple conversion presented to convert back and forth between the modNt number system and modulo 10 (mod10) or any other modulo number system.

CHAPTER 3
NOTES ON MODNT NUMBER SYSTEM

The following gives further details on the new "Nature's Number System" or "modNt" number system. It has many advantages over any other number system especially when dealing with prime numbers and the basic understanding of numbers in general. The following is a table presented in the text for review showing the conversion of modNt to mod10 (modNt numbers are on the left of the matching number pairs with mod10 on the right of each column of numbers). You will recognize a typical counting model but using the values of Spp_n as "powers" to higher order digits rather than powers of 10 as in the mod10 number system. Look at the lower order digit patterns of the modNt numbers. After the table are more details of the modNt number system including how to convert between the two systems. Most important below is to see the modNt values for the magic numbers 1, 2, 6, 30, etc. (values in modNt are as follows 1, 10, 100, 1000, etc.) and their multiples (e.g. 6 x 2 = 12 mod10 = 200 modNt; 30 x 2 = 60 mod10 = 2000 modNt). Even seasoned mathematicians will take some time to understand all the subtleties of this new number system. A word of warning ... the first appearance is that the modNt numbers are larger and more complicated, however because the factors between successive digits of modNt grow as 1, 2, 6, 30, 210, 2310, etc., whereas the mod10 numbers grow as 10, 10, 10, 10, etc., the modNt numbers soon use far fewer digits to represent a given number than mod10 (Figure 4).

000	000		200	012		400	024		1100	036		1300	048		2000	060
001	001		201	013		401	025		1101	037		1301	049		2001	061
010	002		210	014		410	026		1110	038		1310	050		2010	062
011	003		211	015		411	027		1111	039		1311	051		2011	063
020	004		220	016		420	028		1120	040		1320	052		2020	064
021	005		221	017		421	029		1121	041		1321	053		2021	065
100	006		300	018		1000	030		1200	042		1400	054		2100	066
101	007		301	019		1001	031		1201	043		1401	055		2101	067
110	008		310	020		1010	032		1210	044		1410	056		2110	068
111	009		311	021		1011	033		1211	045		1411	057		2111	069
120	010		320	022		1020	034		1220	046		1420	058		2120	070
121	011		321	023		1021	035		1221	047		1421	059		2121	071
200	012		400	024		1100	036		1300	048		2000	060		2200	072

Figure 4) *Nature number system modNt vs mod10 number system to 72.*

Below is a table which defines the modNt number system with relation to the magic numbers and associated values of n, p_n, Spp_n, the maximum digit value for each "power" and the patterns of each digit. It defines the modNt number system up to $Spp_7 - 1 = 510510 - 1$. Each pattern of digits in each column repeats as shown then repeats again and again as with any counting process. Note that the first two rows are subtle so understand that row 1 is the number of the digit (starting from right to left) however "n" represents the "nth" sequential prime product which is listed in row 2 (Table 1 - next page).

Digit in column	7	6	5	4	3	2	1
n mod10	6	5	4	3	2	1	0
n modNt	N/A	N/A	N/A	N/A	N/A	N/A	N/A
$p_n$mod10	13	11	7	5	3	2	1
$P_n$modNt	201	121	101	21	11	10	1
Spp_n mod10	30030	2310	210	30	6	2	1
Spp_n modNt $= 10^n$	1,000,000 $= 10^6$	100,000 $= 10^5$	10,000 $= 10^4$	1000 $= 10^3$	100 $= 10^2$	10 $= 10^1$	1 $= 10^0$
Max digit Value in mod10 $= p_{n+1} -1$	16	12	10	6	4	2	1
Pattern each digit repeats the given pattern over and over (values given in mod10)	0 x 30030 1 x 30030 2 x 30030 3 x 30030 4 x 30030 5 x 30030 6 x 30030 7 x 30030 8 x 30030 9 x 30030 10x30030 11x30030 12x30030 13x30030 14x30030 15x30030 16x30030	0 x 2310 1 x 2310 2 x 2310 3 x 2310 4 x 2310 5 x 2310 6 x 2310 7 x 2310 8 x 2310 9 x 2310 10x2310 11x2310 12x2310	0 x 210 1 x 210 2 x 210 3 x 210 4 x 210 5 x 210 6 x 210 7 x 210 8 x 210 9 x 210 10 x 210	0 x 30 1 x 30 2 x 30 3 x 30 4 x 30 5 x 30 6 x 30	0 x 6 1 x 6 2 x 6 3 x 6 4 x 6	00=0x2 11=1x2 22=2x2	0=0x1 1=1x1
Max number in pattern mod10	510509	30029	2309	209	29	5	1
Max number pattern modNt	16.12.10.6.4.2.1	12.10.6.4.2.1	10.6.4.2.1	6.4.2.1	4.2.1	2.1	1

Table 1 – Definition modNt Number system to 510510 - 1

Note that decimal mod10 numbers (16, 12, 10, 6, etc.) are used to designate digits rather than create individual symbols to represent each digit. This is commonly done in mathematical number systems such as hex numbers or especially where the base number is greater than 10. We could have created other symbols or used the various alphabets or Greek alphabet but even they would eventually run out of symbols so it is easier to use the familiar base 10 system with dots to separate the digits. Eventually we will not use numbers at all but will use tables with indicators in key locations so this problem goes away as the tables get larger. This book does not delve into rational, real or complex numbers using the modNt number system. That is an advanced topic for another book. The negative and complex prime numbers follow the same patterns as the positive prime numbers and interestingly enough the wave patterns that start at any positive magic number (or integral multiple thereof) flow into the negative prime numbers making an even more complex but elegant set of closed number systems.

Notice the last row at the bottom of the table above. The max number up to that column if you add "1" you get the next higher magic number value = Spp_{n+1} . For example, if you add 1 to 30029 in mod10

In mod10 $1 + 30029 = 30030 = Spp_6$

in modNt $1 + 12.10.6.4.2.1 = 1{,}000{,}000 = Spp_6 = 10^6$

There are 6 digits in the number 12.10.6.4.2.1 (12, 10, 6, 4, 2 and 1) and each digit is the max value in its column so by adding "1" you carry to the next column just as with any other form of addition.

There are many subtle relationships in the table above. The modNt counting number "n" is one less than the column number of the digit. The tables of Spp_n start with n = 0 with the value of the prime number $p_0 = 1$. There is a great consistency between the values defined for the tables and the related parameters. This is why I have chosen to call them "Nature's Numbers" because any alien race on the far side of the universe would discover them also and even though they may define strange symbols the end result would be the same. The tables can be built without any number system at all but any other number system is clumsy and awkward in the tables. The Natures Number System flows in the tables and as you go across the rows only the lower order digits increment, whereas as you go down a column all the lower order digits are the same and only the single highest order digit increments. If the number value in the top cell of a column is not relatively prime to the value of Spp_{n-1} , then all the numbers in that column will have the same factor in common and will not be prime. That is why we can eliminate all the non-red columns and only deal with the "red" or relative prime columns, making life much easier. This is because all numbers are organized not in groups based on products of prime numbers (as in a Sieve) but are based on addition and subtraction based on the number system which is based on sequential prime products Spp_n (the modNt number representation itself and its location in the table tells if the number is prime or not).

Remember that the number Spp_{n-1} has factors made up of all the prime numbers up to and including p_{n-1} . If the top number of a column of a table has a factor included in that list of primes, then it is not relatively prime; remember that the cells of any column are obtained by adding multiples of Spp_{n-1} (the magic number of the PRIOR table) to the number in the top cell of that column in table Spp_n . This is how the tables exhibit factorization, a process that is laborious at best with decimal numbers. Factorization is an inherent part of the new number system and that is why large numbers represented in the Nature's Number System and shown in a Spp_n Table have meaning. But this is also how the tables separate out the prime numbers since they occur only in the columns whose top cell value is relatively prime to Spp_{n-1} . By this method we isolate all the prime numbers and then work with them in groups within each table. These groups have advanced mathematical properties many of which are not obvious at first sight.

There is a cross over point when comparing modNt *vs* mod10 numbers in which mod10 numbers have fewer digits up to a point but after that the modNt numbers have fewer digits and represent numbers more efficiently. Not only are there fewer digits, but the digits have meaning and large numbers can be read to give information about the number relative to the prime numbers (not only for prime numbers but for all numbers). Look at the above table and then attempt to construct some numbers using modNt. The conversion between modNt and mod10 is relatively easy (shown in the next chapter) and is useful for example if you have a large decimal mod10 number one can convert it easily to modNt to see if it is a relative prime or not and begin to determine factors.

Also notice the importance of "1" being a prime number in the system as it represents the first column in the new number system (there would be a gaping hole there and we would soon have to invent it if it had not already been there). As discussed in the appendix of the prior book "Calculate Primes", 1 fits all of the criteria to be a prime number being divisible by only itself and 1 (reference the last page for details). One additional point here is very subtle and important.

The number of mod10 digits required to represent a given number is fewer (than modNt numbers) until a "crossover point". This is not the only measure of efficiency of representing numbers. The successive Spp_n values 1, 2, 6 which are the steps between successive digits in modNt (being less than 10) give less than 10 times the prior "digit" in the counting system, however the next step with $Spp_3 = 30$ jumps far beyond 10. It takes a bit of counting before modNt catches up and overtakes mod10 in efficiency of representing numbers (the number of digits used to represent a given number) but when dealing with numbers of extreme size this makes all the difference in the world, not to mention all the benefits rendered to small numbers in the form of organization.

For comparison the modNt table for 210 is given below. Compare the patterns of the mod10 table above with the table below to see the much more organized system of numbers using modNt. Look at the progression of the last digits (lower order digits) as you go vertically down each column and then note the patterns of first digits (higher order digits) as you go horizontally across each row. Do you see the benefits of the modNt over the mod10 representations for the numbers in table Spp_4 = 210? This is why when creating very large tables, unlike mod10 numbers where you would have to write in each number, you only have to write in the higher order digits of the left cells of horizontal rows and only write the lower order digits in the top cells of the red columns and other key numbers to reference changes in the number patterns. With this small amount of information one can create any size tablet and if interested in the value of any cell, quickly determine the value using the rows and columns associated with that particular cell. But more than this we are now able to start to understand the patterns of the prime numbers in the tables without actually writing down numbers.

See below the completed n = 4 with Spp_n = 210 table using modNt numbers. It is followed by two more tables showing the n = 4 table with all non-red columns removed using both the mod10 and modNt (called red column only tables) (Figure 5).

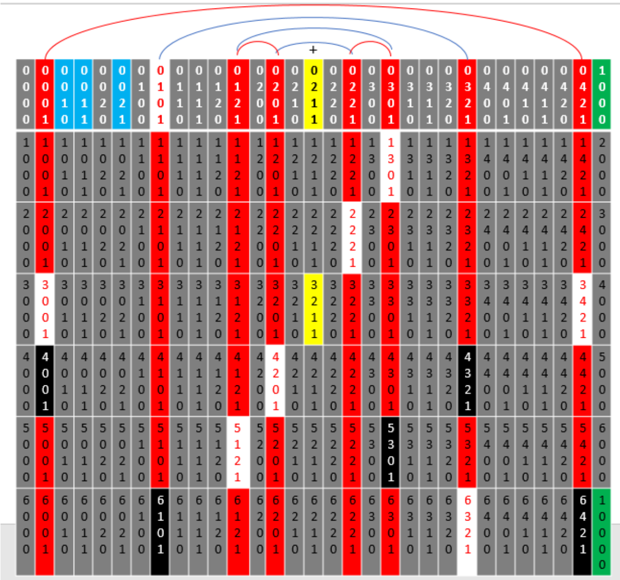

Figure 5) *n = 4; p_n = 7; Spp_n = 210; modNt number system.*

Note that this table follows the exact same structure as the mod10 table shown earlier. Notice again the symmetry around the ½ points of row 1 (0211 modNt = 15 mod10) and of the table (1/2 point of the table is 3211 modNt = 105 mod10). Note the Dead Zones = DZ_n in which the only prime numbers are in row 1 (0010, 0011, 0021 modNt = 2, 3, 5 mod10). These are already discovered primes from the Generator Function and have been "retired" since they are all factors of 30 and 210 and will be factors of all future values of Spp_n to infinity. They will never generate future prime numbers in the elements below them, however, the prime and relative prime numbers that they have generated will continue to generate more prime numbers until they are either discovered to be "false primes" by the natural process of elimination using the boundary conditions of the Generator Function OR they are discovered to be true primes and eventually retired. The right and left Dead Zones DZ_n maintain the symmetry of the tables. Eventually all primes or relative primes will be tested as they will sooner or later become less than the selection rule for discovering primes .... $p_{n-1}^2 < p_i < p_n^2$. The region $p_{n-1}^2 < p_i < p_n^2$ is defined as the "Safe Zone" = SZ_n in table Spp_n because it is the region in which only true primes will be found (the Generator Function selection rule). Although all discovered numbers less than p_n^2 are true primes, we have already discovered all true primes in the prior table up to p_{n-1}^2 so the criteria is to only discover new primes.

Below find the red only column table for n = 4 mod10. The next photo uses modNt. Tables become far more complex with dozens of parameters that are used to measure their growth and properties of prime numbers, twin primes, gaps and related patterns (Figure 6).

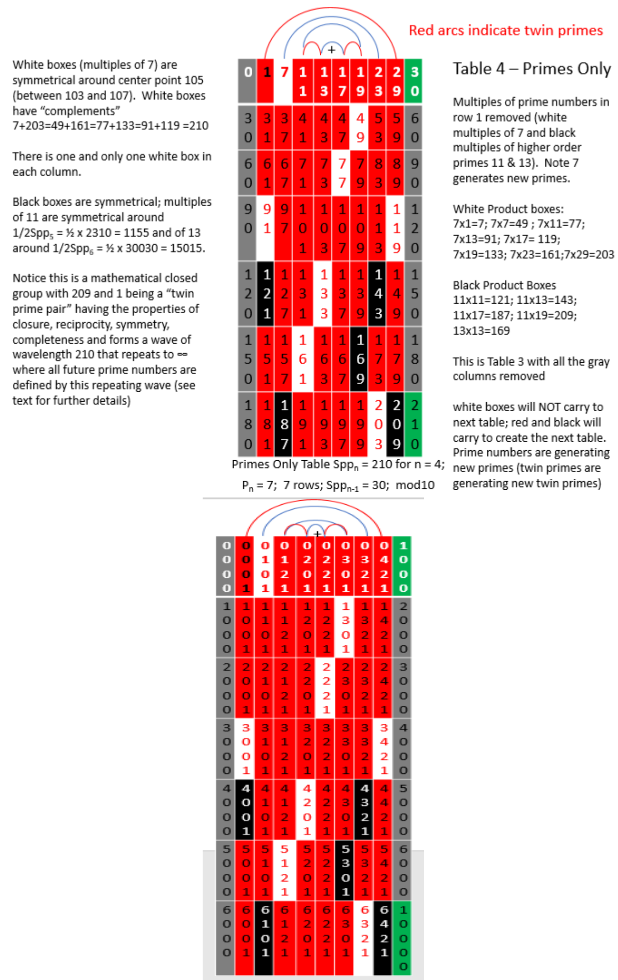

Figure 6) *n = 4; p_n = 7; Spp_n = 210; modNt number system; red columns only.*

CHAPTER 4
CONVERTING BETWEEN Mod10 AND modNt NUMBER SYSTEMS

It is relatively easy to convert between the two number systems and is necessary for many operations and understanding of numbers (especially large numbers). A note is to be conscious of the subscripts as we will be talking about tables using "n", "n + 1", "n + 2", "n – 1", etc.

Conversion from mod10 to modNt

Given a mod10 number N = abcde... xyz where the letters represent decimal digits ... we are going to use both a mathematical as well as visual approach to finding the properties of N

1. Determine the largest magic number Spp_n less than the

given number (this corresponds to the highest value of row 1 of table Spp_n+1 in which the number N lies)

2. Divide N by the magic number Spp_n and determine the result A_1 plus a remainder R_1
3. A_1 is the value of the highest order modNt digit (the multiple of Spp_n) added to the value in the top cell of the table. The remainder R_1 is the top number in the column where the number would lie in the table Spp_{n+1} (R_1 is the value in row 1 of table Spp_{n+1} ; if this is a grey column the number cannot be prime)
4. Next divide R_1 by Spp_{n-1} resulting in A_2 with remainder R_2.
5. A_2 is the second highest order digit modNt.
6. Continue this process until the entire modNt number is calculated = $A_1A_2A_3 \dots A_{n+1}$
7. If there is a "0" it must be placed to hold the digit as with any long division.

Example: N = 737,269,373 mod10 (see section below from table 2)

Table 2
Spp_{10} = 6,469,693,230 mod10 showing just rows 1, 2, 3, 4 and 5 with the local rows and columns

67,990,761	67,990,762	67,990,763	67,990,764	67,990,765
291,083,631	291,083,632	291,083,633	291,083,634	291,083,635
514,176,501	514,176,502	514,176,503	514,176,504	514,176,505
737,269,371	737,269,372	**737,269,373**	737,269,374	737,269,375
960,362,241	960,362,242	960,362,243	960,362,244	960,362,245

The difference between numbers in rows is 1.
The difference between numbers in the columns is Spp_9 = 223,092,870 mod10.

1. Select Spp_9 = 223,092,870 the first magic number less than N.
2. 737,269,373 ÷ 223,092,870 = 3 + R_1 = 67,990,763
3. N lies in table Spp_{n+1} = Spp_{10} = 6,469,693,230 in the column with top number = 67,990,763. N lies in row 4 because you have added 3 times the value of Spp_n to the value in the top cell of the column 67,990,763 and puts N in row 4 of table Spp_{n+1} = Spp_{10} . 737,269,373 = (3 x Spp_9) + 67,990,763
4. The highest order digit in column = A_1 = 3.
5. Divide 67,990,763 by Spp_{n-1} = Spp_8 = 9,699,690.
6. 67,990,764 ÷ 9,699,690 = 7 + R_2 = 92,933
7. The second highest order digit A_2 = 7 and this number lies in the table Spp_9 which is the next lower table. 67,990,763 resides in row 8 and in column with cell value = 92,933 in the top cell. Draw the section of the table that corresponds to this. Your table section will have the number 92,922 in the top cell and in the 8^{th} row down will contain the number 67,990,763. As in the sample table above draw a few columns to the right and left of this column.
8. Divide 92,933 by Spp_7 . But Spp_7 is 510,510 which is greater than 92,923 therefore the third digit modNt A_3 = 0. It appears in row 1 of table Spp_7 .
9. Divide 92,933 by Spp_6 = 30030
10. 92,933 ÷ 30030 = 3 + R_4 = 2,843 so 92,934 lies in table Spp_7 in row 4 in the column with 2,843 in the top cell. A_4 = 3.
11. Divide 2,843 by Spp_5 = 2310.
12. 2843 ÷ 2310 = 1 + R_5 = 533 so 2843 lies in row 2 of table Spp_6 = 30030 in column with 533 top cell. A_5 = 1
13. 533 ÷ 210 = 2 + R_6 = 113 so A_6 = 2
14. 113 ÷ 30 = 3 + R_7 = 23 A_7 = 3
15. 23 ÷ 6 = 3 + R_8 = 5 A_8 = 3
16. 5 ÷ 2 = 2 + R_9 = 1 A_9 = 2
17. 1 ÷ 1 = 1 + R_{10} = 0 A_{10} = 1
18. The modNt number is 3,703,123,321

Note that the modNt number still has more digits than the equivalent mod10 number but this changes as the "powers" of the modNt system are continually increasing whereas the powers of the mod10 system remain at 10 for every additional digit in the number. As one grows to larger and larger numbers the modNt numbers become much more efficient at representing large numbers. The value of having the tables is that all numbers that fall in non-red columns will not be prime. It is a simpler way of factorization than the brute force method and by simply locating a number in modNt in its column you can determine if it is or is not prime. The other value of the tables using modNt is that you do not have to fill in all the numbers in the entire table to locate and identify the ancestry of a number. The remainders R_1 through R_{n+1} give the ancestry of the number. These are the numbers that were used to generate the final number 737,269,373 in mod10 and 3,703,123,321 in modNt. They were the number values in the top cells of the columns where each ancestor was generated going back to 0 the "alpha prime". All numbers including prime numbers have ancestry to the alpha prime "0". We are dealing only with prime numbers in red column only tables. All other numbers (grey columns) were eliminated. We will only be working with the red columns which contain numbers that are relatively prime to that table.

Conversion from modNt to mod10

Converting the same number back to mod10 use the following method. You will see this is the reverse of the process above. Note there are n+1 values of A and n + 1 values of Spp_i starting with i = 0 through n.

A_1 x Spp_n + A_2 x Spp_{n-1} + A_3 + Spp_{n-1} + ... + A_{n+1} x Spp_0

So to convert the number 3,703,123,321 modNt to mod10 as follows (all "digits" given in mod10 representation)

3 x Spp_9 + 7 x Spp_8 + 0 x Spp_7 + 3 x Spp_6 + 1 x Spp_5 + 2 x Spp_4 + 3 x Spp_3 + 3 x Spp_2 + 2 x Spp_1 + 1 x Spp_0 = 3 x 223,092,879 + 7 x 9,699,690 + 0 x 510,510 + 3 x 30030 + 1 x 2310 + 2 x 210 + 3 x 30 + 3 x 6 + 2 x 2 + 1 x 1 = 737,269,373 mod10 the original number above.

Final exercise: draw the local table for the modNt numbers (the same table as above) and see how much easier the numbers are to identify and observe the changes from left to right in the rows and from top downwards in the columns. This at first might seem like a daunting task however if you understand the construction of the modNt numbers it should take only a few seconds. To the contrary in the mod10 table one has to use a calculator or a lot of manual labor with pen and paper to fill in each cell. Also notice the importance of 1 as a prime number and the value of its related Spp_n value. Also note that all prime numbers will end in a single digit "1" and eliminates the quandary of what is the final digit of the prime number. Using modulo N number systems will all turn out differently and is nothing more than a quirk of each number system. The modNt number system cures this problem in that all prime numbers end with the same digit.

Ancestry of twin prime pairs

The following examples show the ancestry of twin prime pairs. First begin with the twin prime pair (97841,97843) (numbers given in mod10). Using the method above of finding the ancestry (the values or R_i) to locate the unique path back to the alpha prime 0.

$97841 \div 30030 = 3 + R_1 = 7751$
$7751 \div 2310 = 3 + R_2 = 821$
$821 \div 210 = 3 + R_3 = 191$
$191 \div 30 = 6 + R_4 = 11$
$11 \div 6 = 1 + R_5 = 5$
$5 \div 2 = 2 + R_6 = 1$
$1 \div 1 = 1 + R_7 = 0$

Notice how this refers ultimately to the prime ancestor 1 and then to the alpha prime 0. The complete unique ancestry path is 7751, 821, 191, 11, 5, 1, and 0. The equivalent modNt number is 3,336,121 (derived from the factors resulting from the division by values of Spp_i). Looking at the second number of the pair 97843, its ancestry path is 7753, 823, 193, 13, 1. All of the corresponding numbers form true twin prime pairs (821,823), (191,193), (11,13) and (5,1) with the exception of (7751,7753) for which 7751 is ultimately found to be not prime (in a future table). So why is it included in the ancestry of this twin prime pair? Because in the table 30030 the number 7751 is relatively prime. The factors of 7751 = 23 x 337 are greater than the prime associated with that table's Spp_{n-1} value of 11 and thus is in the 4th row of a red relatively prime column and therefore carries to the next table to generate more prime numbers. In the red column tables the relative primes are as much a prime number as "real" prime numbers. They are needed to generate "real" primes until they are eliminated naturally by the boundary condition rules of the Generator Function. This realization, that relative primes are as "real" as real primes in their respective tables, is one piece of the 7 part rigorous proof of the Generator Function.

7751 is finally "eliminated" in the table Spp_9 = 223,092,870 with p_n = 23 with 7751 residing in row 1. Before 7751 is eliminated it was able to generate the following list of prime numbers: 37781, 97841 (the 1st of our twin prime pair) and many others in table 30030. It carried to the next 3 tables generating prime numbers and twin prime pairs with its pair 97843. As an exercise see now many other twin prime pairs you can find generated by the pair (97841,97843). You will find an infinite number of them if you continue long enough. This will lead to the formal proof that states that **"Every twin prime pair will generate an infinite number of subsequent twin prime pairs".** Note that all the twin prime pairs in this generation path have the exact same ancestry going back along the same path to 0 and 1 as (97841, 97843). All of the new twin prime pairs in turn will continue to generate twin prime pairs including those which have one or both of the members as relative primes in a given table. Only when 97843 becomes the prime number associated with its own table Spp_n will it cease to generate prime numbers as it will then fall into the DZ_n "Dead Zone" region. But the large number of twin primes that it has generated will continue on generating future twin primes all with ancestry back to (97841,97843) which have their ancestry back to the alpha prime 0 by their own unique paths. This illustrates another of the properties of the Generator Function that is equivalent to the Fundamental Theorem of Arithmetic in which every number has a unique set of prime factors. In the current case it is stated that **"Every prime number has a unique ancestry of prime numbers going back to 0 the "alpha prime"".** Of course included here are numbers that are relatively prime to the table in which they are found in this ancestral path since in that table they are as much a prime number as true prime numbers. There is a formal proof for this but this should be fairly obvious at this point. The same is true for every twin prime pair, and every prime pair of gap k_i and every series or pattern of gaps no matter how large and complex. This will allow us to prove many previously unproven aspects of prime numbers and will show the method of finding any defined gap patterns to infinity (something that previously could only be accomplished in limited scope with super computers).

