<u>**LIMITS OF "LIMIT"**</u>.

INCOMPLETENESS, UNDECIDABILITY & NON-COMPUTABLE VALUES: IMPLICATIONS IN QUANTUM PHYSICS

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Everything in the universe is interrelated and interdependent. The laws of physics are same everywhere. The macro and the micro replicate each other. By properly correlating them, we can know about each other. Completeness must be viewed in that context. Incompleteness is the reductionist approach – hence limited in scope. Extending information on part to the whole leads to confusion.

Language is the transposition of information to another system/person's CPU/mind by signals/sound using energy. Mathematical equations transpose SCALAR QUANTITATIVE ASPECT of information only. Thus mathematics is a language only for quantitative aspects of Nature. Physics is mostly vector - hence not confined to mathematics only. There is no equation for the Observer. Smile is not curvature of lips. Equations in math are different from those of physics and imply special conditions for interaction. Exchanging both (as in renormalization or brute-force approach) is like extending limited information to build abstract models without the restrictions imposed on them by rules of the physical world. This leads to incompleteness issues.

The validity of a mathematical statement is judged by its logical consistency. The validity of a physical statement is judged by its correspondence to reality. The way math is now being done is incomplete and inconsistent. The problem is with dualism of bivalent logic of propositional calculus or sentential logic that leads to incompleteness based on linearity. Mathematics deals with scalar numbers. Physics is all about interactions, which makes it vector. Scalars and Vectors do not follow the same math rules. This dualism must be sublimated within formal systems by logically consistent reasoning - both mathematical and physical. Napier's logarithms, Hilbert's problems, Gödel's negative solution and Wigner's Unreasonable effectiveness of mathematics - all tend to limit the limits of probability in formal theories. They arise out of improper extension or non-inclusion of sectoral issues with consequential implications in fundamental interactions and other theories in physics.

PARADOXES & INCOMPLETENESS:

The view that scientific laws are based on inductive reasoning – assumption that we can't prove, but only infer - is misleading, as is Gödel's view: without using a different set of axioms, a system of axioms can't be proven as consistent. According to Gödel, a formal system is <u>**consistent**</u>, if there is no statement such that the statement itself and its negation are both derivable in the system. A formal system is <u>**complete**</u> if for every statement of the language of the system, either the statement or its negation can be derived in the system. He concluded that if definability is itself definable, then it is also ambiguous. His PhD Thesis: **Gödel's completeness theorem** says: you can prove a statement is true using your <u>chosen axioms</u> if and only if that statement is true <u>in all possible models of those axioms</u>. But he erred when he started building abstract models with insufficient or improperly defined data. These gave rise to paradoxes.

A paradox is imprecise about the definition of something. All paradoxes are incomplete statements - action of indeterminate character. "This statement is unprovable" only shows one's lack of information. It doesn't prove anything. You can't take one part of a fowl and cook it, yet expect the other part to lay eggs. Equivalence principle and Russell's paradox was discussed thousands of years ago by Prashastapada in his book Padartha Dharma Samgraha, who proved it a wrong description of reality (Jaati Saankarya). All other paradoxes including the Zeno's paradoxes are similarly wrong description of reality.

Proper research methodology differentiates valid axioms from invalid ones based on adequate proof and uses the proven ones to form postulates or plan models to be tested. Proof is the identity of time invariant information derived from measurement of any system under similar conditions that invariably leads to similar results. A paradox arises while developing on part observation of conflicting information for