I chose the twin prime pair (97841, 97843) for this example because it is part of a triple twin prime pair sequence. The other two successive twin prime pairs are (97847,97849) with a gap of 4 between these and the following member of the triplet (97859,97861) with a gap of 10 between the original pair. The ancestry sequence of these are as follows (non-primes are noted with an *):

(97841,97843), (7751*,7753), (821,823), (191,193), (11,13), (5,1)
(97847,97849), (7757,7759), (827,829), (197,199), (17,19), (5,1)
(97859,97861), (7769*,7771*), (839,841*), (209*,211), (29,1), (5,1)

The ancestries all converge at (5,1) but this is due to different remainders. For example, 11 ÷ 6 = 1 + R 5 … whereas 17 ÷ 6 = 2 + R 5 and lastly 29 ÷ 6 = 4 + R 5 so all ultimately converge to the same ancestor (5,1). This example shows that two relative primes (7769*,7771*) are able to generate true twin primes. These generate many other twin prime pairs in this table. Note in the 3rd row above (ancestry of (97859,97861)), that the twin prime pair (29,1) appears. In a given table the end prime number can wrap to column 1 to create a twin prime pair that in fact carries forward to generate future twin primes. This is from the second prime of pair (209*,211).

211 ÷ 210 = 1 + R1 where R1 = 1 so technically by the rules it results in the pair (29,1). We have to refer to higher abstract concepts of Abstract Algebra Group Theory for a complete explanation of this issue.

Part of the closure property of the tables is due to the same property as any mathematical "Group" in Abstract Algebra in which the elements wrap to maintain closure. Each table is considered a group under the single operator addition (+) and the reciprocal operator subtraction (-). There are many subtleties buried in the Nature's Number System, The Generator Function and the Spp_n Tables. We will only touch on the major properties here. An Appendix found in an associated file (too large to include in the body of this text) will list all the parameters and properties (Volumes II and III will continue this table of parameters).

Example Table Spp_5 in mod10 Number System (other chapters will show in modNt)

Study the following table. This table was shown earlier, but below we will expand on the table properties. For clarity, the "raw table" is presented below without application of the "selection rules". Then the same table will be presented with the selection rules presented and an exercise will be performed to generate the next Spp_n Table for n = 6 and Spp_n = 30030. Note that the "raw table" contains all the numbers that are relatively prime to Spp_5 = 2310. This includes all real primes. There are no other prime numbers. All the members of this table were generated from the rows of the prior table n = 4 with Spp_4 = 210 which also carries the symmetry from the prior table. The importance of the Generator Function is seen as the tables continue to n = ∞, the counting functions of primes, twin primes, prime pairs of gap 4, 6, 8 … and prime gap patterns generate all future prime patterns. There are more primes, twin primes, prime pairs of gaps 4, 6, 8 … and prime gap patterns than in the prior table. So not only does is this the basis for the solution to the Twin Prime conjecture and gaps of all sizes, but it also additionally creates a basis for the solution to the Goldbach Conjecture (Figure 7 and Table 2).

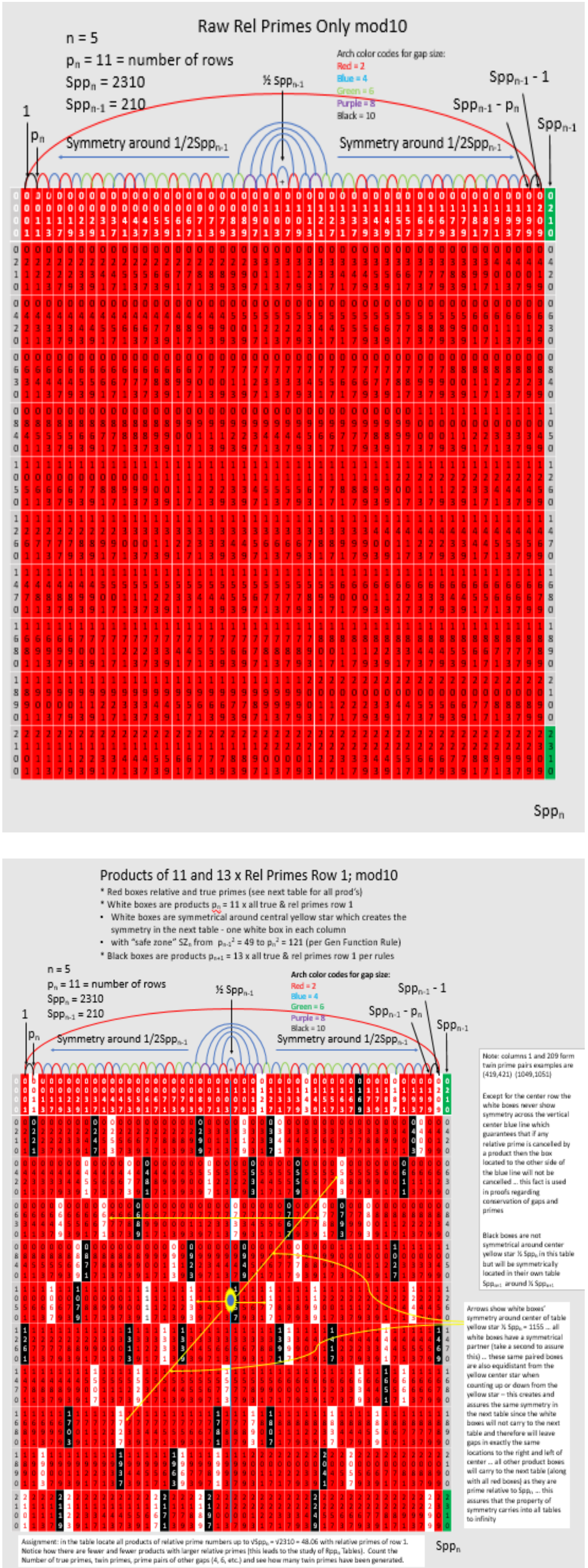

Figure 7) *Twin prime conjecture and gaps of all sizes.*

Table 3

The text from the white boxes are reproduced in the following tables

Note: columns 1 and 209 form twin prime pairs examples are (419,421) & (1049,1051)	Except for the center row the white boxes never show symmetry across the vertical center blue line which guarantees that if any relative prime is cancelled by a product, then the box located to the other side of the blue line will not be cancelled … this fact is used in proofs regarding conservation of gaps and primes	Black boxes (products of p_{n+1} = 13) are not symmetrical around the center yellow star ½Spp_n = 1155 in this table but will be symmetrically located in their own table n=6 where Spp_{n+1} = Spp_6 = 30030 around ½Spp_{n+1} = 15015.
Arrows show white boxes' symmetry around center of table yellow star ½ Spp_n = 1155 … all white boxes have a symmetrical partner compliment (take a second to assure this) … these same paired boxes are also equidistant from the yellow center star when counting up or down from the yellow star – this creates and assures the same symmetry in the next table since the white boxes will not carry to the next table and therefore will leave gaps in exactly the same locations to the right and left of center … all other product boxes will carry to the next table (along with all red boxes) as they are prime relative to Spp_n … this assures that the property of symmetry carries into all tables to infinity.		

Note also that these compliment number pairs all add to Spp_n = 2310 and this gives rise to the understanding for why the values of Spp_n provide local maximums to Goldbach pairs. Note also there are secondary Goldbach maximums at all integral multiples of each number Spp_n . This is because of the wave nature and inherent symmetry of the prime patterns in the Spp_n tables. This is an advanced topic for the next addition of Principles of Prime Numbers. This symmetry carries from one table to the next, assuring that symmetry is a property of all Spp_n tables. In calculating the white boxes (products of p_n with all other members of row 1) you only have to determine products of p_n = 11 up to ½ Spp_n (up to 11 x 103) since all the other products of p_n with numbers of row 1 greater than 103 form products that are symmetrical around ½ Spp_n which greatly reduces time as the tables become larger. Oddly enough this same type of symmetry occurs in DNA structures giving symmetry as an inherent product of DNA and the final product plants and animals.

Assignment: in the table locate all products of relative prime numbers up to $\sqrt{Spp_n}$ = $\sqrt{2310}$ = 48.06 with relative primes of row 1. Notice how there are fewer and fewer products with larger relative primes (this leads to the study of Rpp_n Tables). Count the number of true primes, twin primes, prime pairs of other gaps (4, 6, etc.) and see how many twin primes have been generated.

A final problem is to create the next table row 1 by stringing the rows of this table together (starting with row 1 up to and including row p_n = 11) except knowing that the white boxes (products of 11 and therefore not relatively prime to 30030) do not carry to the next table. If you are in doubt an easier assignment is the create this table from the prior table Spp_4 = 210.

This is the "red only" table which includes all the relative twin primes that were carried over from table Spp_4 = 210. There are 48 red columns in table Spp_5 = 2310 (the number of relative primes from the prior table carry to create row 1) with p_n = 11 horizontal rows total. Notice how the products of 11 (white boxes) fall one and only one in each column. Note how they are symmetrical around the center point in the table (yellow star object in the center of the table showing some examples of symmetry with yellow arrows). For example, the white boxes 1133 and 1177 are equidistant from the center vertical line and center point of the table. The ½ point of the table is 2310 / 2 = 1155 so 1177 – 1155 = 22 and 1133 – 1155 = - 22. This complement pair is ± 22 from the center ½ point of the table. All of the true and relative prime numbers up to 2310 are contained in this table (except for those smaller prime numbers already retired in the Dead Zone = DZ_5 contained in row 1 all prime numbers less than p_5 = 11). 1133 + 1177 = Spp_5 = 2310 as do all the symmetrical white boxes (each white box has a symmetrical partner whose sum = 2310). Only the white boxes are removed when creating row 1 of the next table Spp_6 = 30030. Since the white boxes that removed are symmetrically stationed around the center ½ point (in addition to all red boxes that are relative primes) all carry over cells values will be symmetrical located around the center point and therefore the symmetry carries to the next table and all future tables. Symmetry is a fundamental property of the prime tables that is carried from table to table and tells us a great deal about the distribution of the prime numbers as well as how many prime numbers are in a given table.

This table has only the products of 11 (white boxes) and 13 (black boxes) noted for simplicity but to complete the determination of all true prime numbers in this table one has to multiply all prime numbers less that √2310 = 48.06 by all the relative and true primes of row 1 (that would include all products of row 1 with the primes up to 47). Here is where we also encounter an issue called “duplicate products” in which some products duplicate the black boxes in the table. For example, 11 x 169 = 1859 as does 13 x 143. This is important when we develop equations for the number of products that will eliminate red cells in the tables (so as to not over count the number of products). This is an advanced topic that must be understood in the solution to the Twin Prime Conjecture.

There are two processes occurring here simultaneously. First, the Generator Function is discovering prime numbers in groups with all red cell numbers less than p_n^2 (the square of the nth prime number) being confirmed as “true” prime numbers and then being used to generate future tables. This process is self generating and continues without any help. The second and equally important process is to complete each table discovering all the true prime numbers in the table. This is then used to create parameters that represent the properties of each table and allows us to determine the total number of primes, twin primes, prime pairs of all gap sizes, gap sizes and dozens of other relevant parameters. The understanding gained from this process allows the creation of equations that can be generalized to make exact predictive analysis of the primes, gaps, etc. This will be the basis of the proofs by induction. We are building tools needed to create proofs by induction.

Remember that the prime numbers are calculated and determined in larger numbers than are required to finalize a given table so we now have a method of determining the number of true primes, true twin primes and all other patterns and gaps up to and including the largest gap discovered in the table. The ability to predict the same in the next table is the basis for the proofs by Induction. Notice that $\sqrt{Spp_n}$ = $Spp_n^{1/2}$ (= the square root of the table’s magic number) is an essential parameter. It determines which prime numbers are included in the products to determine all true prime numbers in a given table. This exponent of ½ will come into play in determining the density of primes based on the Generator Function and now gives a visual interpretation based on the Spp_n Tables include all patterns of prior tables including their ½ points and symmetries to be carried forward into all future tables (these also carry forward from the prior tables to the ½ points of integral multiples of Spp_n … a subtle but amazing property … that is, the wave patterns of the prime numbers are also apparent around multiples of Spp_n).

The tables are reduced to just the red columns since all the prime numbers are contained in these and only these columns. There is no need to consider any other part of the full table. We work from the beginning by extracting the red columns and work only with them. All other columns have non-relative prime values in the top cells of the column and therefore when adding Spp_{n-1} to each (to create the cell values below in that column) they result only in non-prime numbers. One of the great powers of the Table method of demonstrating the properties of the Generator Function is that only the red columns are used … all prime numbers are contained in the red columns. Eventually we will isolate twin prime only columns or gaps of other sizes.

Note the arcs showing the symmetry in the table to the right and left of the center point above row 1. Since the white boxes (one in each column) eliminate all the products of 11 in this table, all the remaining red and black boxes move to create row 1 of table 30030. One can imagine that the white boxes take one cell from each column so that would be the equivalent of removing one complete row. All the remaining cells are relatively prime to 2310 which has as its factors all prime numbers up to and including 11. There will be a total of 480 red cells in 11 rows transferring to create the next table which will therefore have 480 red columns.

The formula for the number of columns in the next table is equal to the number of relative primes of the prior table. This is an example of the analytic nature of the Generator Function and its visualization in the tables. The study of formulae leading from a table Spp_n to the subsequent table Spp_{n+1} is a formidable job.

An appendix is dedicated to defining the table parameters and equations. With these equations we can 1) begin rigorous mathematical proofs using induction, 2) develop an equation for each table that will predict prime numbers to infinity using the repetition of the wavelength Spp_n (of which n6 ± 1 is the simplest of examples for Spp_2 = 6), 3) determine prime density within the table and develop upper limits of prime density because it is now understood that with each successive table (although the size of the tables grows faster than exponentially and although there are more primes and prime pairs of gap N in every succeeding table) the Generator Function reduces the number of future primes with every iteration in a given table’s wavelength pattern and therefore proves that there is a monotonically decreasing number of primes with increasing wavelength Spp_n (adding to the Prime Number Theorem and other theorems that deal with the density of primes).

Item 3) above seems like a contradiction at first but this is correctly stated and requires some study to understand what this means. Each table is much larger than the prior table growing faster than exponentially and each table has more primes and other prime patterns (e.g. twin primes) than the prior table. However, each table Spp_n is then used as a wavelength and all of the relative prime numbers that were discovered in this table form what we called in “Calculate Primes” a “comb” with the “teeth” of the comb being the relative prime values discovered in the table. It is a series of relative prime numbers symmetrically placed around the ½ point of the table. The pattern in this table will generate all future prime numbers using a wavelength Spp_n . This is a LINEAR projection to infinity in integer multiples of Spp_n therefore this defines all of the future prime numbers to infinity and is linear (increasing in integer multiples of Spp_n). Any numbers not found in this repeating “comb” will not be prime. What 3) is stating is that with each iteration of the Generator Function, the next iteration modifies the prior table’s “comb” reducing the population of “teeth” in the “comb” and therefore as viewed from a linear progression of the “comb” of a given table, being reduced by the next iteration of the Generator Function … assures that we know where all the primes will be (found within the members of this comb as the comb repeats to infinity with wavelength Spp_n). This is an example of the many subtle properties of the Generator Function, Spp_n Tables and Nature’s Number System.

One final example of the simplicity and meaning of modNt numbers see the following. It will become apparent that the prime numbers are not random lottery numbers but a complete number system with ancestors and descendants. Here is the sequence of ancestry of twin primes in mod10 (97841,97843), (7751*,7753), (821,823), (191,193), (11,13), (5,1) and here is the same sequence modNt (3336121,3336201), (336121*,336201), (36121,36201), (6121,6201), (121,201), (21,1). Look at the first numbers of the pairs in descending order modNt. They are 3336121, 336121, 36121, 6121, 121 and 21. Prime numbers are generating prime numbers and each digit has meaning. You simply remove the higher order digit (or if ascending add the higher order digit). This gives the complete ancestry of the number fully visible in the structure of the number using modNt. Base 10 or other modulo N numbers do not offer any semblance of order. As previously noted, the mod10 or other modulo number systems lack meaning relative to prime numbers and have been a hinderance to their understanding. The next paper based on Vol II of Principles of Prime Numbers will go into more detail on this and other aspects of the modNt number system.

The * indicates composite numbers in the sequence above. They are as valuable as real primes since they are relatively prime in the tables from which they are found. That is a fundamental aspect of the generation of primes, **the relative primes in a given table** are as much a prime number as "real" primes. When their usefulness in generating other future prime numbers is expended (in their own Spp_n table where they are no longer relatively prime), they disappear and literally were the "missing links" necessary to generate the complete list of prime numbers.

CHAPTER 5
PHYSICAL DIMENSIONS OF Spp_n TABLES

One aspect of the tables which requires special examination is the physical dimensions of the tables. They grow in length (horizontal) very rapidly but not so rapidly in depth (vertical). For example, a table for n= 10 with p_n = 29, if the table cells (that contain the numbers) are one centimeter by one centimeter, the table is then 29 centimeters in height (= p_n), but the number of cells in row 1 Spp_{n-1} is 223,092,870 centimeters long = 2230.92870 kilometers long. Any time we deal with large numbers there is an inherent "fear of flying" because with prior number systems, large numbers have no meaning. The Nature's Number System will change this to an excitement that now large numbers are not only manageable, but their extension to infinity will also be understandable. We do not have to calculate all these numbers, but unlike other mathematical systems, we will be able to understand them because of repeatable patterns.

Below is the same table from Chapter 1 showing the first few tables for n = α (the alpha prime table) to n = 4. It is not obvious from these first tables that they in fact grow so fast. This is one of the powerful aspects of the Spp_n tables. We typically view prime numbers (as well as all numbers) progressing outward linearly along the number line. Mathematicians view the prime numbers as diminishing in numbers with increasing size, and even more so the twin primes and other more complex prime patterns. This view of numbers in fact has hindered the true understanding of prime numbers for over 2500 years since they were first defined by the Greeks. To the contrary, the number of primes and other complex patterns grow larger with successive table (for each Spp_{n+1} value). The proof of this is what allows new insight into the structure of numbers, and their building blocks ... the primes.

It is probably obvious to mathematicians familiar with prime numbers as I discuss the "greater than exponential growth" of the tables but for others not familiar with fundamental prime number proofs, one of the best known relations regarding primes is that their "density" or average occurrence diminishes on average as a logarithmic function. Thus if you graphed the occurrence of prime numbers along an exponentially scaled X axis, you would have a level number of primes per unit of measure. But since the Spp_n tables grow at **faster than exponential rate**, this in a sense "overpowers" the logarithmic decline in the presence of prime numbers giving an ever increasing number of primes in each future table. This holds true also for twin primes and other prime pairs of larger gaps as will be shown in the final proofs dealing with these issues (Figure 8).

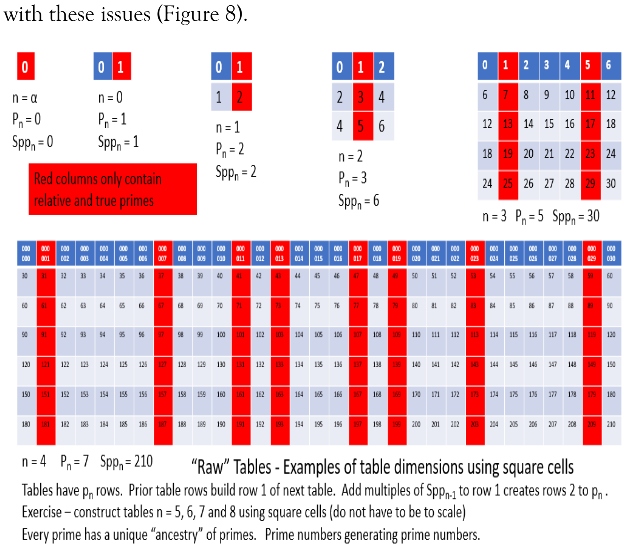

Figure 8) *Relation between the Spp_n and Rpp_n .*

Besides the much more than exponential growth of the tables, we also notice other interesting aspects of the relation between the Spp_n and Rpp_n tables (Rpp_n tables will be defined in later work but essentially are the tables containing the products of prime and relative prime numbers from row 1 of an Spp_n table). For example, an important value in determining the number of products in the Rpp_n table is the square root of $Spp_n = \sqrt{Spp_n}$. This sets the maximum value of prime number that can be used to build products to cancel cells in the Spp_n table in the final determination of how many true prime numbers there are in that particular table. As the counting variable n increases, the value of $\sqrt{Spp_n}$ grows more slowly than Spp_{n-1} (the sequential prime product of the prior table). $\sqrt{Spp_n}$ therefore becomes closer and closer to the left side of row 1. In other words, remembering that the length of row 1 in table Spp_n is equal to Spp_{n-1} , the ratio $\sqrt{Spp_n} / Spp_{n-1}$ becomes very small very fast. This means that the number of products becomes more and more limited with increasing table size. Although this is not the only factor, once again this is an essential observation that helps in understanding the growth of the prime numbers, twin prime pairs, and patterns of gaps, as they generate future primes, twin primes and the patterns of gaps in future tables. It is important not only to understand the numbers of products that cancel cells in the raw table, but how they are distributed evenly and symmetrically throughout the tables.

The following are examples taken from a table of values showing the growth of table size Spp_n with increasing "n". Clearly these tables are not manageable from a practical stand point. But then again, all the numbers we use here as examples are small when compared to infinity. Note also that we will only be using the red columns containing only relative prime numbers, which is only a portion of the tables. The plan is to create understanding for the great region between our comprehension and infinity. The importance here is that we are able to build a mathematical structure to predict the size of future tables and the number of products, and therefore cross into the realm of analysis that has never existed previously to determine the number or primes, twin primes, and other patterns as the tables are created from prior tables. (NOTE: the table dimensions below are based on 1 cm x

1 cm cell sizes each of which contains just one number … for simplicity all numbers below are in mod10). The formula for the number of columns in a given table = # columns in the prior red table (not including 0 and Spp_n) x (p_{n-1} - 1). As an example, n=4 table (prior page) has 8 red columns and 7 rows (= p_4). So the formula for the number of columns in table n = 5 is 8 x (7-1) = 48 with 11 rows. The number of columns in table n = 6 is 48 x (11-1) = 480 with 13 rows. The following table n = 7 will have 480 x (13 -1) = 5760 columns with 17 rows. The ability to calculate these and other parameters from one table to the next gives rise to the proofs by Induction. Note in the following numbers the values of Spp_n and Spp_{n-1} do not represent the numbers of rows and columns in a "red" tables (prime and relative prime only tables). The red only tables have far fewer elements (the last values given below in bold type). Note how many primes are discovered in the few tables up to n = 13.

n = 6 p_n = 13 Spp_n = 30,030 Spp_{n-1} = 2310 $\sqrt{Spp_n}$ = 173.29 $\sqrt{Spp_n} / Spp_{n-1}$ = 0.075

table height = 13 cm table length = 2310 cm = 23.1 meters = .0231 km

number rows in all red table = p_6 = 13 number columns in all red table = 480

n = 10 p_n = 29 Spp_n = 6,469,693,230 Spp_{n-1} = 223,092,870 $\sqrt{Spp_n}$ = 80,434.4

$\sqrt{Spp_n} / Spp_{n-1}$ = .0003606 (note is much smaller than for n = 6)

table height = 29 cm table length = 223,092,870 cm = 2,230,928 m = 2230 km

number rows in all red table = p_{10} = 29 number columns in all red table = 36,495,360

n = 13 p_n = 41 Spp_n = 3,042,632,473,527,210 Spp_{n-1} = 74,210,548,134,810

$\sqrt{Spp_n}$ = 55,160,062.3 $\sqrt{Spp_n} / Spp_{n-1}$ = 0.00000074329… (compare to above)

table height = 41 cm table length = 74,210,548,134,810 cm = 742,105,481 km

number rows in all red table = p_{13} = 41; number columns in all red table = 1,103,619,686,400

This table for n = 13 is about 5 times the distance from earth to the sun, however the red column only table (containing only primes and relative primes) is much smaller but still contains billions of prime numbers).

The concept of infinity and understanding the building blocks of all numbers being calculated directly in the tables may be difficult to imagine since it is a foreign concept on first sight. The realization that standard methods do not give insight into numbers no matter how large they seem, the only logical avenue of pursuit is in the processes developed in this paper to create a system by which proofs by Induction are possible. This requires a system by which one group of primes is directly calculated from a prior group (the process which generates subsequent groups) being the same leading to the processes needed for Induction proofs.

When translated into modNt, the values of Spp_n are as follows.

n = 6; Spp_n = 10^6 = 1,000,000 (compare to mod10 = 30,030)

n = 10; Spp_n = 10^{10} = 10,000,000,000 (mod10 = 6,469,693,230)
It is between n = 10 and n = 11 where the modNt numbers become more efficient at representing a given number. Note how n = 13 modNt has fewer digits below.

n = 13; Spp_n = 10^{13} = 10,000,000,000,000 (mod10 = 3,042,632,473,527,210)

n = 169 Spp_n = 10^{169} (with 169 modNt digits compare to the mod10 number with 422 digits = (see top next column)
2002362020904452815951174109202611157572109628795203328
0890216911029466309299244261280131263405759302102973368
2743921175847121545541478527825219234137613370618124449
2260981760390201481462526087798387011456345464156546841
7567572976451068314416743541124863024839827028842502970
1543248542691881225071572605757942157032719979869504478
5787703752041026949623508706278256040113010362821434482
9307099367702771821422466053941751470

See the Appendix end of this text which lists Spp_n up to n = 169.

The progression of tables continues but the greater effect of the modNt number system is that by just looking at the number you can tell the entire ancestry of the number because every digit translates into a value that existed at the top of the column where that number was generated or "born" from an ancestor that is unique. Each number is unique and has a unique ancestry and relation with its siblings, cousins, aunts and uncles, parent, and ancestors. Likewise, every twin prime is generated from a lineage that brought it into existence. Since the gaps in a given raw table are continually being broken as products cancel non-prime cells, the twin primes that are continually generated in greater and greater numbers in successive tables are set as ancestors of an infinite number of future twin primes (there can be no others). Twin primes are not random or just there by chance, they are generated by a distinct lineage and have a distinct position in a table, with each table having more primes and twin primes than the previous table. All prime gaps that have already been generated and prime gap series are represented in each successive table and continue to generate more offspring to infinity. This occurs because the relative primes and their patterns carry to each new table and carry the patterns with them. The proof of these statements is based on the understanding of the growth of the tables with increasing "n" which are based on basic mathematical principles of common algebra.

Lastly, the "fear of flying" with huge numbers and tables that extend past the sun may be a bit overwhelming to some. The gain here is that we never have to write these out because long before we get to these huge tables, we are already able to create mathematical expressions for the generation of table parameters and thus enter a new universe of pure mathematics to understand the prime numbers in small distinct groups … and create proofs by Induction.

CHAPTER 6
BUILDING Rpp_n TABLES

The Rpp_n tables are simply the representation of the products or row 1 of a Spp_n table. After the Generator Function has created the new nth list of prime numbers (all red column numbers p_i such that $p_{n-1}^2 < p_i < p_n^2$), created the next sequential prime product Spp_{n+1} with the rules being followed to create the next table (n + 1 table) … the second process takes place of locating all prime numbers and relative prime numbers associated with the nth table. This is done by first taking the square root of Spp_n (= $\sqrt{Spp_n}$) which is the upper limit of factors whose products will fit within the limit of the Spp_n table. In the first tables up to n = 4, this value is not in row 1, however for n = 5 and thereafter the square root falls in row 1 and with each increasing table becomes closer to the left side of row 1. This is important to note as the effort to determine the number of products that eliminate red cells in each table is central to determining the number of real primes, twin primes, and other parameters in each table.

First we will review the n = 4 table and then the table that is created from this table with n = 5. With these understood it will then be possible to create the Rpp_n tables (Figure 9).

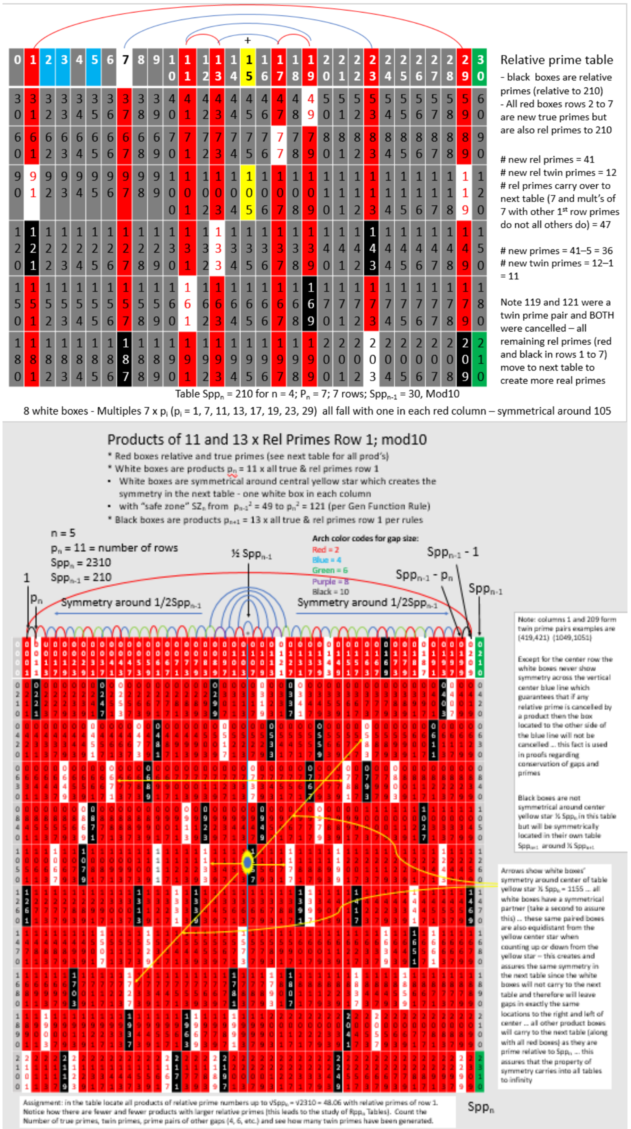

Figure 9) *n = 5, multiply p_5 = 11 with all of the members of row 1 to get the white boxes in table n = 5.*

Note how the n = 4 table creates the n = 5 table. From the n = 4 table, take the successive rows 1, 2, 3, 4, 5, 6, 7 in order and stretch them into a single line (removing the repetition of 30, 60 etc at the beginning and end of each new row). This is row 1 of table n = 5 complete with the symmetry found around the ½ point = 105. See the row 1 numbers of table n = 5 above. Next add the n = 4 value of Spp_4 = 210 (which becomes Spp_{n-1} in table n = 5 ... the top right hand corner cell) to the values of the top cells of table n = 5.

Here is where the Rpp_n table comes in. In table n = 5, multiply p_5 = 11 with all of the members of row 1 to get the white boxes in table n = 5. Next multiply all of the row 1 elements with themselves and all succeeding elements of row 1. You will find the following. P_n = 11 can be multiplied by all members of row and with the products all contained within the table. However the next relative prime (and also real prime) 13 has to stop short of the last member or row 1. Find the maximum element of row 1 that 13 can be multiplied with to remain in the table using the simple equation Spp_n / 13 = 2310 / 13 = 177.69 ... for the next element of row 1 (17) the maximum pairing will be 2310 / 17 = 135.88 and so on for all elements of row 1 up to $\sqrt{Spp_n}$ = 48.06 . The analysis of this product structure is what will provide the equations needed to analyze the complete prime number and gap structure of each table. The result of this is presented in the Rpp_n table below (see accompanying files for better resolution picture) (Figure 10).

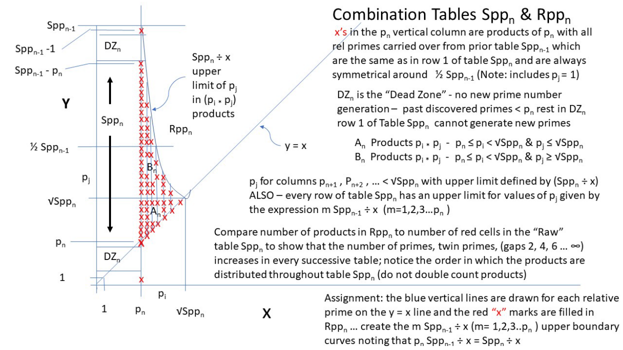

Figure 10) *Spp_n tables, Rpp_n tables generate from one table to the next.*

Like Spp_n tables, Rpp_n tables generate from one table to the next as shown in the following photo. These allow the parameters of one table to be determined from the prior table which is the basis for the equations that create future table values from prior tables. This was the goal in searching for and creating these tables to allow proofs by Induction. Without these building blocks there is no basis for induction proofs. As with the Spp_n tables, the Rpp_n tables can eliminate all but the red cells (Figure 11).

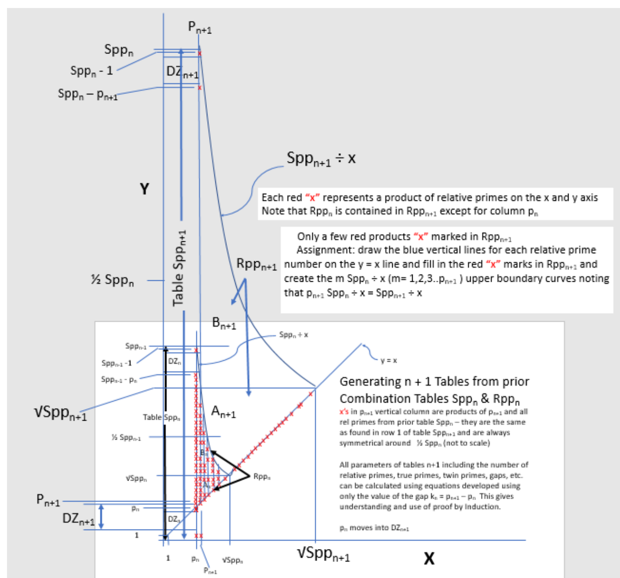

Figure 11) *Basis for determining the number of real primes.*

These tables become very complex but are the basis for determining the number of real primes, twin primes, gaps of all sizes, etc. One of the issues is that there are duplicate products but there is a solution to this. These tables will be discussed in future chapters this was a first pass introduction.

CHAPTER 7
RULES FOR TABLES AND CREATING TABLES

The discussion of creating tables is based on the structure of numbers using the McCanney Generator Function and modNt number system. The tables are simply a visual representation of the Generator Function and allows equations to be constructed to generate one table from the prior table. The Generator Function, its boundary conditions and selection rules not only generate new prime numbers based on prior prime numbers but also forms a mathematical system with properties of - closure – completeness – symmetry – reciprocity – wave functions - and allows the prime numbers to be classified in bounded algebraic Groups. One set of parameters of one table generates (using formulas developed based on the Generator Function) the parameters in the following table and this structure allows for proofs using traditional mathematical techniques such as Induction.

There are 2 basic table types called Spp_n (Sequential Prime Product table "n") and Rpp_n (Relative Prime Product table "n"). The table generation RULES are based on mathematical proofs and allow all related parameters for table "n" to be generated from the prior table "n-1" using just the gap k_n between p_n and p_{n-1}. This gap size is determined using the results of the Generator Function which generates increasingly larger groups of true prime numbers with each iteration assuring that the process will continue to infinity (e.g. assuring that there will always be the next prime to generate the next Spp_n value).

1) Future Tables Spp_{n+1} and Rpp_{n+1} and all parameters associated with these tables are derived from prior tables Spp_n and Rpp_n based on equations and depend only on the gap $k_{n+1} = p_{n+1} - p_n$ and all can be traced back to the first table $n = \alpha$. The prime numbers and associated tables are derived directly from the starting point of the Peano Postulates using the Generator Function and selection rules.
2) All primes and parameters of tables Spp_n can be traced back to the first table of the alpha prime 0 with counting integer $n = \alpha$.
3) Theorem – The Fundamental Theorem of Prime Numbers (equivalent to the Fundamental Theorem of Arithmetic) – Every prime number has a unique ancestry of primes which may include numbers that are relatively prime in the table Spp_n leading back to the original alpha prime "0". This is an alternative way of expressing the new number system "Nature's Number System".
4) Corollary – The Fundamental Theorem of Prime Gap Ancestry - all twin primes (gap $k_n = 2$), prime pairs of any gap size ($k_n = 2, 4, 6, \ldots \infty$) and any pattern of gaps likewise have a unique ancestry leading back to the first incidence of that gap or gap pattern. This leads to the following theorem.
5) Corollary– The Fundamental Theorem of Gap Generation – All gaps of size k_i will continue to be generated in future tables because the relative primes of table Spp_n carry to table Spp_{n+1} and there is in fact an increase in the occurrence of gap sizes in each successive table. Each twin prime pair will generate an infinite number of future twin prime pairs. Every prime pair of gap = N will generate an infinite number of future prime pairs of the same gap. **This is called the "Conservation of Prime Gaps" Theorem.** This also has a corollary which states that **"if there are relatively large gaps in the list of real prime numbers, then there will be smaller gaps in the region of the large gap to conserve the average gap size in the region."** Another way of stating this is that the distribution of products that cancel potential prime numbers may be "grouped" or "clumped" into regions which will create larger than average gaps, but this will be compensated by smaller gaps in the area. This is important in understanding the distribution of prime numbers in problems such as the Goldbach Conjecture as well as the Max Gap tables. The following are the Rules dealing with the mathematical properties of prime numbers, all parameters of prime number tables and tables Spp_n and Rpp_n .
6) Direct Calculation of the Prime Numbers – the McCanney Generator Function – All prime numbers are calculated directly in groups using the Generator Function and boundary conditions starting with just the number "0" and addition and subtraction. Multiplication and division are never used. Prime numbers are generated in every increasingly larger groups upon each iteration of the Generator Function. The Generator Function is neither a Sieve, multiplication table ("odd man out") nor brute force division technique … but is a formulation that directly calculates prime numbers in groups and allows for the other mathematical properties (described below).
7) **Definition of Prime Numbers** – the use of the Generator Function provides a new definition for prime numbers and a set of new criteria for determining that numbers are prime (primality) which does not depend on the traditional definition of primality (that a number is divisible by only itself and "1"). The new definition of prime numbers states that they are all numbers which are discovered by and follow the boundary conditions of the Generator Function starting with the alpha prime 0. The traditional definition actually has been a hindrance in the true understanding of the prime numbers and numbers in general.
8) Nature's Number System – A new natural number system modNt is created based on a counting system in which the values of the Sequential Prime Products Spp_n are used in place of powers of 10 (mod10) or other fixed modulo systems. The new number system not only gives information about the number including its ancestry in the building of the number system, but also provides an understanding of prime numbers that allows for proofs by Induction and other insights never realized before. The base 10 (mod10) number system is good for many applications in mathematics and commerce but is a hindrance to understanding prime numbers and the natural structure of numbers in general.
9) Predictability – with each iteration of the application of the Generator Function a wave "comb" of wavelength Spp_n is created which modifies all previous wave forms of prior tables. With each iteration of the Generator Function one further refines and limits the possible numbers to infinity which can be prime numbers. Specific equations are developed that define which numbers can be prime and which ones will not be prime (the waves repeat to infinity). See other rules below regarding wave nature of prime numbers. None of the other "methods" of determining prime numbers have any predictive capability and this alone sets the Generator Function apart from any prior attempts at understanding.
10) Prime Number Density Theorem – The prime numbers form a monotonically decreasing set of numbers with each application of the Generator Function and its associated wave and it provides an exact determination of where Rogue Waves or groupings of primes and prime gaps will occur. This provides not only an upper limit to prime numbers but also tells exactly where to expect patterns. The traditional method of calculating the density of primes using the Prime Number Theorem (PNT) only gives a general upper limit to

prime numbers in an abstract region of the number line but does not have any specific predictive properties for given primes or groups of primes. The Generator Function provides specific information about any prime number or groupings of numbers or gaps and predicts where these combinations occur.

11) Sequential Prime Product. The tables Spp_n and Rpp_n can be reduced to only the relative prime numbers and columns "0" and Spp_{n-1} which are included to show the structure of the tables. The prime numbers are discovered completely for each table Spp_n and do not require any other numbers (unlike any other method of discovering prime numbers). The Sequential Prime Products have been known in mathematical literature but no one previously understood the connection to directly calculating the prime numbers.
12) The tables Spp_n are Groups by the traditional mathematical definition in Abstract Algebra. The following are just some of the properties of the tables and related number system.
13) Closure – Every table Spp_n is closed. Closure means that the relative and true primes (all prime relative to Spp_n) form a closed Algebraic Group under operations of addition and the inverse operation subtraction. This group does not include any other numbers (numbers not relatively prime to Spp_n). There are two forms of the tables Spp_n (Sequential Prime Product of the n^{th} prime) and Rpp_n (Relative Prime Products of the n^{th} prime) … A) full tables include all numbers inclusive between "0" and Spp_n and B) the "Relative Prime Number Only" tables (also referred to as the red column tables since red is the color of cells which are relatively prime with respect to Spp_n) which include only the columns "0", all relative prime columns from the prior table Spp_{n-1} which comprise rows 1 through Spp_{n-1} -1 of table Spp_n (then creating all members of the columns by adding multiples of Spp_{n-1}) and column Spp_{n-1} which maintains table symmetry with column 0 . Columns "0" and Spp_{n-1} are part of the Group although they do not contribute to prime number generation. The properties refer to the second type "Prime Number Only" tables. Every table identifies and distinguishes between relative primes which are true primes and those which are non-primes. Every table identifies all true times within the table. All relative primes including true primes and non-primes which are relatively prime (after removing all multiples of p_n) with respect to Spp_n move on to the next table Spp_{n+1} to create the next n+1 table. See the additional "Appendix – Introduction to Self-Generating Primal Groups" which gives a brief outline of addition for the Group which will be further developed in Volumes II and III of this set.
14) Completeness - All numbers are located in the tables and are ultimately classified as either a prime or non-prime number but within a given table Spp_n the mathematical structure includes both true primes and primes relative to Spp_n . All relative and real primes are identified in every table relative to the Sequential Prime Product for that table. Since all numbers from "0" to Spp_n are included in the process, the process is complete and thus identifies all true primes and all numbers that are not true primes. The process is complete and therefore the mathematical structure has the property of Completeness.
15) Symmetry – The prime numbers relative to table Spp_n are symmetrical around the ½ point of row 1 and the ½ point of the table. The symmetry found in row 1 of table Spp_n comes from the symmetry found in and carried forward from the prior table around the center point of the prior table ½ Spp_{n-1}. All tables exhibit the property of symmetry around ½ Spp_{n-1} (the center point in row 1) as well as ½ Spp_n the center point of the table Spp_n . Since the relative primes of table Spp_n as well as the products from column 1 of table Rpp_n are all symmetrical around the ½ points of the table, and because these are the numbers that move to create row 1 of the next table, this symmetry is universally carried from one table to the subsequent table. Therefore, all tables past present and future show the same symmetrical structure around these ½ points. There are other symmetries to numerous to mention here but one other used extensively are symmetries around the points ½ m Spp_{n-1} which for example are used in the proof of the Goldbach Conjecture.
16) Reciprocity – All future prime numbers are created by building from currently existing prime numbers and likewise by reversing the process of the Generator Function the ancestors of any prime number can be uniquely determined. Thus, there is a reciprocity in the process and the prime number system exhibits the mathematical property of reciprocity.
17) Wave Nature of Prime Numbers – One of the most unique and characteristic aspects of the Generator Function is the wave nature of prime numbers. This proves conclusively that the patterns found in prime numbers are not random but are calculable and predictable, and additionally allows one to develop equations that can predict whether any future number can be prime or not. Once again, this sets the Generator Function and Direct Calculation of Prime Numbers apart from sieves, multiplication tables (missing number are primes), statistical mathematical analysis and brute force super computer computational methods which have no predictive abilities at all. It also shows why the many classifications and attempts at estimating prime numbers such as Mersenne Primes are only partially successful. Each table Spp_n has associated with it a wave pattern of primes relative to Spp_{n-1} called a "comb" which repeats to infinity with wavelength = Spp_{n-1} . Within each table is contained all the prior infinitely repeating wave functions of all prior wavelengths, with each one modified by the subsequent wave patterns. Each wave pattern modifies the prior wave function. This is why we see patterns of prime numbers emerge in the prime number tables only to fade with other patterns emerging to fade away again. This is why we see "rogue patterns" of both primes and prime gaps in the prime number tables (these are the wave patterns beating one on the other), and more so this is why we see symmetrical patterns around the Sequential Prime Products Spp_n in the + and – directions as well as around the multiples of Spp_n all the way to infinity. The wave nature along with the symmetry factor is the reason why we can begin at any Spp_n value and move in the negative direction and begin at "0" and find the exact same prime patterns of gaps. Are prime numbers random? These insights prove that prime numbers contain great order and are anything but random.
18) Equations for parameters of table Spp_{n+1} are derived and are dependent on only the prime gap $k_{n+1} = p_{n+1} - p_n$ using the values of the same parameters found in table Spp_n . These include the number of relative primes, true primes, twin

primes and prime pairs of gaps that have been discovered up to and including this table and a very long list of other parameters.

19) Proofs by Induction – The classification and discovery of primes using the Generator Function and tables plus the use of equations that create the new parameters for subsequent tables allow for proofs by Induction.

20) Primality - Selection Rules for Prime Numbers – Selection rules define those numbers that remain after the most recent iteration of the Generator Function and are as follows. There are 2 rules for selecting prime numbers from a table Spp_n. A) the first criteria also known as the "weak rule" states using the Generator Function criteria that all relative prime numbers $\leq \sqrt{Spp_n}$ are prime. Since with each table Spp_n the primes are "discovered" in groups up to $\sqrt{Spp_n}$ and the prior table discovered true primes up to $\sqrt{Spp_{n-1}}$, the new group of primes discovered by table Spp_n are p_m such that $\sqrt{Spp_{n-1}} < p_m < \sqrt{Spp_n}$ with each successive group being larger than the last group (in fact much larger). This property of the prime number discovery "Weak Selection Rule" coupled with the fact that prime numbers (and twin prime pairs, etc.) generate future primes (and twin prime pairs, etc.) allows for the proofs of previously unsolved problems regarding prime numbers. B) The second criteria also known as the "strong rule" states that all relative prime numbers in table Spp_n between p_n and p_n^2 will be prime since there can be no new products in this region (all products in this region were eliminated in prior tables with smaller prime number tables). Therefore, no new products can exist in this region. For $n < 6$, p_n^2 is greater than $\sqrt{Spp_n}$ and can be used in this region to discover true primes but for $n \geq 6$, p_n^2 is less than $\sqrt{Spp_n}$ where the strong rule is used. These selection rules constitute the new definition of prime numbers and you can see that it has nothing to do with factorization nor being "only divisible by itself and 1". Only the strong rule can be used but there is a subtle reason for including the weak rule (an advanced topic not covered in this volume). The two definitions result in the same set of prime numbers as the traditional definition of prime numbers, but with the addition of 0 and 1 which are both essential in the complete set of primes including negative and complex prime numbers. Without 0 and 1 the new structure of prime numbers would not be possible, remembering that 0 is the alpha prime. With the new definition comes understanding, predictability of the primes to infinity and the many other mathematical properties that make the prime numbers a closed mathematical structure and last but not least, the development of the prime numbers as a complete autonomous number system starting with Peano´s Postulates and the McCanney Generator Function along with the related boundary conditions and selection rules.

21) Non-Randomness of Prime Numbers – All of the above mathematical properties of prime numbers show that primes are not random nor pseudo-random as previously believed but constitute a highly organized set of numbers (independent of all other numbers) with mathematical properties. The structure of the primes is recognizable using the properties of the Generator Function that puts the prime numbers into manageable groups. Both prime and relative prime numbers in a given table Spp_n generate future prime numbers, prime number gaps and gap patterns, likewise, all prime numbers are in families with ancestors going back to the alpha prime "0", with parents, siblings, cousins, ancestors, and descendants. There is an infinite number of equations that are generated using simple rules. There is a single equation to predict all prime numbers from each table n ($n = \alpha, 0, 1, 2, 3, \ldots \infty$) and there are equations for a given table n which predict all twin primes subsequent to that table as well as equations for all gaps and gap patterns. Primes, twin primes, gaps, and all patterns are generated using just addition of previous primes. The primes exhibit properties of closure, completeness, reciprocity, symmetry and wave nature. The equations generated by rules within each table create the waves that not only generate to infinity but also to negative infinity. The current volume does not deal with negative prime numbers nor complex prime numbers both of which are advanced topics for the next volumes. This shows complete order. The primes are NOT random but a well ordered mathematical structure including their own number system modNt.

22) See the appendix on Parameters for more information on structure of the prime numbers.

CHAPTER 8
INTRODUCTION TO SELF-GENERATING PRIMAL GROUPS & PEANO´S POSTULATES TO GENERATE THE PRIME NUMBERS

This is a brief introduction to the topic of Group Theory related to the tables Spp_n showing the process of addition (and inverse process subtraction). This is related to the full tables which include all numbers between 0 and Spp_n. We will use mod10 format numbers for ease of understanding although this will eventually be translated into modNt number system and will be a much more natural process.

Using the example table for $n = 4$, $P_n = 7$, $Spp_n = 210$ and $Spp_{n-1} = 30$ we will add sets of numbers to show the process. Anyone familiar with Group Theory will recognize the pattern of wrapping numbers larger that the size of the table back into the table so that the process has Closure, Completeness, maintains Symmetry, etc.. Once again the complete table is shown for example (Figure 12).

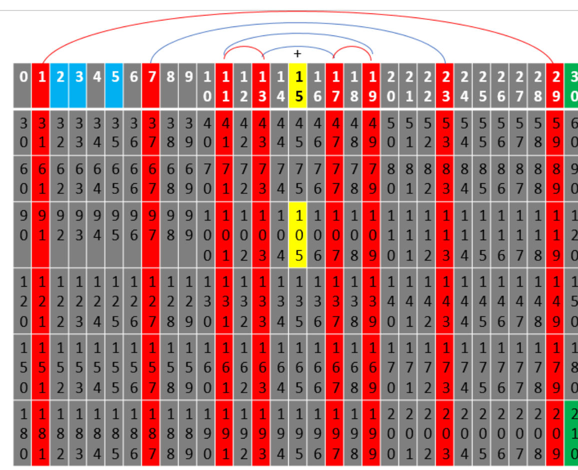

Table $Spp_n = 210$ for $n = 4$; $P_n = 7$; 7 rows; $Spp_{n-1} = 30$, Mod10

Figure 12) *Group theory.*

For those not familiar with Group Theory the rules are as follows. Imagine two numbers that you wish to add together A and B. Find their modNt equivalents (using the method for converting mod10 numbers to modNt). For example, chose 25 and 126 found in row 1 and row 5. To add together in mod10 math 25 + 126 = 151. On a normal number line you would add these linear distances and also arrive at point 151 on the number line. One could do that also in the table above however the full process is as follows. Since each number is a combination of row position and column position, we divide the number into its two components (row and column as described in the chapter on converting mod10 numbers to modNt).

25 = 0 x Spp_{n-1} + 25 = 0 x 30 + 25. 126 = 4 x Spp_{n-1} + 6. Now add the row values and column values noting that the sum of the columns values (25 + 6) goes beyond the right hand boundary (30) and therefore wraps to the next row (as in carrying 1 in standard addition). Thus the final row of 25 + 126 is 0 + 4 + 1 (the row of 25 plus the row of 126 plus the carried 1). The end result is the number with 5 x Spp_{n-1} which according to the table is the 6^{th} row. Adding the 25 and 6 gives 31 so it is the cell in column under 1 (count down 5) which is 151. If you are not familiar with Group Theory and closed group algebra this may seem a bit tedious but the next example will make the effort clear.

The next example will add two numbers whose sum is greater than Spp_n (the largest value in the table) and therefore wraps around to enter the table again so the sum remains in the closed group. Add for example 170 + 187 (= 357 in normal mod10 arithmetic). In this case:
170 = 5 x Spp_{n-1} + 20 = 5 x 30 + 20 and 187 = 6 x Spp_{n-1} + 7 = 6 x 30 + 7.

Adding the columns and rows separately arrives at:
(5 + 6) x Spp_{n-1} + (20 + 7) = 11 x Spp_{n-1} + 27.

The only problem is that the table only has 7 rows and we have to get to row 11. The wrapping process is as follows. First add the columns which gives the cell below top cell 27 in the same row as the number 170 = 177. Now counting down and wrapping back to the top of the table ... staying in the same column (since the row count of 177 is 5 x 30, count down and wrap ... cell 207 will be 6, cell 27 at the top of the table will be 7, cell 57 below that will be 8, cell 87 below that will be 9, cell 117 below that will be 10 and finally cell 143 will be 11. You have wrapped back into the table and so in this group 170 + 187 = 147. This "maps to" traditional arithmetic since 147 + Spp_n = 147 + 210 = 357.

Another and possibly simpler way of looking at this is to create a table below the Spp_n = 210 table and continue the counting process extended from 210 in the first table. Starting with the top left cell of the second lower table = 211 and so on. Now add the two numbers counting into the second table. You will end up in cell 357. Now take this table and lay it over the upper table and you will find 357 laying over the cell with 147. This is another way of visualizing the wrapping process to contain all the additions (and subtractions) within the same table. This in abstract algebra is a closed group. These are all the elements of the group.

In the system of self-generating groups of relative primes forming tables Spp_n , these form an infinite number of closed groups with one table or group formed from the prior group and maintaining the properties found in the prior group. This is of significance in the pure mathematical sense and more so because the properties of one group translate to the next forming the basis for proofs by Induction. The prime numbers found in one table are directly related to the prime numbers found in the prior table and that table is directly related to the prime numbers found in the table before that going back to the alpha table for n = α, p_α = 0 with Spp_α = 0. This then uses Peano´s postulates to generate the Prime numbers using the Generator Function, its boundary conditions and selection rules as defined in the prior and current text being visualized in the tables.

Peano axioms, also known as **Peano's postulates**, in number theory, five axioms introduced in 1889 by Italian mathematician Giuseppe Peano. Like the axioms for geometry devised by Greek mathematician Euclid (*c.* 300 BCE), the Peano axioms were meant to provide a rigorous foundation for the natural numbers (0, 1, 2, 3,...) used in arithmetic, number theory, and set theory. In particular, the Peano axioms enable an infinite set to be generated by a finite set of symbols and rules.

The five Peano axioms are:

1. Zero is a natural number.

2. Every natural number has a successor in the natural numbers.

3. Zero is not the successor of any natural number.

4. If the successor of two natural numbers is the same, then the two original numbers are the same.

5. If a set contains zero and the successor of every number is in the set, then the set contains the natural numbers.

The fifth axiom is known as the principle of induction because it can be used to establish properties for an infinite number of cases without having to give an infinite number of proofs. In particular, given that *P* is a property and zero has *P* and that whenever a natural number has *P* its successor also has *P*, it follows that all natural numbers have *P*.

This may seem like a long way of accomplishing the same goal, however this creates a mathematical Group structure that deals with prime numbers in the red columns that originate with Peano´s Postulates and ultimately generates the entire set of prime numbers using the Generator Function. Each table when viewed as a closed Group is generated from the prior table so it is a Self-Generating Primal Group.

There are properties in the closed Group structure such as in table Spp_n = 210 where (209,1) is a relatively prime twin prime pair (rather than (209,211) because 211 is not found in the closed Group). (209,1) then generates future true twin primes in future tables. This entire topic is deferred to the upcoming Volumes II and III. When we look at tables for this Volume I the actual relative prime and twin prime values from the two end columns are used in creating row 1 of the next table (except for multiples of the table prime number 7). The twin prime pair parents (e.g. (29,31), (59,61), etc.), in addition to twin prime pairs in the middle of the table with top (row 1) with cell values of (11,13) and (17,19), all carry to the next table to generate more twin prime pairs. Note that the cells 91 and 119 do NOT carry to the next table and will not generate twin prime pairs since they are eliminated by the selection rules (since they are not relatively prime to 210). 209 however will proceed to build row 1 of the following table since, although it is not a true prime (it has factors 11 and 19 which are larger than p_n = 7) it is relatively prime to 210 (thus it is as real a prime as any true prime relative to the current table). These numbers are all eliminated eventually by the natural selection process of the Generator Function selection rules based on the selection rule that all numbers less than p_n^2 are prime so eventually all prime numbers are identified by this naturally occurring process. The selection rules are simple when you become familiar with using them just like the selection rules and boundary conditions of other mathematical systems (such as Quantum Mechanics or Nuclear Physics). In other words, no detailed calculations, division, brute force calculations are made and no other numbers need be involved in the process as would be the case with Sieves, odd man out multiplication tables, etc.

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APPENDIX 1 – Problem Session

1) In the table Spp_n why is p_n still generating primes (since p_n is a factor of Spp_n)? P_n is prime relative to Spp_{n-1} … to create the table Spp_n you add the members of the first row (row 1) of Spp_n to the prior table magic number (and multiples of the prior table magic number) of the PRIOR table Spp_{n-1} (e.g. in table Spp_n = 2310, p_n = 11; to create the potential primes in rows 2 through 11 below the cell containing the value p_n = 11 … you add m ∘ Spp_{n-1} = m ∘ 210 where (m = 1,2,3 … p_n-1) = 210, 420, 630 … 2100 and since p_n has no common factors with any of these, these cells will generate true primes, relative primes or non-primes. It in fact will generate many relative and true primes (relative to 2310) which will then advance to the next table to generate more true primes. Without this the next table would be incomplete. This same holds true for all elements of row 1 of table Spp_n (this is a simple process but the rules to create tables must be followed exactly … the boundary conditions and selection rules are a result of simple algebra).

2) What is a proof by "Induction"? Induction is defined in the Postulates of Peano in number theory which is the basis for all numbers and mathematics. It is used to generate elements of the number system starting from only the given number "0". The McCanney Generator Function for prime numbers begins with Peano's Postulates and creates the prime numbers beginning from just the number "0" and additionally allows for the organization and mathematical structure which sets up the equations that allow for Induction to be used in the proofs of certain problems involving prime numbers. Induction is defined as one of the Peano Postulates. It states that if a property is known of a certain element in a mathematical logical structure and this property can propagate to the next logical element, then this can be inferred to continue to infinity for all elements. This was first used by the ancient Greeks to prove the infinite number of prime numbers. The current work with the Geneator Function uses proofs by Induction using the tables as visual aids to prove properties of the prime numbers.

3) Before doing this problem understand that this may be a very difficult problem even for trained mathematicians as you will be dealing with new notation and concepts. It is divided into 2 parts A and B. A) Draw tables Spp_n for n = α, 0, 1, 2, 3, 4, 5, 6, 7 and 8 (more if you can) using square cells (larger tables do not have to be to scale but please use square cells such as 1/4" graph paper taped together … e.g. use 11" x 17" graph paper marked with a 1/4" grid). There is an example in this book up to n = 4. Include the numbers in each cell for all tables up to n = 4 thereafter you can include just the main numbers at the top cells and left hand side cells. The idea is to conceptualize the growth of the tables and the pivotal ½ points in each table that gives them symmetry. The tables grow faster than exponentially and this is one of the strengths of this method of understanding prime numbers. In the base10 (mod10) number system, the number of primes per unit length diminishes as you move out the number line whereas with the Spp_n tables the number of primes, twin primes, and numbers of various size gaps in general grow in successive tables with increasing "n". Hint: for a given table Spp_n the number of rows is p_n and the number of columns is Spp_{n-1} + 1 (the plus one is for the "0" cell the top left cell of row 1 … the 0 column is needed to balance the table). B) mark the following cells on your tables … 0 and 1 and p_n and ½ Spp_{n-1} and Spp_{n-1} and Spp_{n-1} - 1 and Spp_{n-1} – p_n and Spp_n and ½ Spp_n (the center cell of the table) also mark the difference between rows as Spp_{n-1} and lastly the DZ_n "Dead Zones" between 1 & p_n & Spp_{n-1} -1 & Spp_{n-1} – p_n (only on tables and higher). Hint: Spp_{n-1} is the upper right hand corner cell and Spp_n is the lower right hand corner cell.

4) Use the tables you built in the prior exercise, building each successive table from the previous table. Use the rows from one table stringing them together to create row 1 of the subsequent table (do not repeat the numbers found in column 0 rows 2 to p_n since it is a duplicate of the values on the right hand column); use the value of the first table Spp_n as the difference between the rows in table Spp_{n+1}.

5) What are the weaknesses of base10 (mod10 or any fixed modulo) number system in understanding prime numbers ? Large numbers are just strings of digits with no meaning. They do not tell you anything about the number. They do not give understanding of the family structure of the numbers or its primality or factorization. In base 10 thinking, primes are defined as the numbers which only have themselves and 1 as factors. Although base 10 (mod10) numbers are good for some forms of mathematics and commerce, they are a hindrance to understanding prime numbers. This has given rise to statements such as "prime numbers look like so many random lottery ticket numbers strung together" or that "prime numbers are random or pseudorandom" or that "prime numbers become scarce as you progress out the number line" (although this is true in a linear number line view). When viewed with the Spp_n tables, the primes become more abundant as you progress out the number line). The mod10 number system is used primarily because we have 10 fingers. If we had 6 fingers, we would probably be using a mod6 number system, which would likewise gives no understanding of the natural construction of prime numbers.

6) Print off the files of prime numbers from 1 to 9109 taken from the Calculate Primes book and another table (look inline) listing the first 1,000,000 prime numbers. Circle in red ink as many twin primes as you can (successive primes differing by 2). Note that even though the prime numbers become farther apart with increasing size, there is a near constant "density" of twin primes throughout the table.

That is, relative to the prime numbers, there is a near constant density of twin primes. Now circle twin primes on the table to 100,000 by selecting random pages and circle as many as you can. Is the relative density of twin primes the same as earlier in the table? In the next problem, we will be taking examples of these primes and converting to the modNt number system and discovering their ancestry back to "0" the mother of all primes. Also note you can see the property of "Law of Conservation of Prime Numbers" in that if there is a larger than average gap or Maximal Gap (locally relatively large gap) there will be adjacent many small gaps typically including gaps of size 2 or twin prime pairs. This can be understood from a practical viewpoint in that if there is a larger than average gap that means that the products of relative primes and true primes of row 1 of table Spp_n have bunched together to create this gap, but since there is a limited set number of products in row 1 and this was created from the prior table, that must necessarily create near by regions where there are small gaps (regions with fewer products to cancel red cells of the table) because a large number of relative primes from row 1 were used in creating the gap. Part of this study is to examine "Maximal Gaps" and their formation as well as structure in the patterns of the prime numbers (Maximal Gaps are locally large gaps and have very interesting properties). Understanding these are essential in the proof of The Goldbach Conjecture since they affect the locally minimal number of Goldbach pairs. See also in the accompanying materials the folder on Maximal Gaps. We will use the prime number tables for illustration.

7) Every prime number has a unique set of ancestors going back to the alpha prime "0". Select random prime numbers from the prime number list and convert to its modNt form. Determine the ancestry going back to "0". Pick any twin prime pair from the list of primes. By converting the mod10 numbers to modNT, show that the twin primes have a unique ancestry of twin prime pairs going back as far as you can, eventually reaching the alpha prime "0". What is the parent twin prime of the pair you chose? Note how Nature's Number System along with the Sppn Tables help in this process whereas if using the mod10 number system this would be impossible without massive amounts of super computing power.

8) Pick any set of primes that differ by 4 and convert to their modNt form. Follow the ancestry back to the first set of ancestral primes with gap = 4.

9) There is a "rogue gap" of 34 between 1327 and 1361 (1361 – 1327 = 34 … in this book the gap convention is to use the actual gap found by subtracting the two prime numbers on both sides of the gap). The average gap between prime numbers in that region of the prime number table is about 4 or 6 with some reaching 18, but 34 is a large gap seemingly out of place. Large gaps occur but how do you explain them in terms of the "wave nature" of prime numbers as explained by the Generator Function? (Hint: first take the table for Sppn = 2310 that you created above. Find the numbers 1327 and 1361 in the table and remove all multiples of p_n = 11 by multiplying 11 times all members of row one of the red columns only table. By completing the products of all members of row 1 of table 2310, find that every relative prime number product of row 1 will cancel all numbers between 1327 and 1361). This constitutes a 100% "hit rate" amongst the products of row 1 in this region where the products "hit" cells between 1327 and 1361. Once again look at a Maximal Gap table to see how the relative size of the Max Gaps diminishes with increasing prime number size. This is basically stating that the products are spread throughout the table and the Maximal Gaps become relatively smaller with respect to the prime numbers that bound the gap. How do you similarly explain the fact that twin primes (gap = 2) continue to occur as far out as we can see in the prime number table? (Hint: understand that the entire table of relative primes of the table 2310 will carry to the next table 30030). Does this gap of 34 carry to the next table to continue to make larger and larger Maximal Gaps? (Hint: think of the rule for building subsequent tables and you will find that this rogue gap does NOT propagate to the next table since the subsequent tables are built from relative primes of the prior table so the gap of 34 does NOT propagate to the next table. This is important in understanding the orderly progression from one table to the next). Finally note that every time there is a large gap, that this is balanced by equally small gaps. Can you find numerous gaps of length 2 (twin primes) in the vicinity of the gap 34? How far away and in what direction (positive or negative) from 1327 or 1361 are these twin primes located?

10) Print out prime number tables that are available with this text or found online. It is very handy to have print copies but if you are a purely electronic person you can use them in electronic form also. Minimally you could print the 2 pages with prime numbers to 9109. The following problems will help you understand the prime numbers as described in this and prior books. First of all, take a good look at the prime number tables … what even experts in mathematics call "lists of seemingly random lottery numbers" since they will never look the same again. Take a good look since they will never look the same.

11) Using the "^" symbol in the prime number table you have printed out place the symbol in the space between prime numbers where the magic numbers would go (e.g. place ^2 between 2 an 3 and place ^6 between 5 and 7 in the prime number table; continue by placing ^30 between 29 and 31, etc to as large numbers as your table will accommodate). Hint: the magic numbers are 2, 6, 30, 210, 2310, 30030, 510510, 9699690, 223092870, etc.

12) Write small numbers in blue between the black printed prime numbers with the "gap size" (e.g. the difference between the two adjacent prime numbers … for example between 5 and 7 write "2" not including the quote marks of course, between 7 and 11 write "4", etc.). Although this may seem like a tedious task the information you are gathering is important. Note the patterns of gaps for example a gap size that seems totally out of place comes between the numbers 1327 and 1361 with a gap size of "34". Note the first time each given gap size appears. See an online listing "Maximal Gap" table. Even though the prime numbers in

general become farther apart with size, the gap sizes are not in very good order. This is the working of the Generator Function and the waves as they create the prime numbers and is typical of other wave systems that have irregular wave patterns interacting. Most importantly note every time you find a gap of "2" (circle these) "twin primes". We will work with other gap sizes and gap patterns later in this problem set. Also note however that since it is the relative primes that carry over to the next table to continue generating prime numbers, the unusual patterns found in the real prime lists **do not** continue to generate future primes and prime patterns. It is the orderly symmetrical relative primes that carry the patterns forward to future tables. This is an extremely important point and one that cannot be overstressed (that is why it is repeated many times). This is what guarantees that all prime gaps including gap = 2 are abundant in future tables which in turn guarantees their propagation in greater and greater numbers with each subsequent Spp_n table. Note for example that in the gap region 34 between 1327 and 1361 that some relative prime and twin prime pairs carry to the next table to generate future primes and twin prime pairs. This Maximal Gap (1327,1361) is relative to the particular table Spp_n = 2310 and does not carry forward to affect future tables.

13) The twin primes keep occurring in your table quite regularly. When you have a gap that is small (2) or large (like 34) you will then nearby have many larger of smaller gaps sizes respectively. In a sense, the large gaps "average out" with the smaller gaps to give an "average gap size" in that region. All of this is related to the spacing of primes and the wave nature of primes. Do you remember the discussion of "rogue primes" in the text and in the Calculate Primes book? If not, you may possibly want to review that concept at this time as it is critical to understanding what is yet to come. This leads to the **"Law of Conservation of Prime Gaps"**.

14) Go into the very large tables of the prime numbers and continue looking for twin primes (pairs of primes with gap = 2). Find online a separate table which lists just twin primes, but it is instructive to see them mixed in with all the other primes and gap sizes. Do you see that they continue to occur? Take a given twin prime pair, reduce each member of the pair to modNt number system and determine the ancestry of each going back to the number "0". Use the tables you created to visualize this process by plotting the regression of ancestors into prior tables. Do you see where this twin prime pair was born and how it was carried through various tables Spp_n to get to the final twin prime? You can do this for ANY twin prime pair convincing yourself that this ancestry is unique. Next use your selected twin prime to calculate new twin primes as it creates not just one but many twin primes in the following table. Follow one or two of the twin primes you located and create future twin primes with these. In what future tables will the twin primes you discovered be retired to the "Dead Zones". Do you see all the other twin primes (and relative twin primes) that will continue to generate more twin primes into the future? These are exercises to prepare you for the induction proofs which will prove that each twin prime pair creates an infinite number of twin primes (with gap =2). Likewise take prime pairs of any gap size OR gap patterns and follow them backwards in the tables to the alpha prime "0". Next take any twin prime (or prime pairs of any gap size or gap pattern) in row 1 of any table that you have produced and follow it into future tables watching the vast number of future twin primes (or related gap patterns) that are developed from just this one twin prime (or prime pattern), remembering that the entire prior table of relative primes carries forward to create row 1 of the subsequent table. This leads to the Theorem that every twin prime generates an infinite number of twin prime numbers which is a much more powerful proof than just the solution of The Twin Prime Conjecture that simply seeks a single future twin prime. So there are different infinities of twin prime pairs (a problem which requires the work of George Cantor on infinities to fully understand).

15) Review the Chapter "PHYSICAL SIZE OF TABLES". The tables become large very quickly. Review this important concept.

16) Using what you learned in the problem dealing with table size, create the tables up to n = 8 in both mod10 and modNt number systems. Select out the relative prime only (red) columns and show that they are symmetrical around the center ½ points of ½ Spp_{n-1} in row 1 and ½ Spp_n which is the center cell of the table Spp_n . You do not have to write the numbers into each cell but simply mark major locations so you could locate any given cell easily. Your ability to understand the construction of the tables from the prior is important.

17) Using the tables you developed in the prior problems realize the following: A) develop the list of the products of p_n with all the relative prime members of row 1 of a given table Spp_n ... these are products of p_n with (1, p_n , p_{n+1} , p_{n+2} , ... p_i ... ,(Spp_{n-1} - 1)). Remember that these include all the relative primes also that in fact are not all true primes (even true primes are called relative primes as they are relatively prime to the given table and therefore are not any more or less prime than the numbers which are not true primes but still relatively prime to the given table). This is also defined as the "$comb_{n-1}$" (note the subscript n-1 relates to the prior table which becomes row 1 of table Spp_n). Show that the products of row 1 between the nth prime number (the prime associated with table Spp_n) p_n with (1, p_n , p_{n+1} , p_{n+2} , ... p_i ... ,(Spp_{n-1} - 1)) fall with one and only one product in each of the relative prime columns of table Spp_n and that they are symmetrically spaced around the center cell ½ Spp_n (if you count backwards in the negative direction and forward in the positive direction from ½ Spp_n the product locations are symmetrically centered around the ½ cell.) B) except for the central row containing ½ Spp_n if there is one of these products located to the right of the vertical center line of the table then there is NOT a product located on the other side of the vertical center line thus giving an anti-symmetry across the vertical center line of the table. Since the table is completely a-symmetrical across the center vertical line, this means that if one prime or twin prime or other gap is "canceled" by a product on one side of the

vertical center line of the table, its symmetrical counterpart on the other side of the vertical center line will NOT be canceled which guarantees the preservation of the prime gaps as carried into future tables (all of the cells not cancelled by products of p_n will carry to the next table and propagate future primes .. this is a proof by induction. So the Spp_n tables have symmetry around the ½ point of the table ½ Spp_n , BUT are asymmetrical around the vertical center line of the table (except for the row that contains the ½ point. C) count the number of primes, twin primes and other prime gaps that will carry to the next table since only the products of p_n are not relatively prime to Spp_n and therefore will never produce prime numbers again (since when added to any future Spp_n to create future columns their offspring will never be prime due to the distributive law of arithmetic … e.g. they both will have the same factors and therefore will not create new prime numbers). They are symmetrical around the ½ point of table Spp_n therefore by removing them the numbers that remain will also be symmetrical around the ½ point which carries this symmetry to create row 1 of the next table Spp_{n+1} .

18) Vertical "stacking" of Spp_n tables. You may have noticed in filling out the complete set of products in a given table to discover all the true prime numbers in the table, that the multiples of p_n with all the members of row 1 of the relative prime only (red column) tables are symmetrical around the ½ center point of the table. However all the other products of row 1 are not symmetrical around this center point. These other products are in fact centered around ½ points of future tables and these can be observed by stacking tables vertically. Take table Spp_n and immediately below place another table that continues the counting cell values. Then below that stack another table and continue the counting process in the cells of that table and continue until you have stacked p_{n+1} tables. This is the vertical extension of table Spp_n and the products of p_{n+1} that you find in table Spp_n will be symmetrically located around the center point of this "stack" of tables. This is an advanced topic that will be discussed at length in Volumes II and III of this set.

19) There are many more problem solutions with the tables dealing with ancestry, descendants, symmetry, closure, gap sizes and gap patterns, wave patterns and properties of repeating tables, vertical and horizontal extensions of the Sppn Tables and their symmetries, formalization of methods to create an infinite number of formulas to predict future prime numbers as well as the formulae that create future tables from prior tables, etc. This book is an introduction to the mathematics of primes using these methods. Future texts are planned to continue where this text left off. If the reader comprehends what is in this book you will be ready for the next step which will also include negative and complex prime numbers.

Another set of observations gives a prelude to the upcoming papers and Volumes II & III of Principles of Prime Numbers. This is but one example of the dozens of subtleties that emerge from the Spp_n tables. Looking at the table for n = 5 with p_5 = 11 and Spp_5 = 2310, the center point of the red only table (prime and relative prime only table) = 1155. To the left of this center point is the product 11 x 103 = 1133. To the right of this center point is the product 11 x 107 = 1177. These are two of the products of 11 which **will not carry** to form row 1 of the next table Spp_6. Since the only cells of the current table that DO NOT carry to the following table are the "white boxes" with products of 11, the space between these products form a "safe zone" that will always carry to the next table carrying the two sets of twin primes with them. In this case to the left of 1155 will be the twin prime pair (1151,1153) and to the right will be the twin prime pair (1157,1159) with a gap of 4 between 1153 and 1157. These will carry to build row 1 of the following table and will be along side the center point of row 1 of the n= 6 table. These will then generate a similar set of twin prime pairs to the left and right of the center point of table n = 6 which will be (15011,15013) to the left of 15015 and (15017, 15019) to the right of 15015 with a similar gap of 4 between 15013 and 15017. This then carries to every future table thus giving a rich set of numbers to search not only for large primes, but also for twin primes and even consecutive twin primes. The future offspring of these numbers will be far more fruitful to search for large primes than the search for Mersenne Primes. If searches for large primes look in this area, we will see not only twin primes but dual twin primes with gap 4 between the pairs.

Another area will be $Spp_n \pm 1$ which will produce an abundance of primes and possible twin primes or $Spp_n \pm p_{n+1}$. These are just a few examples of what lay hidden in the Spp_n Tables, the modNt number system and the Generation Function.

APPENDIX 2

Parameters for tables Spp_n and Rpp_n and table generation

The following are the parameters associated with the prime number tables. The parameters are given for tables Spp_n and Rpp_n . Formulae for generating the same parameters for the subsequent tables Spp_{n+1} and Rpp_{n+1} are given. All formulae can be rewritten using the only variable between tables being the gap $K_n = p_{n+1} - p_n$. There are 3 tables involved in table generation 1) Spp_{n-1} and 2) Spp_n and 3) Spp_{n+1} this guarantees the transition from past to current to future tables. The subscript notation is more easily understood if you recall that relative primes and related parameters from the past and present tables carry into the future tables and that the tables are constructed by taking the p_{n-1} rows (rows 1 through p_{n-1}) of table Spp_{n-1} and placing them in sequential order to build row 1 of table Spp_n. All the relative primes from table Spp_{n-1} (which are symmetrical around the midpoint of table Spp_{n-1}) carry to row 1 of table Spp_n which are then used to generate the columns of table Spp_n by adding multiples of Spp_{n-1} to the row one cell values. Then all of the products of p_n with the relative primes list of row 1 (= 1, p_n, p_{n+1} …) are mapped in table Spp_n and eliminated since they are not relatively prime to Spp_n. Since these products are symmetrical around ½ Spp_n then all of the relative primes remaining in table Spp_n will be symmetrical around ½ Spp_n, this symmetry is carried to the next table Spp_{n+1}. Using the Generator Function each iteration creates a larger group of prime numbers than was generated by the prior iteration and therefore there is always a prime number p_{n+1} to continue the process of generating a new table. For each parameter below make sure you understand what it is and how it fits into the past, present and future tables. The goal is to use these as building blocks to generate equations that calculate all pertinent values from one table to the next in terms of abstract parameters (with only one variable = Kn the gap between the n and n+1 primes) calculating the number of primes, number of twin primes, number of gaps, etc. Ultimately the equations can be used to allow proofs including by Induction.

Spp_n types of tables are 1) Complete table including all numbers from 0 to value of Spp_n, 2) "raw" relative prime only table (red columns with no modifications) just created by carrying all relative primes from prior table to row 1 of current table, 3) relative prime table (with only products of p_n removed … used to carry and build the next table) and 4) true primes only table (where all products of all relative primes from row 1 have removed cells and all that remains in the red table are true primes). Rpp_n types of tables are 1) table Rpp_n and 2) table showing both Rpp_n and Rpp_{n+1} showing the progression from one table to the next. In the next paper we will deal with twin prime only tables.

NOTE: one has to be careful in the numbers below to differentiate between tables with all cells including all non-prime columns and tables which only include relative prime columns. After creating the first few tables with all numbers (for illustration), only the relative prime tables will be used which is consistent with the process of directly calculating prime numbers from previously discovered prime numbers. For notation "x" (small x) is used for multiplication (standard mathematical notation applies if two quantities are listed they represent a product); "/" and "÷" are both used for division (the notation is obvious from the use); other abbreviations and definitions are Pr = primes; Rel = relative; Cel = Cells (or boxes containing numbers); Pd = products; Tot = Total number of; T = true (e.g. true primes); Col = columns; N = new (e.g. newly discovered primes in a table); # = number of; √ = square root of the argument that follows; % = ratio of two numbers: α = the first counting iteration of generating the prime numbers known as the "alpha prime"; "raw table" refers to the tables Spp_n before any products of relative primes have been marked and/or eliminated; $k_n = (p_n, p_{n+1})$ = successive prime pair p_n and p_{n+1} with gap $k_n = p_{n+1} - p_n$.

Parameter	Parameter name	Values / Equation & Notes	Equation for generating parameter for subsequent tables / Notes
n - 1	Table iteration "n-1"	= α, 0, 1, 2, 3, 4 … ∞ / Note: α represents the alpha prime "0" the first and starting iteration of the tables	= n
n	Table iteration "n"	= α, 0, 1, 2, 3, 4 … ∞ / also exponent in Nature's Number System modNt $10^n = Spp_n$	= n + 1
P_{n-1}	(n – 1) th prime number - associated with table Spp_{n-1}	= 0, 1, 2, 3, 5, 7 …∞ / number of rows table Spp_{n-1} / top cell of column outside Dead Zone DZ_{n-1} in table Spp_{n-1}	P_n = Generator Function Selection Rules
P_n	nth prime number -associated with table Spp_n	= 0, 1, 2, 3, 5, 7 … ∞ / number of rows table Spp_n / top cell of column outside Dead Zone DZ_n table Spp_n / 0 and 1 are prime by new definition (factor definition explained in book "Calculate Primes")	P_{n+1} = Generator Function Selection Rules
P_n^2	nth prime number squared	This value has many uses in the tables but primarily is the upper limit if primes discovered by the Generator Function (the Strong Rule for discovering primes)	P_{n+1}^2
K_{n-1}	(n – 1)th Gap (between p_{n-1} & p_n)	= 2, 4, 6 … ∞ / = $p_n - p_{n-1}$	$K_n = P_{n+1} - p_n$
K_n	nth Gap (between p_n & p_{n+1})	= $P_{n+1} - p_n$	$K_{n+1} = P_{n+2} - p_{n+1}$
Spp_{n-1}	Sequential prime Product n - 1	= 1 x 2 x 3 x 5 … x p_{n-1} … is the top right hand cell value of table Spp_n	$Spp_n = Spp_{n-1}$ x p_n
½ Spp_{n-1}	One half Spp_{n-1}	Center cell value table Spp_{n-1} carries to create center cell row 1 table Spp_n guarantees symmetry is carried from one table to next	½ Spp_n = ½ (Spp_{n-1} x p_n)
Spp_n	Sequential prime Product n	$Spp_n = Spp_{n-1}$ x p_n / value of nth Sequential Prime Product / highest value cell (lower right corner cell) in table Spp_n / used as base (modulo) in modNt Nature's Number System / nth wavelength repeats to ∞	$Spp_{n+1} = Spp_n$ x p_{n+1}
$\sqrt{Spp_n}$	Square root of Spp_n	Is the upper limit of x axis prime numbers in the Rpp_n (Relative Prime Product) table which are the products of row 1 prime numbers in the Spp_n table with all relative primes of row 1 (bounded by selection rules described below) / related to upper limit curve Spp_n / x … All these numbers are always true prime numbers as they are always less than p_n^2 (see Chapter 1 for more details)	$\sqrt{Spp_{n+1}} = \sqrt{(Spp_n \text{ x } p_{n+1})} = \sqrt{Spp_n}$ x $\sqrt{p_{n+1}}$ / the second form is used to create the Rpp_{n+1} products graph from prior table Rpp_n
½ Spp_n	One half Spp_n	Center cell table Spp_n carries to create center cell row 1 table Spp_{n+1} and guarantees symmetry is carried from nth table to the next table	½ Spp_{n+1} = ½ (Spp_n x p_{n+1})
m Spp_n	m ∘ Spp_n	The multiples of Spp_n - important properties m = 1, 2, 3, …	m Spp_{n+1}
½ m Spp_n	One half m ∘ Spp_n	The symmetries here are very important and this has important implications in proofs dealing with all aspects of prime numbers including Maximal Gaps, The Goldbach Conjecture and others. In the proofs the Maximal Gaps problem is closely related to the solution of the Goldbach Conjecture and these ½ point symmetries of primes are important	½ m Spp_{n+1}

$(1, p_n, p_{n+1}, \ldots, Spp_{n-1} - 1)$	"comb of n-1" = $comb_{n-1}$	$Comb_{n-1}$ (note subscript = n-1) is the set of ***relative*** prime numbers of row 1 of table Spp_n (before removing multiples of p_n) carried from combining in sequence all rows of table Spp_{n-1} … these are used to create the repeating wave of potential prime values to infinity … in general $m\, Spp_{n-1} \pm comb_{n-1}$ = pattern for all ***future*** primes (the patterns are symmetrical and extend to positive and negative infinity). Where m is any positive or negative integer (although in this Volume I we only use the positive integers to predict positive primes) Examples are $m6 \pm comb_2$ (n = 2 for Spp_n=6) where $comb_2$ = (1,5) and $m\, 30 \pm comb_3$ (n = 3 for Spp_n = 30) $comb_3$ = (1,7,11,13,17,19,23,29) which are symmetrical around the ½ point of row 1 of table n = 4 which is 15.	$(1, p_{n+1}, p_{n+2}, \ldots, Spp_n - 1)$ Note that the traditional way mathematicians state the n = 2 equation is $m6 \pm 1$ which one can show easily is the same as $m6 \pm (1,5)$ where m = 1,2,3… This is where modern mathematical attempts at organizing or predicting the prime numbers with analytic equations ends. The current work shows that there are an infinite number of such equations (one for each table Spp_n). There are similarly an infinite number of equations for prediction of twin primes. The first example from table n = 3 is (5 + (m – 1)6, 1 + m6), m = 1,2,3… (all twin primes meet this criteria)
$(1, p_{n+1}, p_{n+2}, \ldots, Spp_n - 1)$	"comb of n" = $comb_n$	Elements of row 1 of table Spp_{n+1} . Multiples of Spp_n = m Spp_n added to members of $comb_n$ as well as products of $comb_n$ with p_n are important in the theoretical structure of the prime numbers. Each table n has a $comb_n$ which predicts fewer potential primes than the prior $comb_{n-1}$ of the previous table .. this is essential in creating the McCanney Prime Density Function	$(1, p_{n+2}, p_{n+3}, \ldots, Spp_{n+1} - 1)$ (see notes immediately above regarding one use of the "comb"
$\#TotCol_{n-1}$	Total number of columns in Spp_{n-1} (including non-relative prime columns)	= $Spp_{n-2} + 1$ / the rows of table Spp_{n-2} are placed in sequence to build row 1 of table Spp_{n-1} / have to add 1 to include column "0" … note: there is a "0" cell in table Spp_{n-1} so it requires adding 1 to the value of Spp_{n-2} to determine the number of columns in Spp_{n-1} … the 0 column is the upper left cell and is symmetrical with Spp_{n-2} in row 1 which is the upper right cell of table Spp_{n-1})	$\#TotCol_n = Spp_{n-1} + 1$
$\#TotCol_n$	Total number of columns in Spp_n (including non-relative prime columns)	= $Spp_{n-1} + 1$ / the rows of table Spp_{n-1} are placed in sequence to build row 1 of table Spp_n … (have to add 1 to include column "0" … note: there is a "0" cell in table Spp_n so it requires adding 1 to the value of Spp_{n-1} to determine the number of columns in Spp_n … the 0 column is the upper left cell and is symmetrical with Spp_{n-1} which is the upper right cell of table Spp_n)	$\#TotCol_{n+1} = Spp_n + 1$
DZ_{n-1}	Dead Zone table Spp_{n-1}	= 2, 3, 5 … p_{n-2} / region between 1 and p_{n-1} of table Spp_{n-1} refers to true primes < p_{n-1} in row 1 which cannot generate primes and are not included in the relative prime only tables of Spp_{n-1}	$DZ_n = DZ_{n-1} + K_{n-1}$ / region between 1 and p_n in table Spp_n / the prior table prime number p_{n-1} enters the DZ_n (see explanation below)
DZ_n	Dead Zone table Spp_n	= 2, 3, 5 … p_{n-1} / region between 1 and p_n of table Spp_n refers to true primes < p_n in row 1 which cannot generate primes and are not included in the relative prime only tables of Spp_n/ the prior table prime number p_{n-1} enters the DZ_n of table Spp_n	$DZ_{n+1} = DZ_n + K_n$ / Dead Zone table Spp_{n+1} / the prior table prime number p_n enters the DZ_{n+1}
$Spp_{n-1} - 1$		Row 1 of each table Spp_n is created by placing in order the rows of table Spp_{n-1} with all cells symmetrical around ½ Spp_{n-1} therefore $(Spp_{n-1} - 1)$ is the column in table Spp_n symmetrical with column 1 and creates in cells below twin prime pairs / in table Spp_{n-1} this value is always relatively prime to Spp_{n-1} and therefore always carries to row 1 of table Spp_n to created twin primes with column 1 of table Spp_n	= $Spp_n - 1$ / carries to table Spp_{n+1} row 1 and is the symmetrically located cell related to column 1 of table Spp_{n+1}
$Spp_{n-1} - p_n$		Row 1 of each table Spp_n is created by placing in order the rows of table Spp_{n-1} with all cells symmetrical around ½ Spp_{n-1} therefore $(Spp_{n-1} - p_n)$ is the column in table Spp_n symmetrical with column p_n	$Spp_n - p_{n+1}$ carries to table Spp_{n+1} row 1 and is the symmetrically located cell related to column p_{n+1} of table Spp_{n+1}
$A_1A_2A_3 \ldots A_{n+1}$	Nature's Number System	Representation modNt of counting numbers using successive values of Spp_n (1, 2, 6, 30, 210 … mod10 = 0, 10,100, 1000, 10000 modNt) (in reverse order from right to left) to represent numbers. This system of numbers results naturally from the Generator Function and is much easier to represent all numbers especially large numbers	$A_1A_2A_3 \ldots A_{n+2}$ Nature's Number System would be discovered by beings on the far side of the universe as opposed to the use of for example mod10 which has more to do with the number of toes and fingers we have than a natural progression of numbers
$\#NPr<p_n^2$	Number of NEW prime numbers in table Spp_n – to find the number of NEW primes using the Generator Function Rule use $p_{n-1}^2<\#NPr<p_n^2$	= "Generator Function Rule" for discovering prime numbers / number of "discovered" prime numbers p_m in table Spp_n such that $p_{n-1}^2 < p_m < p_n^2$ / no new products can exist in this region also called the "Safe Zone" SZ / for n < 6 p_n^2 is greater than $\sqrt{Spp_n}$ and is used in this region to discover true primes and is called the "Strong Rule" but one could also use the "Weak Rule" using $\sqrt{Spp_{n-1}} < p_m < \sqrt{Spp_n}$ but for n ≥ 6 p_n^2 is less than $\sqrt{Spp_n}$ … since there can be relative primes that are not true primes between p_n^2 and $\sqrt{Spp_n}$ the use of the Strong Rule $p_{n-1}^2 < p_m < p_n^2$ can be used for all n to maximize prime number discovery	$\#NPr<p_{n+1}^2$ = number of new primes in Spp_{n+1} such that $p_n^2 < p_m < p_{n+1}^2$ NOTE: the complete compliment of prime numbers is discovered in every table by completing the products of all members of row 1 per rules of table Rpp_n … the $\#NPr<p_n^2$ "discovery" is based on the natural process and boundary conditions of the Generator Function which discovers prime numbers in groups by adding and subtracting prior table primes … this is the basis for the direct calculation of prime numbers and should not

			be confused with Rpp_n tables which discover all prime numbers in a given table Spp_n
SZ_{n-1}	Safe Zone Table Spp_{n-1}	The region between $p_{n-2}^2 < p_i < p_{n-1}^2$ in which all numbers not eliminated by the boundary conditions of the Generator Function are discovered to be true primes	$= SZ_n\ p_{n-1}^2 < p_i < p_n^2$
SZ_n	Safe Zone Table Spp_n	The region between $p_{n-1}^2 < p_m < p_n^2$ in which all numbers not eliminated by the boundary conditions of the Generator Function are discovered to be true primes	$= SZ_{n+1}\ p_n^2 < p_m < p_{n+1}^2$
NOTE:	ON FORMULAE	The construction of notation can be tedious but is necessary to build the formulae	This is what will lead to proofs by induction
Rpp_n	NEED ALL RPPN PARAMENTERS	**** **** ***	
$\#Pdp_n$	Number of products of p_n in tables Spp_n and Rpp_n	$= p_n \times p_j$ ($p_j = 1, p_n, p_{n+1}, p_{n+2} \dots (Spp_{n-1} - 1)$) / number of products resulting from column p_n of table Rpp_n where p_n is multiplied by all relative primes in column p_n of Rpp_n (also as viewed in table Spp_n it is the series of products of p_n with all relative primes of row 1) / these products are not relatively prime to Spp_n because they all contain factor p_n and are eliminated (do not carry forward to build columns in next table) / these products (white boxes in the table Spp_n) eliminate one and only one cell in each column and are symmetrical around center cell ½ Spp_n which preserves the symmetry when carried to the the next table / all other products ARE relatively prime to Spp_n and although not symmetrically located around ½ Spp_n (they will be symmetrically located in their respective future tables) this does not matter in maintaining the symmetry of the following table Spp_{n+1} because all relative products other than Pdp_n carry to the next table … There are duplicate products which have to be accounted for in determining the true number of products.	$\#Pdp_{n+1}$ = number of products of p_{n+1} with the relative primes ($1, p_{n+1}, p_{n+2} \dots (Spp_n - 1)$) in column p_{n+1} of table Rpp_{n+1} NOTE: VERY IMPORTANT OBSERVATION The number of products of p_n is also the same number of red or relative prime columns in table Spp_n (there is one product for each member of row 1 and therefore the same number of products as columns … additionally, so there is one and only one product for each column which **eliminates one cell in each column** … the eliminated cells are symmetrical around $1/2Spp_n$ and when eliminated leave the remaining cells symmetrically located around the table's center cell $1/2Spp_n$ … it is this group of symmetrical cells which carry to the next table and guarantee that the next table will by symmetrical … table symmetry is always preserved from Spp_n to Spp_{n+1}
$\#RelPrCol_n$	Number of relative prime only columns Spp_n this is the number of columns in which prime numbers are generated and the only columns in the "red" cell only relative prime only table	$= (\#RelPrCol_{n-1} \times p_{n-1}) - \#Pdp_{n-1} - 2$ / total number of relative primes from rows 1 through p_{n-1} carried from table Spp_{n-1} less the non-relative prime products eliminated from table Spp_{n-1} less the two cells p_{n-1} and $(Spp_{n-1} - p_{n-1})$ that enter the Dead Zone DZ_n / to these cell values in row 1 of Spp_n are added multiples of Spp_{n-1} to create the raw table Spp_n /	$\#RelPrCol_{n+1} = (\#RelPrCol_n \times p_n) - \#Pdp_n - 2$ NOTE: since the number products of p_{n-1} with relative primes of row 1 of table Spp_n is also equal to ($\#Pdp_n = \#RelPrCol_{n-1}$) this expression can also be written as $\#RelPrCol_n = (\#RelPrCol_{n-1} \times (p_{n-1} - 1)) - 2$ This is one of the most important equations / it is the basis for creating new tables from prior tables
$\#RelPrCel_n$	Number of relative Prime Cells Spp_n	$= \#RelPrCol_n \times p_n$ / Number of Relative Prime only columns Spp_n multiplied by p_n rows gives total number of cells (red cells) in the "raw" table of Spp_n	$\#RelPrCel_{n+1} = \#RelPrCol_{n+1} \times p_{n+1}$
$\#NRelPrCel_n$	Number of New Relative Prime Cells Spp_n	$= \#RelPrCol_n \times (p_n - 1)$ /Relative Prime Cells rows 2 to P_n / same result as $\#RelPrCel_n$ above except not including row 1 of Spp_n which came completely from prior table Spp_{n-1} and therefore is not new / this gives number of new cells in Spp_n which will be the base for discovering new primes, twin primes, etc. in Spp_n	$\#NRelPrCel_{n+1} = \#RelPrCol_{n+1} \times (p_{n+1} - 1)$
X and Y	X and Y (caps) axis on combination table Spp_n and Rpp_n	Used to mark X and Y axis in the combination graphs of Spp_n and Rpp_n also in some proofs continuous variables "x" and "y" (small letters) replace the prime numbers, gaps or other variables	
$Spp_n \div X$	1/X upper limit curve for table Rpp_n	Equation limiting products $p_i \times p_j$ in section B_n of table Rpp_n / Spp_n X (substituting p_i for X gives the upper limit of relative prime factors p_j without exceeding table size maximum value of table Spp_n)	$Spp_{n+1} \div X = (Spp_n \times p_{n+1}) \div X = (Spp_n \div X) \times p_{n+1}$ / the second form is used to create the Rpp_{n+1} products graph to compare to prior table Rpp_n
$mSpp_{n-1} \div X$	m = 1,2,3…. P_n	The complete set of limiting 1/X curves for table Rpp_n / each curve represents the upper limit of relative prime product values for each m_{th} row of table Spp_n with the final value = Spp_n (Note that the first curve for m = 0 is the same as the upper limit curve for tables Rpp_{n-1} & Spp_{n-1}) these are very important in showing product distribution	$= mSpp_n \div X$ (m = 1,2,3…. P_{n+1})
$\#A_n$	Number of products in section A_n table Rpp_n	$= \left(\sum_{i=n}^{\#Pdpn<\sqrt{Sppn}} i \right) \div 2$	XXX = XXXXX

$\#B_n$	Number of products in section B_n table Rpp_n	p_i and $p_j < \sqrt{Spp_n}$ XXXXXXXXXXXXXX including products in column p_n $\#Pdp_n$ of table Rpp_n XXXXXXXXXXXXX /XXXX / GIVE RULES ON ONLY MULT PRIMES BY NON REL PRIMES HAVE TO BE DONE IN ORDER !!! including products in column p_n $\#Pdp_n$ of table Rpp_n	XXX = XXXXXXXXXXXX
$\#PdRpp_n$	Number products in table Rpp_n	$= A_n + B_n$	XXX = XXX
$\#RelPdRpp_n$	Number of products relatively prime to Spp_n from table Rpp_n	$= \#A_n + \#B_n - \#Pdp_n = \#PdRpp_n - \#Pdp_n$ / Total number of relative prime products table Rpp_n which includes all products from both regions A_n and B_n less the products in the p_n column of Rpp_n which are not prime relative to Spp_n / this is a very important number compared to the number of cells in raw table	XXX = XXXXXXXXXXXXXX
$\#RelPr_n$	Number of Relative Primes table Spp_n	$= \#RelPrCel_n - \#PdRpp_n$ / the number of relative primes table Spp_n which will carry to the next table includes true primes and primes relative to Spp_n	
$\#TPr_n$	Number of New True Primes table Spp_n	$= - \#PdRpp_n$ / also known as the "strong rule" for the number of new true twin? primes between Spp_{n-1} and Spp_n = the number of new true primes in columns 2 through p_n in table Spp_n	= XXXXXXXXXXXXX **** Two patterns … GEN FUNCTION and ALL PRIMES m
$\#RelPdRpp_n + \#Tpr_n + \#Pdp_n$	Sum of total number of relative prime products plus total number of true primes plus number of non-relative primes in prime only table	$= \#RelPrCel_n$ = total number of cells in the primes only table of Spp_n / there are three possible cells in the table 1) products relatively prime to Spp_n and 2)	
$\%TPr_n/TPr_{n-1}$	Ratio number true primes $\#TPr_n$ table Spp_n and number true primes $\#TPr_{n-1}$ table Spp_{n-1}	$= \#TPr_n \div \#TPr_{n-1}$ / ratio shows the growth of the new prime numbers from table Spp_{n-1} to Spp_n / this ratio increases with increasing n is fundamental to proof of infinite number of prime numbers and also base for other proofs such as the twin primes conjecture and generalized twin prime conjecture / it is also important to understand the distribution of the products in the table in building these proofs	$\%TPr_{n+1} = \#TPr_{n+1} \div \#TPr_n$
Mpgi	ith Maximal Prime Gap	Using the accepted definition of Maximal Prime (a locally large prime gap). Note this uses the counting subscript "i" to note the "ith" Maximal Prime Gap in the standard Maximal Prime tables (we use the definition where the gap is the even number difference between the two prime numbers on both sides of the gap (this is consistent with nomenclature for example such that gap = 2 is a twin prime	See accepted tables of Maximal Primes
$MMpg_n$	$= p_{n-1} \circ comb_{n-1}$ Complete set Maximum Maximal Prime Gaps of table Spp_n	Note this uses the counting subscript "n" which is different from the "i" used in the Mpg_i definition above because this parameter represents many gaps within a given table Spp_n . This is the set of all gaps in table Spp_n found by multiplying p_{n-1} by the set of all relative primes of the prior table Spp_{n-1} which is the same as $comb_{n-1}$. These are products that carry to build the table Spp_n … there can not be any gaps larger that these (there will be smaller gaps but none larger than this set. Essential in the proof of the Goldbach Conjecture.	$MMpg_{n+1} = p_n \circ comb_n$
Ngb_i	Number of Goldbach Prime Pairs for number "i" where i is any natural number	The essence of the Goldbach conjecture lies in the analysis of this parameter. If this is ever 0 for any natural number "i" then this would disprove the Goldback Conjecture.	Ngb_{i+1} The proof of the Goldbach Conjecture is directly related to the understanding of Maximal Gaps

APPENDIX 3

Values n, p_n and Spp_n to n = 170; p_n = 1013, all numbers given in base 10 (mod10)

To find the magic number in modNt "Nature's Number System" take 1 and write the number of zeros after = to the "iteration number" … the first few magic numbers in modNt are noted below … it is interesting to see the modNt numbers with far fewer digits as you go to larger and larger Spp_n values … for example the last iteration n = 170 the magic number has a mod10 number with 422 digits whereas the modNt number equivalent only has 170 digits (1 followed by 170 zeros) … also which number is easier to identify ? There are many great advantages to using a number system constructed from the prime numbers.

This is iteration number α
The prime number is 0 (zero is the "α" alpha prime)
The magic number is undefined = 0
The magic number has 1 digits (mod10)

This is iteration number 0
The prime number is 1
The magic number is 1 (mod10) (= 1 = 10^0 (modNt))
The magic number has 1 digits (mod10)

This is iteration number 1
The prime number is 2
The magic number is 2 (mod 10) (= 10 = 10^1 (modNt))
The magic number has 1 digits (mod10)

This is iteration number 2
The prime number is 3
The magic number is 6 (mod10) (= 100 = 10^2 (modNt))
The magic number has 1 digits (mod10)

This is iteration number 3
The prime number is 5
The magic number is 30 (mod 10) (= 1000 = 10^3 (modNt))
The magic number has 2 digits (mod10)

This is iteration number 4
The prime number is 7
The magic number is 210 mod10 (= 10000 = 10^4 (modNt))
The magic number has 3 digits (mod10)

This is iteration number 5
The prime number is 11
The magic number is 2310 (from here on create the modNt equivalent number = 10^n)
The magic number has 4 digits (mod10)

This is iteration number 6
The prime number is 13
The magic number is 30030
The magic number has 5 digits (mod10)

This is iteration number 7
The prime number is 17
The magic number is 510510
The magic number has 6 digits (mod10)

This is iteration number 8
The prime number is 19
The magic number is 9699690
The magic number has 7 digits (mod10)

This is iteration number 9
The prime number is 23
The magic number is 223092870
The magic number has 9 digits (mod10)

This is iteration number 10
The prime number is 29
The magic number is 6469693230
The magic number has 10 digits (mod10)

This is iteration number 11
The prime number is 31
The magic number is 200560490130
The magic number has 12 digits (mod10)

This is iteration number 12
The prime number is 37
The magic number is 7420738134810
The magic number has 13 digits (mod10)

This is iteration number 13
The prime number is 41
The magic number is 304250263527210
The magic number has 15 digits (mod10)

This is iteration number 14
The prime number is 43
The magic number is 13082761331670030
The magic number has 17 digits (mod10)

This is iteration number 15
The prime number is 47
The magic number is 614889782588491410
The magic number has 18 digits (mod10)

This is iteration number 16
The prime number is 53
The magic number is 32589158477190044730
The magic number has 20 digits (mod10)

This is iteration number 17
The prime number is 59
The magic number is 1922760350154212639070
The magic number has 22 digits (mod10)

This is iteration number 18
The prime number is 61
The magic number is 117288381359406970983270
The magic number has 24 digits (mod10)

This is iteration number 19
The prime number is 67
The magic number is 7858321551080267055879090
The magic number has 25 digits (mod10)

This is iteration number 20
The prime number is 71
The magic number is 557940830126698960967415390
The magic number has 27 digits (mod10)

This is iteration number 21
The prime number is 73
The magic number is 40729680599249024150621323470
The magic number has 29 digits (mod10)

This is iteration number 22
The prime number is 79
The magic number is 3217644767340672907899084554130
The magic number has 31 digits (mod10)

This is iteration number 23
The prime number is 83
The magic number is 267064515689275851355624017992790
The magic number has 33 digits (mod10)

This is iteration number 24
The prime number is 89
The magic number is 23768741896345550770650537601358310
The magic number has 35 digits (mod10)

This is iteration number 25
The prime number is 97
The magic number is 2305567963945518424753102147331756070
The magic number has 37 digits (mod10)

This is iteration number 26
The prime number is 101
The magic number is
232862364358497360900063316880507363070
The magic number has 39 digits (mod10)

This is iteration number 27
The prime number is 103
The magic number is
23984823528925228172706521638692258396210
The magic number has 41 digits (mod10)

This is iteration number 28
The prime number is 107
The magic number is
2566376117594999414479597815340071648394470
The magic number has 43 digits (mod10)

This is iteration number 29
The prime number is 109
The magic number is
279734996817854936178276161872067809674997230
The magic number has 45 digits (mod10)

This is iteration number 30
The prime number is 113
The magic number is
31610054640417607788145206291543662493274686990
The magic number has 47 digits (mod10)

This is iteration number 31
The prime number is 127
The magic number is
4014476939333036189094441199026045136645885247730
The magic number has 49 digits (mod10)

This is iteration number 32
The prime number is 131
The magic number is
525896479052627740771371797072411912900610967452630
The magic number has 51 digits (mod10)

This is iteration number 33
The prime number is 137
The magic number is
72047817630210000485677936198920432067383702541010310
The magic number has 53 digits (mod10)

This is iteration number 34
The prime number is 139
The magic number is
1001464665059919006750923313164994005736633465320043309
0
The magic number has 56 digits (mod10)

This is iteration number 35
The prime number is 149
The magic number is
1492182350939279320058875736615841068547583863326864530
410
The magic number has 58 digits (mod10)

This is iteration number 36
The prime number is 151
The magic number is
2253195349918311773288902362289920013506851633623565440
91910
The magic number has 60 digits (mod10)

This is iteration number 37
The prime number is 157
The magic number is
3537516699371749484063576708795174421205757064788997742
2429870
The magic number has 62 digits (mod10)

This is iteration number 38
The prime number is 163
The magic number is
5766152219975951659023630035336134306565384015606066319
856068810
The magic number has 64 digits (mod10)

This is iteration number 39
The prime number is 167
The magic number is
9629474207359839270569462159011344291964191306062130754
15963491270
The magic number has 66 digits (mod10)

This is iteration number 40
The prime number is 173
The magic number is
1665899037873252193808516953508962562509805095948748620
46961683989710
The magic number has 69 digits (mod10)

This is iteration number 41
The prime number is 179
The magic number is
2981959277793121426917245346781042986892551121748260030
6406141434158090
The magic number has 71 digits (mod10)

This is iteration number 42
The prime number is 181
The magic number is
5397346292805549782720214077673687806275517530364350655
459511599582614290
The magic number has 73 digits (mod10)

This is iteration number 43
The prime number is 191
The magic number is
1030893141925860008499560888835674370998623848299590975
192766715520279329390
The magic number has 76 digits (mod10)

This is iteration number 44
The prime number is 193
The magic number is
1989623763916909816404152515452851536027344027218210582
12203976095413910572270
The magic number has 78 digits (mod10)

This is iteration number 45
The prime number is 197
The magic number is
3919558814916312338316180455442117525973867733619874846
7804183290796540382737190
The magic number has 80 digits (mod10)

This is iteration number 46
The prime number is 199
The magic number is
7799922041683461553249199106329813876687996789903550945
093032474868511536164700810
The magic number has 82 digits (mod10)

This is iteration number 47
The prime number is 211
The magic number is
1645783550795210387735581011435590727981167322669649249
414629852197255934130751870910

The magic number has 85 digits (mod10)

This is iteration number 48
The prime number is 223
The magic number is
3670097318273319164650345655501367323398003129553317826
1946245703998807331115766721293 0
The magic number has 87 digits (mod10)

This is iteration number 49
The prime number is 227
The magic number is
8331120912480434503756284637988103824113467104086031465
4617977748077292641632790457335110
The magic number has 89 digits (mod10)

This is iteration number 50
The prime number is 229
The magic number is
1907826688958019501360189182099275775721983966835701205
5907516904309700014933909014729740190
The magic number has 92 digits (mod10)

This is iteration number 51
The prime number is 233
The magic number is
4445236185272185438169240794291312557432222642727183809
026451438704160103479600800432029464270
The magic number has 94 digits (mod10)

This is iteration number 52
The prime number is 239
The magic number is
1062411448280052319722448549835623701226301211611796930
357321893850294264731624591303255041960530
The magic number has 97 digits (mod10)

This is iteration number 53
The prime number is 241
The magic number is
2560411590354926090531101005103853119955385919984430602
16114576417920917800321526504084465112487730
The magic number has 99 digits (mod10)

This is iteration number 54
The prime number is 251
The magic number is
6426633091790864487233063522810671331088018659160920811
424475868089815036788070315252520074323442023 0
The magic number has 101 digits (mod10)

This is iteration number 55
The prime number is 257
The magic number is
1651644704590252173218897325362342532089620795404356648
5360902980990824644545340710198976591011245999110
The magic number has 104 digits (mod10)

This is iteration number 56
The prime number is 263
The magic number is
4343825573072363215565699965702960859395702691913457985
64991748400058688151542460678233084343595769776593 0
The magic number has 106 digits (mod10)

This is iteration number 57
The prime number is 269
The magic number is
1168489079156465704987173290774096471177444024124720198
13982780319615787112764921922444699688427262069903517 0
The magic number has 109 digits (mod10)

This is iteration number 58
The prime number is 271
The magic number is
3166605404514022060515239617997801436890873305377991736
9589333466615878307559293840982513615563788020943853107
0
The magic number has 111 digits (mod10)

This is iteration number 59
The prime number is 277
The magic number is
8771496970503841107627213741853909980187719055897037111
3762453702525982911939243939521562715111692818014473106
390
The magic number has 113 digits (mod10)

This is iteration number 60
The prime number is 281
The magic number is
2464790648711579351243247061460948704432749054707067428
2967249490409801198254927547005559122946385681862066942
895590
The magic number has 116 digits (mod10)

This is iteration number 61
The prime number is 283
The magic number is
6975357535853769564018389183934484833544679824821000822
0797316057859737391061444958025732317938271479669649448
39451970
The magic number has 118 digits (mod10)

This is iteration number 62
The prime number is 293
The magic number is
2043779758005154482257388030892804056228591188672553240
8693613604952903055581003372701539569155913543543207288
37959427210
The magic number has 121 digits (mod10)

This is iteration number 63
The prime number is 307
The magic number is
6274403857075824260530181254840908452621774949224738449
4689393767205412380633680354193726477308654578677646375
3253544153470
The magic number has 123 digits (mod10)

This is iteration number 64
The prime number is 311
The magic number is
1951339599550581345024886370255522528765372009208893657
7848401461600883250377074590154248934442991573968748022
7261852231729170
The magic number has 126 digits (mod10)

This is iteration number 65
The prime number is 313
The magic number is

61076929465933196099278943388997855150356143888238371488665496574810764573680243467182799164806563626522181311132959748531230210
The magic number has 128 digits (mod10)

This is iteration number 66
The prime number is 317
The magic number is
19361386640700823163471425054312320082662897612571563761906962414215012369856637179096947335243680669607531475629148240284399976570
The magic number has 131 digits (mod10)

This is iteration number 67
The prime number is 331
The magic number is
6408618978071972467109041692977377947361419109761187605191204559105169094422546906281089567965658301640092918433248067534136392244670
The magic number has 133 digits (mod10)

This is iteration number 68
The prime number is 337
The magic number is
2159704595610254721415747050533376368260798239989520222949435936418441984820398307416727184404426847652711313512004598759003964186453790
The magic number has 136 digits (mod10)

This is iteration number 69
The prime number is 347
The magic number is
749417494676758388331264226535081599786496989276363517363454269937199368732678212673604332988336116135490825788665595769374375572699465130
The magic number has 138 digits (mod10)

This is iteration number 70
The prime number is 349
The magic number is
261546705642188677527611215060743478325487449257450867559845540208082579687704696223087912212929304531286298200244292923511657074872113330370
The magic number has 141 digits (mod10)

This is iteration number 71
The prime number is 353
The magic number is
92325987091692603167246758916442447848897069587880156248625475693453150629759757766750033011164044499544063264686235401999614947429856005620610
The magic number has 143 digits (mod10)

This is iteration number 72
The prime number is 359
The magic number is
33145029365917644537041586451002838777754047982048976093256545773949681076083753038263261851007891975336318712022358509317861766127318306017798990
The magic number has 146 digits (mod10)

This is iteration number 73
The prime number is 367
The magic number is
12164225777291775545094262227518041831435735609411974226225152299039532954922737365042617099319896354948428967312205572919655268168725818308532229330
The magic number has 149 digits (mod10)

This is iteration number 74
The prime number is 373
The magic number is
4537256214929832278320159810864229603125529382310666386381981807541745792186181037160896178046321340395764004807452678699031415026934730229082521540090
The magic number has 151 digits (mod10)

This is iteration number 75
The prime number is 379
The magic number is
1719620105458406433483340568317543019584575635895742560438771105058321655238562613083979651479555788009994557822024565226932906295208262756822275663694110
The magic number has 154 digits (mod10)

This is iteration number 76
The prime number is 383
The magic number is
658614500390569664024119437665618976500892468548069400648049333237337193956369480811164206516669866807827915645835408481915303111064764635862931579194844130
The magic number has 156 digits (mod10)

This is iteration number 77
The prime number is 389
The magic number is
256201040651931599305382461251925781858847170265198996852091190629324168449027728035542876334984578188245059186229973899465052910204193443350680384306794366570
The magic number has 159 digits (mod10)

This is iteration number 78
The prime number is 397
The magic number is
101711813138816844924236837117014535397962326595284001750280202679841694874264008030110521904988877540733288496933299638087626005351064797010220112569797363528290
The magic number has 162 digits (mod10)

This is iteration number 79
The prime number is 401
The magic number is
40786437068665554814618971683922828694582892964708884701862361274616519644579867220074319283900539893834048687270253154873138028145776983601098265140488742774844290
The magic number has 164 digits (mod10)

This is iteration number 80
The prime number is 409
The magic number is
16681652761084211919179159418724436936084403222565933843061705761318156534633165693010396587115320816578125913093533540343113453511622786292849190442459895794911314610
The magic number has 167 digits (mod10)

This is iteration number 81
The prime number is 419
The magic number is

6989612506894284794136067796445539076219364950255126280
2428547139923075880112964253713561700013194221462347575
8619055340376453702136994745670381079539069633806784082
1590
The magic number has 169 digits (mod10)

This is iteration number 82
The prime number is 421
The magic number is
2942626865402493898331284542303571951088352644057408163
9822418345907614945527557950813409475705554767235648329
4378622298298487008599674787927230434485948315832656098
5889390
The magic number has 172 digits (mod10)

This is iteration number 83
The prime number is 431
The magic number is
1268272178988474870180783637732839510919079989588742918
6763462307086182041522377476800579484029094104678564429
9877186210566647900706459833596636317263443724123874778
4918327090
The magic number has 175 digits (mod10)

This is iteration number 84
The prime number is 433
The magic number is
5491618535020096187882793151383195082279616354919256837
8685791789683168239791894474546509165845977473258183981
8468216291753585410058971079473435253750711325456377790
869635629970
The magic number has 177 digits (mod10)

This is iteration number 85
The prime number is 439
The magic number is
2410820536873822226480546193457222641120751579809553751
8243062595670910857268641674325917523806384110760342768
0307546952079823995015888303888838076396562271875349850
191770041556830
The magic number has 180 digits (mod10)

This is iteration number 86
The prime number is 443
The magic number is
1067993497835103246330881963701549630016492949855632312
0581676729882213509770008261726381463046228161066831846
2376243299771362029792038518622755267843677086440779983
634954128409675690
The magic number has 183 digits (mod10)

This is iteration number 87
The prime number is 449
The magic number is
4795290805279613576025660017019957838774053344851789081
1411728517171138658867337095151452769077564443190074989
6069332415973415513766252948616171152618110118119102126
52094403655944384810
The magic number has 185 digits (mod10)

This is iteration number 88
The prime number is 457
The magic number is
2191447898012783404243726627778120732319742378597267610
0815159932347210367102373052484213915468446950537864270
2503684914099850889791177597517590216746476323980429671
82007142470766583858170
The magic number has 188 digits (mod10)

This is iteration number 89
The prime number is 461
The magic number is
1010257480983893149356357975405713657599401236533340368
2475788728812063979234193977195222615030954044197955428
5854198745400031260193732872455609089920125585354978078
70905292679023395158616370
The magic number has 191 digits (mod10)

This is iteration number 90
The prime number is 463
The magic number is
4677492136955425281519937426128454234685227725149365904
9862901814399856223854318114413880707593317224636533634
3504940191202144734696983199469470086330181460193548504
4229150510387831958439379310
The magic number has 193 digits (mod10)

This is iteration number 91
The prime number is 467
The magic number is
2184388827958183606469810778001988127598001347644753877
6285975147324732856539966559431282290446079143905261207
2416807069291401591103491154152242530316194741910387151
565501328835111752459119013777O
The magic number has 196 digits (mod10)

This is iteration number 92
The prime number is 479
The magic number is
1046322248591969947499039362662952313119442645521837107
3840982095568547038282643981967584217123671909930620118
2687650586190581362138572262838924172021457281375075445
5998751365120185294279180075991830
The magic number has 199 digits (mod10)

This is iteration number 93
The prime number is 487
The magic number is
5095589350642893644320321696168577764891685683691346712
9605582805418824076436476192182135137392282201362119975
9688858354748131233614846920025560717744496960296617420
071391914813530238313960697008021210
The magic number has 201 digits (mod10)

This is iteration number 94
The prime number is 491
The magic number is
2501934371165660779361277952818771682561817670692451236
0636341157460642621530309810361428352459610560868800908
2007229452181332435704889837732550312412548007505639153
2550534301734433470121547022309384141 10
The magic number has 204 digits (mod10)

This is iteration number 95
The prime number is 499
The magic number is
1248465251211664728901277698456567069598347017675533166
7957534237572860668143624595370352747877345669873531653
1921607496638484885416740029028542605893861455745313937
4742716616565482301590651964132382686408 90
The magic number has 207 digits (mod10)

This is iteration number 96
The prime number is 503
The magic number is
6279780213594673586373426823236532360079685498907931828
9826397214991489160762431714712874321823048719463864215
5565685708091578973646202346013569307646123122398929105
4955864581324375977000979379585884912636767O
The magic number has 209 digits (mod10)

This is iteration number 97
The prime number is 509
The magic number is
3196408128719688855464074253027394971280559918944137300
9521636182430667982828077742788853029807931798207106885
7182934025418613697585916994120906777591876669301054914
697253507189410737229349850420921542053211440 30
The magic number has 212 digits (mod10)

This is iteration number 98
The prime number is 521
The magic number is
1665328635062957893696782685827272780037171717769895533
7960772451046378019053428503992992428529932466865902687
4592308627243097736442262753936992431125367744705849610
557269077245682994096491272069300123409723160396 30
The magic number has 215 digits (mod10)

This is iteration number 99
The prime number is 523
The magic number is
8709668761379269784034173446876636639594408083936553641
7534839918972557039649431075883350401211546801708671055
4117774120481401161593034203090470414785673304811593463
21451727399492205912464935292243964543285212887264 90
The magic number has 217 digits (mod10)

This is iteration number 100
The prime number is 541
The magic number is
4711930799906184953162487834760260422020574773409675520
1886348396164153358450342212052892567055446819724391040
9777715799180438028421831503871944494399049257903072063
5990538452312528339864352999310398481791730017201031090
The magic number has 220 digits (mod10)

This is iteration number 101
The prime number is 547
The magic number is
2577426147548683169379880845613862450845254401055092509
5431832572701791887072337189992932234179329410389241899
4148410542151699601546741832617953638436279944072980418
7886824533414953001905801090622787969540076319408964006
230
The magic number has 223 digits (mod10)

This is iteration number 102
The prime number is 557
The magic number is
1435626364184616525344593631006921385120806701387686527
8155530742994898081099291814826063254437886481586807737
9740664671978496678061535200768200176609007928848650093
2652961265112128822061531207476892899033822509910792951
470110
The magic number has 226 digits (mod10)

This is iteration number 103
The prime number is 563
The magic number is
8082576430359391037690062142568967398230141728812675151
6015638083061276196589012917470736122485300891333727564
7939942103238936297486443180324966994308714639417900025
0836171922581285268206420698094907021560420730797764316
77671930
The magic number has 228 digits (mod10)

This is iteration number 104
The prime number is 569
The magic number is
4598985988874493500445645359121742449592950643694412161
2612898069261866155859148350040848853694136207168890984
3677827056742954753269786169604906219761658629828785114
2725781823948751317609453377216002095267879395823927896
24595328170
The magic number has 231 digits (mod10)

This is iteration number 105
The prime number is 571
The magic number is
2626020999647335788754463500058514938717574817549509344
0801964797548525574995573707873324695459351774293436752
0740039249400227164117047902844401451483907077632236300
2496421421474737002354997878390337196397959135015462828
75643932385070
The magic number has 234 digits (mod10)

This is iteration number 106
The prime number is 577
The magic number is
1515214116796512750111325439533763119640040669726066891
5342733688185499256772446029442908349280045973767313005
9467002646903931073695536639941219637506214383793800345
2440435160190923250358833775831224562321622420903922052
19246548986185390
The magic number has 237 digits (mod10)

This is iteration number 107
The prime number is 587
The magic number is
8894306865595529843153480330063189512287038731292012653
3061846749648880637254258192829872010273869866014127344
9071305537326075402592800076454959272161478432869608026
5825354390320719479606354264129288180827923610706022446
3697724254890823930
The magic number has 239 digits (mod10)

This is iteration number 108
The prime number is 593
The magic number is
5274323971298149196990013835727471380786213967656163503
4105675122541786217891775108348114102092404830546377515
5299284183634362713737530445337790848391756710691677559
7634435153460186651406568078628667891230958701148671310
6972750483150258590490
The magic number has 242 digits (mod10)

This is iteration number 109
The prime number is 599
The magic number is
3159320058807591368997018287600755357090942166626041938
5429299398402529944517173289900520347153350493497280131
8024271225996983265528780736757336718186662269704314858

2983026656922651804192534279098572066847344261988054115
1076677539407004895703510
The magic number has 245 digits (mod10)

This is iteration number 110
The prime number is 601
The magic number is
1898751355343362412767207990848053969611656242142251205
0643008938439920496654821147230212728639163646591865359
2132587006824186942582797222791159367630184024092293229
8372799020810513734319713101738241812175253901454820523
1797083201183609942317809510
The magic number has 248 digits (mod10)

This is iteration number 111
The prime number is 607
The magic number is
1152542072693420984549695250444768759554275338980346481
4740306425633031741469476436368739126283972333481262273
0424480313142281474147757914234233736151521702624021990
5112289005631981836732065852755112779990379118183076057
5700829503118451234986910372570
The magic number has 251 digits (mod10)

This is iteration number 112
The prime number is 613
The magic number is
7065082905610670635289631885226432496067707827949523931
4358078389130484575207890554940370844120750404240137733
7502064319562185436525756014255852802608828037085254801
8338331604524048659167563677388841341341023994462256232
904608485411610607046976058385410
The magic number has 253 digits (mod10)

This is iteration number 113
The prime number is 617
The magic number is
4359156152761783781973702873184708850073775729844856265
6958934366093508982903268472398208810822502999416164981
7238773685169868414336391460795861179209646898881602212
7314750599991338022706386788948915107607411804583212095
702143435498963744547984228023797970
The magic number has 256 digits (mod10)

This is iteration number 114
The prime number is 619
The magic number is
2698317658559544161041722078501334778195667176773966028
4657580372611882060417123184414491253899129356638606123
6870800911120148548474226314232638069930771430407711769
6807830621394638236055253422359378451608987907037008287
239626786573858557875202237146730943430
The magic number has 259 digits (mod10)

This is iteration number 115
The prime number is 631
The magic number is
1702638442551072365617326631534342245041465988544372563
9618933215118097580123204729365543981210350624038960464
0465475374916813734087236804280794622126316772587266126
6685741122100016726950864909508767802965271369340352229
248204502328104750019252611639587225304330
The magic number has 262 digits (mod10)

This is iteration number 116
The prime number is 641
The magic number is
1091391241675237386360706370813513379071579698656942813
4995736190890700548858974231523313691955834750008973657
4538369715321677603549918791543989352782969051228437587
1945560059266110721975504406995120161700738947747165778
948099085992315144762340924060975411420075530
The magic number has 265 digits (mod10)

This is iteration number 117
The prime number is 643
The magic number is
7017645683971776394299341964330891027430257462364142290
8022583707427204529163204308694907039276017442557700617
4281717269518386990825977829627851538394490999398853685
6609951181081091942302493336978622639735751434014275958
63627712293058638082185214171207189543108565790
The magic number has 267 digits (mod10)

This is iteration number 118
The prime number is 647
The magic number is
4540416757529739327111674250922086494747376578149600062
1490611658705401330368593187725604854411583285334832299
4760271073378396383064407655769219945341235676611058334
6226638414159466486669713189025168847909031177807236545
23767129853608938839173833568771051634391242066130
The magic number has 270 digits (mod10)

This is iteration number 119
The prime number is 653
The magic number is
2964892142666919780603923285852122481070036905531688840
5833369413134627068730691351584819969930763885323645491
5578457010916092838141058199217300624307826896827021092
5085994884446131615795322712433435257684597359108125464
04019935794406637061980513320407496717257481069182890
The magic number has 273 digits (mod10)

This is iteration number 120
The prime number is 659
The magic number is
1953863922017500135417985445376548715025154320745382945
9444190443255719238293525600694396360184373400428282378
9366203170193705180334957353284201111418857925009006899
9631670628850000734809117667493633834814149659652254680
8024913768851397382384515827814854033667268002459152451
0
The magic number has 276 digits (mod10)

This is iteration number 121
The prime number is 661
The magic number is
1291504052453567589511288379393898700631627006012698127
2692609882992030416512020422058995994081870817683094652
4771060295498039124201406810520856934647865088430953560
8756534285669850485708826778213291964812152925030140344
0104468001210773669756164962185618516254064149625499770
1110
The magic number has 279 digits (mod10)

This is iteration number 122
The prime number is 673
The magic number is
8691822273012509877410970793320938255250849750465458396
5221264512536364703125897440457043040170990603007227011
1709235788701803305875467834805367170180132045140317464

6931475742558093768820404217375454923185789185452844515
1903069648148506797458990195509212614389851726979613452
847030
The magic number has 281 digits (mod10)

This is iteration number 123
The prime number is 677
The magic number is

5884363678829469187007227227078275198804825281065115334
4454796074987118904016232567189418138195760638235892686
5627152628951120838077691724163233574211949394559994923
5972609077711829481491413655163182982996779278551575736
7838378151796539101879736362359736939941929619165198307
577439310
The magic number has 284 digits (mod10)

This is iteration number 124
The prime number is 683
The magic number is
4019020392640527454725936196094461960783695666967473773
4262625719216202211443086843390372588387704515915114704
9223345245573615532407063447603488531186761436484476532
8169292000077179535858635526476453977386800247250726228
2233612277677036206583859935491700329980337929889830444
075391048730
The magic number has 287 digits (mod10)

This is iteration number 125
The prime number is 691
The magic number is
2777143091314604471215621911501273214901533705874524377
4375474371978395728107173008782747458575903820497344261
1013331564691368332893280842294010575050052152610773284
1764980772053331059278317148795229698374278970850251823
7023426083874832018749447215424764928016413509553872836
856095214672430
The magic number has 290 digits (mod10)

This is iteration number 126
The prime number is 701
The magic number is
1946777307011537734322150959962392523645975127818041588
5837207534756855405403128279156705968461708578168638327
0320345426848649201358189870448101413110086558980152072
2077251521209385072554100321305456018560369558566026528
4153421684796257245143362498012760214539505870197264858
636122745485373430
The magic number has 293 digits (mod10)

This is iteration number 127
The prime number is 709
The magic number is
1380265110671180253634405030613336299264996365622991486
3058580142142610482430817949922104531639351381921564573
8657124907635692283762956618147703901895051370316927819
1952771328537454016440857127805568317159302017023312808
6464775974520546386806644011091046992108509661969860784
773011026549129761870
The magic number has 296 digits (mod10)

This is iteration number 128
The prime number is 719
The magic number is
9924106145725786023631372170109887991715323868829308786
5391191222005369368677581059939931582486936436016049286
0944728085900627520255658084481991054625419352578711020
0140425852184294378209762748922036200375381502397619094
1681739256802728521139770439744627873260184469563299042
51794928088824298784530
The magic number has 298 digits (mod10)

This is iteration number 129
The prime number is 727
The magic number is
7214825167942646439180007567669888569977040452638907487
8139396018397903531028601430576330260468002788983667830
9906817318449756207225863427418407496712679869324722911
5502089594537982012958497518466320317672902352243069081
4602624439695583634868613109694344463860154109372518403
91054912720575265216353310
The magic number has 301 digits (mod10)

This is iteration number 130
The prime number is 733
The magic number is
5288466848101959839918945547102028321793170651784319188
5676177281485663288243964848612450080923046044325028520
1161697094423671299896557892297692695090394344215021894
1663031672796340815498578681035812792854237424194169636
7103723714296862804358693409405954492009492962170055990
06643251024181669403586976230
The magic number has 304 digits (mod10)

This is iteration number 131
The prime number is 739
The magic number is
3908177000747348321700100759308398929805153111668611880
3514695011017905170012290023124600609802131026756196076
3658494152779093090623556282407994901671801420374901179
7888980406196495862653449645285465653919281456479491361
5289651824865381612421074429551000369595015299043671376
65909362506870253689250775433970
The magic number has 307 digits (mod10)

This is iteration number 132
The prime number is 743
The magic number is
2903775511555279803023174864166140404845228761969778627
1011418393186303541319131487181578253082983352879853684
7398261155514866166333302317829140211942148455338551576
5831512441803996425951513086447100980862026122164262081
6160211305874978538028858301156393274609096367189447832
85770656342604598491113326147439710
The magic number has 310 digits (mod10)

This is iteration number 133
The prime number is 751
The magic number is
2180735409178015132070404322988771444038766800239303748
9529575213282913959530667746873365268065320498012770117
2396094127791664490916310040689684299168553489959252234
0139465843794801315889586327921772836627381617745360823
2936318690712108882059672584168451349231431371759275322
47613762913296053466826107936727222210
The magic number has 313 digits (mod10)

This is iteration number 134
The prime number is 757
The magic number is
1650816704747757454977296072502499983137346467781152937
9573888436455165867364715484383137507925447616995666978

7503843254738290019623646700802091014470594991899153941
1485575643752664596128416850236782037326927884633238143
2332793248869066423719172146215517671368193548421771419
1144361852536511247438736370810250721 2970
The magic number has 316 digits (mod10)

This is iteration number 135
The prime number is 761
The magic number is
1256271512313043423237722311174402487167520661981457385
7855729100142381225064548483615567643531265636533702570
8290424716855838704933595139310391262012122788835256149
2140523064895777757653725223030191130405792120205894227
0005255662389359548450290003270008947911195290348968049
94608593697802850593008783781866007989070170
The magic number has 319 digits (mod10)

This is iteration number 136
The prime number is 769
The magic number is
9660727929687303924698084572931155126318233890637407296
6910556780094911620746377839003715178755432744944172769
6753366072621399640939346621296908804873224246143119787
4560622369048530956357146965102169792820541404383326605
6340416043774174927582730125146368809437091782783564304
08540085536103921060237547282549601435949607 30
The magic number has 321 digits (mod10)

This is iteration number 137
The prime number is 773
The magic number is
7467742689648285933791619374875782912643994797462715840
3421860391013366682836950069549871833177949511841845550
9590351974136341922446114938262510506167002342268631595
7035361091274514429264074604023977249850278505588311466
1551141601837437219021450386738143089694871948091695207
0580148611940833097956362404941084190998904644290
The magic number has 324 digits (mod10)

This is iteration number 138
The prime number is 787
The magic number is
5877113496753201029894004448027241152250823905603157366
3493004127727519579392679704735749132711046265819532448
6047607003645301092965092456412595768353430843365413065
8186829178833042855830826713366870095632169183898001123
8640748440646063091369881454362918611589864223148164127
954657695759743564809165721268863325831613795505 6230
The magic number has 327 digits (mod10)

This is iteration number 139
The prime number is 797
The magic number is
4684059456912301220825521545077711198343906652765716420
9803924289798833104775965724674392058770703873858167361
5379942781905304971093178687760838827377684382162234213
4574902855529935156097168890553395466218838839566706895
7196676507194912283821795519127246133437121785849086809
9798621835205156211529050798512840706877961950179815310
The magic number has 330 digits (mod10)

This is iteration number 140
The prime number is 809
The magic number is
3789404100642051687647846929967868359460220482087464584
5731374750447255981763756271261583175545499433951257395
4842373710561391721614381558398518611348546665169247478
6871096410123717541282609632457696932171040621209465878
6372111294320684037611832574973942121950631524751911229
2737085064680971375127002095996888131864271217695470585
790
The magic number has 333 digits (mod10)

This is iteration number 141
The prime number is 811
The magic number is
3073206725620703918682403860203941239522238810972933778
0888144922612724601210406335993143955367400040934469747
7377165079265288686229263443861198593803671345452259705
2152459188610334925980196411923192211990713943800876827
5747782259694074754503196218303867060901962166573800006
9409775987456267785227998699853476274941923957551026645
075690
The magic number has 336 digits (mod10)

This is iteration number 142
The prime number is 821
The magic number is
2523102721734597917238253569227435757647758063808778631
8109166981465046897593743601850371187356635433607199662
8926652530076802011394225287410044045512814174616305217
9817168993849084974229741254188940806044376147860519875
4388929235208835373447124095227474857000510938757089805
6985426085701595851672186932579704021727319569149392875
607141490
The magic number has 339 digits (mod10)

This is iteration number 143
The prime number is 823
The magic number is
2076513539987574085887082687474179628544104886514624813
9803844425745733596719650984322855487194510961858725322
5606635032253208055377447411538466249457046065709219194
3989530081937796933791077052197498283374521569689207857
4862088760576871512346983130372211807311420502597084910
0899005668532413385926209845513096409881584005409950336
624677446270
The magic number has 342 digits (mod10)

This is iteration number 144
The prime number is 827
The magic number is
1717276697569723769028617382541146552805974741147594721
1617779340091721684487151364035001487909860565457165841
7576687171673403061797149009342311588300977096341524273
7679341377762558064245220722167331080350729338132974898
1410947404997072740710955048817819164646544755647789220
6443477687876305870160975542239330730972069972474028928
388608248065290
The magic number has 345 digits (mod10)

This is iteration number 145
The prime number is 829
The magic number is
1423622382285301004524723810126610492276153060411356023
8431139072936037276439848480785016233477274408763990482
8171073665317251138229836528744776306701510012867123622
9536174002165160635259287978676717465610754621312236190
5589675398742573302049381735469972087491985602432017263
9141643003249457566363448724516405175975846007180969981
634156237646125410
The magic number has 348 digits (mod10)

This is iteration number 146
The prime number is 839
The magic number is
119441917873736754279624327669622620301969241768512770400437256821933352749330328753786286198874332289529880150835530805201173704974832847616867321322566900795516719658084998781656977298254261410976595364742312728096616387897376595450190004194312760593065814057759204404624844239838479726294898178933479869263942643734800024833814591057083385099218990
The magic number has 351 digits (mod10)

This is iteration number 147
The prime number is 853
The magic number is
101883955946297451400519551502188095117579763228541393151572980069109149895178770426979702127639805442968987768662707776836601170343532419017187825088149566378575761868346503960753401635410884983563035846125192757066413778876462235919012073577748784785885139391268601357144992136582223206529548146630258328482143075105784421183243846171692127489633798470
The magic number has 354 digits (mod10)

This is iteration number 148
The prime number is 857
The magic number is
87314550245976915850245255637375197515765857086859973930898043919226541460168206255921604723387313264624422517743940564748967202984407283097729966100544178386439427921172953894365665201547128430913521720129290192805916608497128136182593347056130708561503564458317191363073258261050965287995822761662131387509196615365657248954039976169140153258616165288790
The magic number has 356 digits (mod10)

This is iteration number 149
The prime number is 859
The magic number is
75003198661294170715360674592505294666042871237612717606641419726615599114284489173836658457389702094312378942742044945119362827363605856180950040880367449233951468584287567395260106408128983322154715157591060275620282366699033068980847685121216278654331561869694467380879928846242779182388411752267770861870399892599099576851520339529291391649151285983070610
The magic number has 359 digits (mod10)

This is iteration number 150
The prime number is 863
The magic number is
64727760444696869327356262173332069296794997878059775294531545224069262035627514157021036248727312907391583027586384787638010120014791853884159885279757108688900117388240170662109471830215312607019519181001085017860303682461265538530471552259609648478688137893546325349699378594307518434401199342207086253794155107313022934822862053013778470993217559803389936430
The magic number has 362 digits (mod10)

This is iteration number 151
The prime number is 877
The magic number is
56766245909999154400091441926012224773289213139058422933304165161508742805245329915707448790133853419782418315193259458758534875252972455856408219390346984320165402949486629670670006795098829156356118321737951560663486329518529877291223551331677661715809496932640127331686355027207693666969851823115614644577474029113521113839650020493083719061051799947572974249110
The magic number has 365 digits (mod10)

This is iteration number 152
The prime number is 881
The magic number is
50011062646709255026480560336816770025267796775510470604240969507289202411421135655738262384107924862828310535685261583166269225097868733609495641282895693186065719998497720739860275986482068486749740241451135324944531456305824821893567948723208019971628166797655952179215678778969978120600439456164856501872754619649012101292731668054406756492786635753811790313465910
The magic number has 368 digits (mod10)

This is iteration number 153
The prime number is 883
The magic number is
44159768317044272188382334777409207932311464552775745543544776074936365729284862784016885685167297653877398203010085977935815725761418091777184651252796897083296030758673487413296623696063666473800020633201352491926021275918043317732020498722592681634947671282330205774247444361830490680490188039793568291153642329150077685441482062892041165983130599370615810846790398530
The magic number has 371 digits (mod10)

This is iteration number 154
The prime number is 887
The magic number is
39169714497218269431095130947561967435960269058312086297124216378468556401875673289422977602743393018989252206069946262429068548750377847406362785661230847712883579282943383335594105218408472162260618301649599660338380871739304422828302182366939708610198584427426892521757483148943645233594796791296895074253280745956118906986594589785240514227036841641736224221103083496110
The magic number has 374 digits (mod10)

This is iteration number 155
The prime number is 907
The magic number is
35526931048976970374003283769438704464415964035889062271491664255270980656501235673506640685688257468223251750905441260023165173716592707597571046594736378875585406409629648685383853433096484251170380799596186891926911450667549111505270079406814315709450116075676191517234037216091886226870480689706283832347725636582199848636841292935213146403922415369054755368540496730971770
The magic number has 377 digits (mod10)

This is iteration number 156
The prime number is 911
The magic number is
323650341856180200107169915139586597670829432366949357293289061365518633780726256985645496646620025535513823450748569878811034732558159566213872234478048411556583052391726099523846904775508971528162169084321262585454163315558137240581301042339607841611309055744941010472200207903859708352679007908322424571268778054926384062108162417863979176373973320401208882140740392521915282470
The magic number has 380 digits (mod10)

This is iteration number 157
The prime number is 919
The magic number is
2974346641658296038984891520132800832594922483452264593
5253264739491162444448743016980821141824380346713720375
1237935718627340919220948641350548583485326490220499825
1479962854624153054886927448343810333884912403160323760
8701928124094215657910099606440793022229600788623951991
0636470719761120082677483081809960070324773469530774012
62016996863087681481448710962687340420727640144589930
The magic number has 383 digits (mod10)

This is iteration number 158
The prime number is 929
The magic number is
2763168030100557020216964222203371973480682987127153807
3850282942987289910892882262775182840754849342097046228
4900042282604799713956261287814659634057868309414844337
5624885491945838187989955599511399800179083622535940773
8484091227283526346198482534383496717651299132631651399
6981281298658080556807381783001452905331714553194089057
7241379008580845609626585248433653925085597769432404497
0
The magic number has 386 digits (mod10)

This is iteration number 159
The prime number is 937
The magic number is
2589088444204221927943295476204559539151399958938143117
5197715117579090646506630680220346321787293833544932316
0951339618800697331977016826682336077112222605921709144
2960517705953250382146588396742181612767801354316176505
0959593479964664186387978134717336424439267287275857361
5171460576842621481728516730672361372295816536342861447
0875172131040252336220110377782333727805205109958163013
6890
The magic number has 389 digits (mod10)

This is iteration number 160
The prime number is 941
The magic number is
2436332225996172834194641043108490526341467361360792673
5861049925641924298362739470087345888018434973657813309
4455210581291456189390372833908078248562601472172328304
7825847161302008609599939681334392897614501074411522091
2952977464646748999391087424769013575397350517326581777
1876344402808906814306534243562692051330363360698632621
7093536975308877448383123865493176037864698008470631395
8813490
The magic number has 392 digits (mod10)

This is iteration number 161
The prime number is 947
The magic number is
2307206618018375673982325067823740528445369591208670661
8860414279582902310549514278172716556695345792005394900
0449084420483009011352683073710950101388783594147194904
6291077261753002153291142878223670074040932517467711420
4566469659020471302423359791256255855901290939908272942
9966898149460034753148287928653869372609854102581605092
7587579515617506943618818300622037707857869014021687931
8996375030
The magic number has 395 digits (mod10)

This is iteration number 162
The prime number is 953
The magic number is
2198767906971512017305155789636024723608437220421863140
7773974808442505901953687107098598878530664539781141339
7427977452720307587819106969246535446623510765222276744
1115396630450611052086459162947157580561008689146728983
6951845585046509151209461881067211830673930265732584114
6758453936435413119750318396007137512097190959760269653
3990963278383484117268733840492801935588549170362668599
1003545403590
The magic number has 398 digits (mod10)

This is iteration number 163
The prime number is 967
The magic number is
2126208566041452120734085648578035907729358792147941657
1317433639763903207189215432564345115539152609968363675
5312854196780537437421076439261399776884934909969941611
5558588541645740887367606010569901380402495402404886927
2332434680739974349219549638991993840261690566963408838
8915424956533044486798557888938901974197983658088180754
8369261490196829141398865623756539471714127047740700535
3300428405271530
The magic number has 401 digits (mod10)

This is iteration number 164
The prime number is 971
The magic number is
2064548517626250009232797164769272866405207387175651349
0749228064210750014180728185019979107188517184279281128
9408781425073901851735865222522819183355271797580813304
8207389473938014401633945436263374240370823035735145206
3434794074998515093092182699461226018894101540521469982
5636877632793586196681399710159673816946242132003623512
9466552906981121096298298520667599827034417363356220219
805471598151865563O
The magic number has 404 digits (mod10)

This is iteration number 165
The prime number is 977
The magic number is
2017063901720846259020442829979579590477887617270611368
0461995818733902763854571436764519587723181289040857662
9752379452297202109145940322404794342138100546236454598
8098619516037440070396364691229316632842294105913236866
5975793811273549245951062497373617820459537205089476172
9647229447239333714157727516826001319156478562967540172
1488822190120555311083437654692245031012625763999027154
7499457513943726550510
The magic number has 407 digits (mod10)

This is iteration number 166
The prime number is 983
The magic number is
1982773815391591872617095301869926737439763527777010974
7894141889815426416869043722339522754731887207127163082
7046589001608149673290459336923912838321752836950434870
6300942984264803589199626491478418250083975106112711839
8654205316481898908769894434918266317511725072602955078
0243226546636265041017046149039959296730818427397091989
2223512212888505870795019214562476865485411126011043693
1191966736206683199151330
The magic number has 410 digits (mod10)

This is iteration number 167
The prime number is 991
The magic number is

1964928851053067545763541444153097396802805656027017876
0163094612807087579117222328838467049939300222263018614
9603169700593676326230845202891597622776857061417880956
7944234497406420356896829853055112485833219330157697433
3066317468633561818590965385004001920654119546949528482
3221037507716538655647892733698599663060241061550518161
3193500602972509317957864041631414573696042425876944299
8811239035580823050358968030
The magic number has 413 digits (mod10)

This is iteration number 168
The prime number is 997
The magic number is
1959034064499908343126250819820638104612397239058936822
3882605328968666316379870661851951648789482321596229559
1154360191491895297252152667282922829908526490233627313
9240401793914201095826139363495947148375719672167224341
0067118516227661133135192488848989914892157188308679896
8751374395193389039680949055497503864071060338365866606
8353920101163591790003990449506520329974954298599313466
9814805318474080581207891125910
The magic number has 416 digits (mod10)

This is iteration number 169
The prime number is 1009
The magic number is
1976665371080407518214387077199023847553908814210467253
7897548776929384313227289497808619213628587662490595625
1474749433215322354927422041288469135377703228645729959
7493565410059428905688574617767410672711101149216729360
0757722582873710083333409221248630824126186603003458015
9470136764750129541038077596996981398847699881411159406
29691053820740641161114026363552079012944728887286707288
1843138566340347306438762146043190
The magic number has 419 digits (mod10)

This is iteration number 170
The prime number is 1013
The magic number is
2002362020904452815951174109202611157572109628795203328
0890216911029466309299244261280131263405759302102973368
2743921175847121545541478527825219234137613370618124449
2260981760390201481462526087798387011456345464156546841
7567572976451068314416743541124863024839827028842502970
1543248542691881225071572605757942157032719979869504478
5787703752041026949623508706278256040113010362821434482
9307099367702771821422466053941751470
The magic number has 422 digits (mod10)

APPENDIX 4

RSA codes easily broken

The author spent 25 years as a physicist, mathematician, engineer in the telecommunications industry with specialty in telecommunications protocols, network and computer security and encryption. He also spent many years as a faculty member at major universities with subjects including computer science. The solutions regarding prime numbers were not intended to breach security methods but was an unintended consequence.

The RSA codes were designed to be used in secure computing. They consist of two prime numbers which are factors of a larger number. Their use is somewhat likened to a bank security box in which the owner has one key (the public key) and the bank has its own key. Only the two keys (the 2 prime factors) can open the box and allow secure transmission. They are also used to encode transmissions so that no one else can read the message. They are calculated using extensive computing power within private corporations like RSA and other entities. The perceived inability of computers to calculate these prime factors within reasonable amounts of time (which are believed to be sufficiently large) gave rise to extreme confidence in their "security" and the "RSA Factoring Challenge".

When you enter an internet page and it has the little lock symbol at the top left of your browser near the web page name, this implies that the site you are looking at is "secure". The technical name for this is Secure Socket Layer or SSL. If you own a web page then you are demoted in search engines to essentially non-existent because you lack the credentials. To cure this, you would contact your Internet Service Provider ISP and for a handsome fee you can register your page and get the little lock symbol placed next to your web page name so when people look at your page. SSL uses a version of the RSA system otherwise called "public key encryption". In reality nothing has changed on your page. In fact, nothing has changed at all anywhere. You just got charged for something that someone invented … sort of like requiring motorcyclists to wear helmets. For the vast majority of motorcyclists, they will never benefit from wearing a helmet. Some states require helmets but most have rescinded their helmet laws since many bikers refuse to wear them.

The point is that the SSL lock symbol really does not do anything to protect you. The company that issues your SSL certificate never even visited your page to see if it is safe or not. Even if you web page has nothing like sales or things that people should be apprehensive about, the SSL certificate really does nothing to make you "safe". The safety you receive in making on line purchases or other interactions is based on the fact that most of the internet is safe and has legitimate vendors who would soon be out of business if they were scamming their internet customers. It has nothing to do with an SSL certificate.

But let us play devil's advocate and imagine you are depending on an SSL certificate to keep you safe. The only reason you are safe is because you are not a big fish and there is most likely no one sitting outside your house or office intercepting your transactions (the government is all the time … another story that is part of this scam). The big fish that hackers love to break into are corporations who unwittingly hold your credit card data and they get hacked … they are the big fish that a real hacker would prey on. So if someone wanted to break into your data stream they could with ease because SSL depends on prime number public key encryption that can be broken in a matter of minutes if not seconds. The solutions today to combat the fact that the encryption codes can be broken easily is to change the codes frequently. One vendor complained that his encryption key changed eight times in one day.

The more nefarious aspect of this, as explained in my book "Breaking RSA Codes for Fun and Profit" is that the government snooping agencies like the CIA, NSA and other agencies depend on worthless public key encryption in your computers so they can easily break through your firewalls and capture all your computer activities on a daily basis. If someone complained and demanded real computer security, then the companies that are pawning off SSL and other computer protection schemes would have to retool and produce real products with real protection. But even if they wanted to do this, the CIA and NSA would block them and force them to keep the tainted software on your computer since they would have to retool also.

The challenges of breaking the published RSA codes were many times associated with cash prizes because of the perceived difficulty based on the number of computer calculations necessary to "solve" the problem. This of course assumed that no one would come up with a completely different method of calculating prime numbers. With the release of the McCanney Generator Function in the book "Calculate Primes" in

March 2007, the RSA Factoring Challenge remained BUT the prize offerings were immediately removed from the company internet page. Additionally, new rules were installed in groups such as those associated with computational mathematics which were apparently very offended that there was now a new method of directly and easily calculating prime numbers (e.g. where calculations were previously being performed to find the largest known prime numbers using vast computer resources).

The following is a list of the RSA Challenge numbers as they stood at that time with the prize amounts still listed (2007). You will readily see that the size of the prime numbers and their products are relatively small compared to the size of the rapidly growing tables Spp_n as described in this and prior books of this series. For example, the largest number given below RSA-2048 has only 617 decimal (mod10) digits (2048 binary digits in computer language). See the other appendix which has values of n, p_n , Spp_n and the number of digits in the related magic number Spp_n. We stop in that appendix with n = 170 and the value of Spp_n has 422 digits (for p_n = 1013). This means that the two prime numbers that are factors of RSA-2048 are contained in the complete tables of prime numbers that we show can easily be achieved. It is a simple matter to identify those prime numbers with a brief computer scan of the prime number tables. Remember we are not laboriously determining prime numbers one at a time through brute force calculations with endless computer time, but calculating directly vast tables of prime numbers simply and quickly. We do not have to calculate and populate the entire tables, but just the parts of the table that pertain to the known public key number.

To find the factors, you only have to scan the first and last few digits of these numbers in the prime number tables (not the entire numbers). There are many short cuts in this method. For example, in the Spp_n tables the top row cells begin with a specific digit and all the cells of the column below it end with a specific set of digits. Therefore, if your public key number begins and ends in a certain digits, you know exactly where to search for the two prime numbers that are the factors. The size of the factors also helps isolate to certain regions of the tables since we know the magnitude of the product and therefore magnitudes of the factors. In other words, there are short cuts that make breaking the RSA codes extremely fast. The task is made even simpler by the fact that you will notice that the prime factors are generally about the same number of digits. This was done in creating the "public encryption keys" to make it more difficult to find the numbers assuming you are number crunching with large computers (it would take longer for you to reach the size of the numbers involved if both were about the same size … about the size of the square root of the primary RSA number). However, that actually makes finding the prime factors much faster using the McCanney Generator Function method. This fast and simple process is described in full in the second book of this series "Breaking RSA Codes for Fun and Profit". If you have time and a computer handy you could easily break even the largest codes in a matter of hours if not minutes.

Unfortunately, RSA codes are still being used widely and is the cause of much of the computer hacking you read about in the news recently. As noted, when you use SSL "Secure Socket Layer" encryption you are in fact using a form of RSA codes. You may ask why would these companies continue to use broken codes to sell products for "secure computing". The answer is that the NSA / CIA and other spy agencies who snoop on the public would have to retool all the home and business computers which might then have real secure computing algorithms. They do not allow companies to sell any products for which they cannot hack on a daily basis. The problem is that hackers know this and use the same entry points into your computers whether you are an individual or large corporation. So the "solution" that is being pawned off on the public is to replace regularly the public encryption keys. But these are broken in minutes sometimes from the time the IT people install them.

The following is taken from Wikipedia dealing with the RSA numbers as viewed in 2007 and you will notice the prize dollar amounts are still associated with the RSA Challenge, but as mentioned they were all removed upon the release of the McCanney Generator Function. (Note: some of the large numbers below wrap to the next page).

RSA numbers

In mathematics, the **RSA numbers** are a set of large semiprimes (numbers with exactly two prime factors) that are part of the RSA Factoring Challenge. The challenge was to find the prime factors but it was declared inactive in 2007. It was created by RSA Laboratories in March 1991 to encourage research into computational number theory and the practical difficulty of factoring large integers.

RSA Laboratories published a number of semiprimes with 100 to 617 decimal digits. Cash prizes of varying size were offered for factorization of some of them. The smallest RSA number was factored in a few days. Most of the numbers have still not been factored and many of them are expected to remain unfactored for many years to come. As of September 2013, 18 of the 54 listed numbers have been factored: the 17 smallest from RSA-100 to RSA-704, plus RSA-768.

The RSA challenge officially ended in 2007 (**my note … note the date 2007 … it was with the release of the book "Calculate Primes" and the McCanney Generator Function March 2007)** but people are still attempting to find the factorizations. According to RSA Laboratories, "Now that the industry has a considerably more advanced understanding of the cryptanalytic strength of common symmetric-key and public-key algorithms, these challenges are no longer active." Some of the smaller prizes had been awarded at the time. **The remaining prizes were retracted. (my note … note how they cover the fact that the RSA codes were completely broken but cover this up with the ridiculous statement about "industry awareness" and "strength of common symmetric-key and public-key algorithms" … they were colluding with the NSA / CIA and other US government agencies which continued to use these broken codes to spy on anyone and everyone both domestically and internationally).**

The first RSA numbers generated, from RSA-100 to RSA-500, were labeled according to their number of decimal digits. Later, beginning with RSA-576, binary digits are counted instead. An exception to this is RSA-617, which was created prior to the change in the numbering scheme. The numbers are listed in increasing order below.

RSA-100
RSA-100 has 100 decimal digits (330 bits). Its factorization was announced on April 1, 1991.

The value and factorization of RSA-100 are as follows:

RSA-100 =
15226050279225333605356183781326374297180681149613
80688657908494580122963258952897654000350692006139

RSA-100 =
37975227936943673922808872755445627854565536638199
× 40094690950920881030683735292761468389214899724061

It takes four hours to repeat this factorization.

RSA-110
RSA-110 has 110 decimal digits (364 bits), and was factored in April 1992 by Arjen K. Lenstra and Mark S. Manasse in approximately one month.

The value and factorization are as follows:

RSA-110 =
35794234179725868774991807832568455403003778024228226193532908190484670252364677411513516111204504060317568667

RSA-110 =
6122421090493547576937037317561418841225758554253106999

×5846418214406154678836553182979162384198610505601062333

RSA-120
RSA-120 has 120 decimal digits (397 bits), and was factored in June 1993 by Thomas Denny, Bruce Dodson, Arjen K. Lenstra, and Mark S. Manasse. The computation took under three months of actual computer time.

The value and factorization are as follows:

RSA-120 =
227010481295437363334259960947493668895875336466084780038173258247009162675779735389791151574049166747880487470296548479

RSA-120 =
327414555693498015751146303749141488063642403240171463406883
×693342667110830181197325401899700641361965863127336680673013

RSA-129
RSA-129, having 129 decimal digits (426 bits), was not part of the 1991 RSA Factoring Challenge.

The value and factorization are as follows:

RSA-129 =
114381625757888867669235779976146612010218296721242362562561842935706935245733897830597123563958705058989075147599290026879543541

RSA-129 =
3490529510847650949147849619903898133417764638493387843990820577
×32769132993266709549961988190834461413177642967992942539798288533

The factorization was found using the Multiple Polynomial Quadradic Sieve algorithm.

The factoring challenge included a message encrypted with RSA-129. When

RSA-130
RSA-130 has 130 decimal digits (430 bits), and was factored on April 10, 1996 by a team led by Arjen K. Lenstra.

The value and factorization are as follows:

RSA-130 =
1807082088687404805951656164405905566278102516769401349170127021450056662540244048387341127590812303371781887966563182013214880557

RSA-130 =
39685999459597454290161126162883786067576449112810064832555157243
×45534498646735972188403686897274408864356301263205069600999044599

The factorization was found using the Number Field Sieve algorithm and the polynomial

$$5748302248738405200 x^5 + 9882261917482286102 x^4 - 13392499389128176685 x^3 + 16875252458877684989 x^2 + 3759900174855208738 x^1 - 46769930553931905995$$

which has a root of 12574411168418005980468 modulo RSA-130.

RSA-140
RSA-140 has 140 decimal digits (463 bits), and was factored on February 2, 1999 by a team led by Herman te Riele.

The value and factorization are as follows:

RSA-140 =
21290246318258757547497882016271517497806703963277216278233383215381949984056495911366573853021918316783107387995317230889569230873441936471

RSA-140 =
3398717423028438554530123627613875835633986495969597423490929302771479
×6264200187401285096151654948264442219302037178623509019111660653946049

The factorization was found using Number Field Sieve algorithm and an estimated MIPS of computing time.

RSA-150
RSA-150 has 150 decimal digits (496 bits), and was withdrawn from the challenge by RSA Security. RSA-150 was eventually factored into two 75-digit primes by Aoki et al. in 2004 using the general number field sieve (GNFS), years after bigger RSA numbers that were still part of the challenge had been solved.

The value and factorization are as follows:

RSA-150 =
155089812478348440509606754370011861770654545830995430655466945774312632703463465954363335027577729025391453996787414027003501631772186840890795964683

RSA-150 =
348009867102283695483970451047593424831012817350385456889559637548278410717
×445647744903640741533241125787086176005442536297766153493419724532460296199

RSA-155
RSA-155 has 155 decimal digits (512 bits), and was factored on August 22, 1999 by a team led by Herman te Riele.

The value and factorization are as follows:

RSA-155 =
1094173864157052742180970732204035761200373294544920599
0913842131476349984288934784717997257891267332497625752
899781833797076537244027146743531593354333897

RSA-155 =
1026395928297411057720541965739916759007165678080380668
033419335217907113077779
×1066034883801684548209272203600128786792079585759892915
22270608237193062808643

The factorization was found using the general number field sieve algorithm and an estimated 8000 MIPS years of computing time.

RSA-160
RSA-160 has 160 decimal digits (530 bits), and was factored on April 1, 2003 by a team from the University of Bonn.

The value and factorization are as follows:

RSA-160 =
2152741102718889701896015201312825429257773588845675980
1704976767781331452188591356730110597734910596024979071
11585214302079314665202840140619946994927570407753

RSA-160 =
4542789285848139407168619064973883165613714577846979325
0959984709250004157335359
×4738809060383201619663383230378895197326892292104095794
4741354648812028493909367

The factorization was found using the general number field sieve algorithm.

RSA-170
RSA-170 has 170 decimal digits (563 bits), and was factored on December 29, 2009 by D. Bonenberger and M. Krone.

The value and factorization are as follows:

RSA-170 =
2606262368413984492152987926667443219708592538048640641
6164785191859999628542069361450283931914514618683512198
1648059198820530572229741164780650958098323773365107115
45759

RSA-170 =
3586420730428501486799804587268520423291459681059978161
140231860633948450858040593963
×7267029064107019078863797763923946264136137803856996670
313708936002281582249587494493

The factorization was found using the general number field sieve algorithm

RSA-576
RSA-576 has 174 decimal digits (576 bits), and was factored on December 3, 2003 by J. Franke and T. Kleinjung from the University of Bonn. A cash prize of US$10,000 was offered by RSA Security for a successful factorization.

The value and factorization are as follows:

RSA-576 =
1881988129206079638386972394616504398071635633794173827
0076335642298885971523466548531906060650474304531738801
1303396716199692321205734031879550656996221305168759307
650257059

RSA-576 =
3980750864240649373971255005503864911990643623425267084
06385189575946388957261768583317
×4727721461074353025362230719730482246329146953020971164
59852171130520711256363590397527

The factorization was found using the general number field sieve algorithm.

RSA-180
RSA-180 has 180 decimal digits (596 bits), and was factored on May 8, 2010 by S. A. Danilov and I. A. Popovyan from Russia.

RSA-180 =
1911479277189866096892294666314546498129862462766673548
6418850363880726070343679905877620136513516127813425829
6128109200046702912984568752800330221777752773957404540
495707851421041

RSA-180 =
4007800823297508779525813391041005725268293178158071765
64882178998497572771950624613470377
×4769396887386118369955354773570708579399020760277882320
31989775824606225595773435668861833

The factorization was found using the general number field sieve algorithm implementation running on 3 Intel Core i7 PCs.

RSA-190
RSA-190 has 190 decimal digits (629 bits), and was factored by I. A. Popovyan from Moscow State University, Russia and A. Timofeev from Netherlands.

RSA-190 =
1907556405060696491061450432646028861081179759533184460
6479756223189150255871841757540549761551215932934922604
6415263009323850924660320741712472612158085818598593894
6945490481721756401423481

RSA-190 =
3171195257690152709485171289740475929805147316029450327
7847619278327936427981256542415724309619
×6015260020444561641587641685526676183243543359471811072
5997638280836157040460481625355619404899

RSA-640
RSA-640 has 640 bits (193 decimal digits). A cash prize of US$20,000 was offered by RSA Security for a successful factorization. On November 2, 2005, F. Bahr, M. Boehm, J. Franke and T. Kleinjung of

the German Federal Office for Information Security announced that they had factorized the number using GNFS as follows:

RSA-640 =
3107418240490043721350750035888567930037346022842727545
7201619488232064405180815045563468296717232867824379162
7283803341547107310850191954852900733772482278352574238
6454014691736602477652346609

RSA-640 =
1634733645809253848443133883865090859841783670033092312
181110852389333100104508151212118167511579
×1900871281664822113126851573935413975471896789968515493
666638539088027103802104498957191261465571

The computation took 5 months on 80 2.2 GHz computers.

The slightly larger RSA-200 was factored in May 2005 by the same team.

RSA-200
RSA-200 has 200 decimal digits (663 bits), and factors into the two 100-digit primes given below.

On May 9, 2005, F. Bahr, M. Boehm, J. Franke, and T. Kleinjung announced that they had factorized the number using GNFS as follows:

RSA-200 =
2799783391122132787082946763872260162107044678695542853
7560009929326128400107609345671052955360856061822351910
9513657886371059544820065767750985805576135790987349501
44178863178946295187237869221823983

RSA-200 =
3532461934402770121272604978198464368671197400197625023
649303468776121253679423200058547956528088349
×7925869954478333033347085841480059687737975857364219960
734330341455767872818152135381409304740185467

The CPU time spent on finding these factors by a collection of parallel computers amounted – very approximately – to the equivalent of 75 years work for a single 2.2 GHz Opteron based computer. Note that while this approximation serves to suggest the scale of the effort, it leaves out many complicating factors; the announcement states it more precisely.

RSA-210
RSA-210 has 210 decimal digits (696 bits) and was factored in September 2013 by Ryan Propper:

RSA-210 =
2452466449002782119765176635730880184670267876783327597
4341445171506160083003858721695220839933207154910362682
7191679864079776723243005600592035631246561218465817904
10013185929961993381701214933503487587055106 7

RSA-210 =
4359585683259407917999519653872144063854709102652201963
187054821445240853452759997402446252554284559 44579
×
5625457617268841037562770073044474817438769440075105451
049468510945483965774794734721462285507993229 39273

RSA-704
RSA-704 has 704 bits (212 decimal digits), and was factored by Shi Bai, Emmanuel Thomé and Paul Zimmermann. The factorization was announced July 2, 2012. A cash prize of US$30,000 was previously offered for a successful factorization.

RSA-704 =
7403756347956171282804679609742957314259318888923128908
4936232638972765034028266276891996419625117843995894330
5021275853701189680982867331732731089309005525051168770
632990723963807867100860969625379346505637963 59

RSA-704 =
9091213529597818878440658302600437485892608310328358720
428512168960411528640933367824950788367956756806141
×
8143859259110045265727809126284429335877899002167627883
200914172429324360133004116702003240828777970252499

RSA-220
RSA-220 has 220 decimal digits (729 bits), and has not been factored so far.

RSA-220 =
2260138526203405784941654048610197513508038915719776718
3211977681094456418179666766085931213065825772506315628
8667697044807000181114971186300211248792819948748206607
0131066586646083327982803560379205391980139946496955261

RSA-230
RSA-230 has 230 decimal digits (762 bits), and has not been factored so far.

RSA-230 =
1796949159794106673291612844957324615636756180801260007
0888918835531726460341490933493372247868650755230855864
1999292218144366847228740520652579374956943483892631711
5252252565441098081917061174250970244071801036483163828
518852689

RSA-232
RSA-232 has 232 decimal digits (768 bits), and has not been factored so far.

RSA-232 =
1009881397871923546909564894309468582818233821955573955
1411205162058310213385285453743661097571543636649133800
8491706516992170152473329438927028023438096090980497644
0540711201965410747553824948672771374075011577182305398
340606162079

RSA-768
RSA-768 has 232 decimal digits (768 bits), and was factored on December 12, 2009 by Thorsten Kleinjung, Kazumaro Aoki, Jens Franke, et.al.

RSA-768 =
1230186684530117755130494958384962720772853569595334792
1973224521517264005072636575187452021997864693899564749
4277406384592519255732630345373154826850791702612214291
3461670429214311602221240479274737794080665351419597459
856902143413

RSA-768 =
334780716989568987860441698482126908177047949837137685689124313889828837938780022876147116525317430877378144679994 89
×
367460436667995904282446337996279526322791581643430876426760322838157396665112792333734171433968102700927987363089 17

RSA-240
RSA-240 has 240 decimal digits (795 bits), and has not been factored so far.

RSA-240 =
124620366781718784065835044608106590434820374651678805754818788883289666801188210855036039570272508747509864768438458621054865537970253930571891217684318286362846948405301614416430468066875699415246993185704183030512549594371372159029236099

RSA-250
RSA-250 has 250 decimal digits (829 bits), and has not been factored so far.

RSA-250 =
2140324650240744961264423072839333563008614715144755017797754920881418023447140136643345519095804679610992851872470914587687396261921557363047454770520805119056493106687691590019759405693457452230589325976697471681738069364894699871578494975937497937

RSA-260
RSA-260 has 260 decimal digits (862 bits), and has not been factored so far.

RSA-260 =
22112825529529666435281085255026230927612089502470015394413748319128822941402001986512729726569746599085900330031400051170742204560859276357953757185954298838958709229238491006703034124620545784566413664540684214361293017694020846391065875914794251435144458199

RSA-270
RSA-270 has 270 decimal digits (895 bits), and has not been factored so far.

RSA-270 =
233108530344407544527637656910680524145619812480305449042948611968495918245135782867888369318577116418213919268572658314913060672626911354027609793166341626693946596196427744273886601876896313468704059066746903123910748277606548649151920812699309766587514735456594993207

RSA-896
RSA-896 has 896 bits (270 decimal digits), and has not been factored so far. A cash prize of $75,000 was previously offered for a successful factorization.

RSA-896 =
412023436986659543855531365332575948179811699844327982845455626433876445565248426198098870423161841879261420247188869492560931776375033421130982397485150944909106910269861031862704114880866970564902903653658867433731720813104105190864254793282601391257624033946373269391

RSA-280
RSA-280 has 280 decimal digits (928 bits), and has not been factored so far.

RSA-280 =
1790707753365795418841729699379193276395981524363782327873718589639655966058578374254964039644910359346857311359948708984278578450069871685344678652553655035251602806563637363071753327728754995053415389279785107516999221971781597724733184279534477239566789173532366357270583106789

RSA-290
RSA-290 has 290 decimal digits (962 bits), and has not been factored so far.

RSA-290 =
30502351862940031577691995198949664002982179597487683486715266186733160876943419156362946151249328917515864630224371171221716993844781534383325603218163254920110064990807393285889718524383600251199650576597076902947432221039432760575157628357292075495937664206199565578681309135044121854119

RSA-300
RSA-300 has 300 decimal digits (995 bits), and has not been factored so far.

RSA-300 =
276931556780344213902868906164723309223760836398395325400503672280937582471494739461900602187562551243171865731050750745462388288171212746300721613469564396741836389979086904304472476001839015983033451909174663464663867829125664459895575157178816900228792711267471958357574416714366499722090015674047

RSA-309
RSA-309 has 309 decimal digits (1,024 bits), and has not been factored so far.

RSA-309 =
133294399882575758380143779458803658621711224322668460285458826191727627667054255404674269333491950155273493343140718228407463573528003686665212740575911870128339157499072351179666739658503429931021985160714113146720277365006623692721807916355914275519065334791400296725853788916042959771420436564784273910949

RSA-1024
RSA-1024 has 1,024 bits (309 decimal digits), and has not been factored so far. US$100,000 was previously offered for factorization.

Successful factorization of RSA-1024 has important security implications for many users of the RSA public-key authentication algorithm, as the most common key length currently in use is 1024 bits.

RSA-1024 =
13506641086599522334960321627880596993888147560566702752448514385152651060485953383394028715057190944179820728

2164471551373680419703964191743046496589274256239341020
8643832021103729587257623585096431105640735015081875106
7659462920556368552947521350085287941637732853390610975
0544334999811150056977236890927563

RSA-310
RSA-310 has 310 decimal digits (1,028 bits), and has not been factored so far.

RSA-310 =
1848210397825850670380148517702559371400899745254512521
9257074455803347106014125276757082979328578439013881047
6689842943312641913946269652458346498372465163148188847
3364151368736236317783587518465017087145416734026424615
6906116201163809824841208576884836765760948659301883671
4138879545437867134338625829168764l

FROM THIS POINT NUMBERS ARE UNFORMATTED

RSA-320
RSA-320 has 320 decimal digits (1,061 bits), and has not been factored so far.

RSA-320 =
2136810696410071796012087414500377295863767938372793352
315068620363196552357

8837094085435000951700943373838321997220564166302488321
590128061531285010636

8571638978998117122840139210685346167726847173232244364
004850978371121744321

8270343654835754061017503137136489303437996367224915212
044704472299799616089

2591129924218437

RSA-330
RSA-330 has 330 decimal digits (1,094 bits), and has not been factored so far.

RSA-330 =
1218708633106058693138173980143325249157710686226055220
408666600017481383238

1352456802425903555880722805261111079089882303717632638
856140900933377863089

0634828167900405006112727432172179976427017137792606951
424995281839383708354

6364684839261149319768449396541020909665209789862312609
604983709923779304217

018624446552446986967592 67

RSA-340
RSA-340 has 340 decimal digits (1,128 bits), and has not been factored so far.

RSA-340 =
2690987062294695111996484658008361875931308730357496490
239672429933215694995

2758588771223263308836649715112756731997946779608413232
406934433532048898585

9176676580752231563884394807622076177586625973975236127
522811136600110415063

0004691128152106812042872285697735145105026966830649540
003659922618399694276

990464815739966698956947129133275233

RSA-350
RSA-350 has 350 decimal digits (1,161 bits), and has not been factored so far.

RSA-350 =
2650719995173539473449812097373681101529786464211583162
467454548229344585504

3495841191504413349124560193160478146528433707807716865
391982823061751419151

6068496555750496764686447379170711424873128631468168019
548127029171231892127

2886825928263239383444398948209649800021987837742009498
347263667908976501360

338232297255220406880606182953552982073164015l

RSA-360
RSA-360 has 360 decimal digits (1,194 bits), and has not been factored so far.

RSA-360 =
2186820202343172631466406372285792654649158564828384065
217121866374227745448

7764963889680817334211643637752157994969516984539482486
678141304751672197524

0052350576247238785129338002757406892629970748212734663
781952170745916609168

9358372359962787832802257421757011302526265184263565623
426823456522539874717

6159101911392672562309560656645791824061476701380659064
9

RSA-370
RSA-370 has 370 decimal digits (1,227 bits), and has not been factored so far.

RSA-370 =
1888287707234383972842703127997127272470910519387718062
380985523004987076701

7212819937261952549039800018961122586712624661442288502
745681454363170484690

7379449525034797494321694352146271320296579623726631094
822493455672541491544

2700993152879235272779266578292207161032746297546080025
793864030543617862620

8788022443052862927724673556030442659859059706227306826
58082529621

RSA-380
RSA-380 has 380 decimal digits (1,261 bits), and has not been factored so far.

RSA-380 =
3013500443120211600356586024101276992492167997795839203
528363236610578565791

8270750937407901898070219843622821090980641477056850056
514799336625349678549

2187941807116344787358312651772858878058620717489800725
333606564197363165358

2237779263423501952646847579678711825720733732734169866
406145425286581665755

6977260763553328252421574633011335112031733393397168350
585519524478541747311

RSA-390
RSA-390 has 390 decimal digits (1,294 bits), and has not been factored so far.

RSA-390 =
2680401941182388454501037079346656065366941749082852678
729822424397709178250

4623002472848967604282562331676313645413672467684996118
812899734451228212989

1630084759485063423604911639099585186833094019957687550
377834977803400653628

6955344904367437281870253414058414063152368812498486005
056223028285341898040

0795447435865033046248751475297412398697088084321037176
392288312785544402209

1083492089

RSA-400
RSA-400 has 400 decimal digits (1,327 bits), and has not been factored so far.

RSA-400 =
2014096878945207511726700485783442547915321782072704356
103039129009966793396

1419850865094551022604032086955587930913903404388675137
661234189428453016032

6191193056768564862615321256630010268346471747836597131
398943140685464051631

7519403149294308737302321684840956395183222117468443578
509847947119995373645

3607109795994713287610750434646825511120586422993705980
787028106033008907158

74500584758146849481

RSA-410
RSA-410 has 410 decimal digits (1,360 bits), and has not been factored so far.

RSA-410 =
1965360147993876141423945274178745707926269294439880746
827971120992517421770

1079138139324539033381077755540830342989643633394137538
983355218902490897764

4412968474332754608531823550599154905901691559098706892
516477785203855688127

0635069372091564594333528156501293924133186705141485137
856845741766150159437

6063244163040088180887087028771717321932252992567756075
264441680858665410918

431223215368025334985424358839

RSA-420
RSA-420 has 420 decimal digits (1,393 bits), and has not been factored so far.

RSA-420 =
2091366302476510731652556423163330737009653626605245054
798522959941292730258

1898373570076188752609749648953525484925466394800509169
219344906273145413634

2427186266197097846022969248579454916155633686388106962
365337549155747268356

4666583846809964354191550136023170105917441056517493690
125545320242581503730

3405952887826925813912683942756431114820292313193705352
716165790132673270514

3817744164107601735413785886836578207979

RSA-430
RSA-430 has 430 decimal digits (1,427 bits), and has not been factored so far.

RSA-430 =
3534635645620271361541209209607897224734887106182307093
292005188843884213420

6950355315163258889704268733101305820000124678051064321160104990089741386777

2424190744453885127173046498565488221441242210687945185565975582458031351338

2070785777831859308900851761495284515874808406228585310317964648830289141496

3289966226854692560410075067278840383808716608668377947047236323168904650235

70092246473915442026549955865931709542468648109541

RSA-440
RSA-440 has 440 decimal digits (1,460 bits), and has not been factored so far.

RSA-440 =
260142821195560259007078848737132055053981080459523528942350858966

339127083743102526748005924267463190079788900653375731605419428681

140656438533272294845029942332226171123926606357523257736893667452

341192247905168387893684524818030772949730495971084733797380514567

326311991648352970360740543275296663078122345977663907504414453144

081718020709040727392759304102993590060596193055907019396277252961
16299946059898442103959412221518213407370491

RSA-450
RSA-450 has 450 decimal digits (1,493 bits), and has not been factored so far.

RSA-450 =
1984634237142836623497230721861131427789462869258862089878538009871598692569

0078791591684242367262529704652673686711493985446003494265587358393155378115

8032447061155145160770580926824366573211993981662614635734812647448360573856

3132247491715526997278115514905618953253443957435881503593414842367096046182

7643434794849824315251510662855699269624207451365738384255497823390996283918

3287667419172988072221996532403300258906083211160744508191024837057033

RSA-460
RSA-460 has 460 decimal digits (1,526 bits), and has not been factored so far.

RSA-460 =
1786856020404004433262103789212844585886400086993882955081051578507634807524

1464078819812169681394445771476334608488687746254318292828603396149562623036

3564554675355258128655971003201417831521222464468666642766044146641933788836

8932452217321354860484353296131403821175862890998598653858373835628654351880

4806362231643082386848731052350115776715521149453708868428108303016983133390

0416365515466857004900847501644808076825638918266848964153626486460448430073

4909

RSA-1536
RSA-1536 has 463 decimal digits (1,536 bits), and has not been factored so far. $150,000 was previously offered for successful factorization.

RSA-1536 =
18476997032117414743068356202001644030185493386634101714717857749106516967

11161249859337684305435744585616061544571794052229717732524660960646946071

24962372044202226975675668737842756238950876467844093328515749657884341508

84755282981867264513398633649319080846719904318743812833635027954702826532

97802934916155811881049844908319545009848393775227257052578591944993870073

69575568843693381277961308923039256969525326162082367649031603655137144791

3932347169566988069

RSA-470
RSA-470 has 470 decimal digits (1,559 bits), and has not been factored so far.

RSA-470 =
1705147378468118520908159923888702802518325585214915968358891836980967539803

6897711442383602526314519192366612270595815510311970886116763177669964411814

0957486602388713064698304619191359016382379244440741228665455229545368837485

5874455212895044521809620818878887632439504936237680657994105330538621759598

4047709603954312447692725276887594590658792939924609261
264788572032212334726

8553025718835659126454325220771380103576695555550710440
908570895393205649635

76770285413369

RSA-480
RSA-480 has 480 decimal digits (1,593 bits), and has not been factored so far.

RSA-480 =
3026570752950908697397302503155918035891122835769398583
955296326343059761445

7144169659817040125185215913853345598217234371231338324
773210726853524776378

4105186549246199888070331088462855743520880671299302895
546822695492968577380

7067958428022008294111984222973260208233693152589211629
901686973933487362360

8129660418514569063995282978176790149760521395548532814
196534676974259747930

6858645849268328985687423881853632604706175564461719396
117318298679820785491

875674946700413680932103

RSA-490
RSA-490 has 490 decimal digits (1,626 bits), and has not been factored so far.

RSA-490 =
1860239127076846517198369354026076875269515930592839150
201028353837031025971

3738522164743327949206433999068225531855072554606782138
800841162866037393324

6578171804201717222449954030315293547871401362961501065
002486552688663415745

9758925793594165651020789220067311416926076949777767604
906107061937873540601

5942747316176193775374190713071154900658503269465516496
828568654377183190586

9537640698044932638893492457914750855858980849190488385
315076922453755527481

1376719096144119390052199027715691

RSA-500
RSA-500 has 500 decimal digits (1,659 bits) and has not been factored so far.

RSA-500 =
1897194133748626656330534743317202527237183591953428303
184581123062450458870

7687605943212347625766427494554764419515427586743205659
317254669946604982419

7301601038125215285400688031516401611623963128370629793
265939405081077581694

4786041721411024641038040278701109808664214800025560454
687625137745393418221

5494821277335671735153472656328448001134940926442438440
198910908603252678814

7850601132077287172819942445113232019492229554237898606
631074891074722425617

39680319169243814676235712934292299974411361

RSA-617
RSA-617 has 617 decimal digits (2,048 bits) and has not been factored so far.

RSA-617 =
2270180129378501419358040512020458674106123596276658390
709402187921517148311

9139894870133091111044901683400949483846818299518041763
507948922590774925466

0881718792594659210265970467004498198990968620394600177
430944738110569912941

2854289188085536270740767072259373777266697344097736124
333639730805176309150

6836310795312607239520365290032105848839507981452307299
417185715796297454995

0235053160409198591937180233074148804462179228008317660
409386563445710347785

5345712108053073639453592393265186603051504106096643731
332367283153932350006

7937107541955437362433248361242525945868802353916766181
532375855504886901432

221349733

RSA-2048
RSA-2048 has 617 decimal digits (2,048 bits). It is the largest of the RSA numbers and carried the largest cash prize for its factorization, US$200,000. The largest factored RSA number is 768 bits long (232 decimal digits). All RSA cash prizes were removed from circulation as soon as the McCanney Generator Function was released in March 2007.

RSA-2048 =
2519590847565789349402718324004839857142928212620403202
777713783604366202070

7595556264018525880784406918290641249515082189298559149
176184502808489120072

8449926873928072877767359714183472702618963750149718246
911650776133798590957

0009733045974880842840179742910064245869181719511874612
151517265463228221686

9987549182422433637259085141865462043576798423387184774
447920739934236584823

8242811981638150106748104516603773060562016196762561338
441436038339044149526

3443219011465754445417842402092461651572335077870774981
712577246796292638635

6373289912154831438167899885040445364023527381951378636
564391212010397122822

120720357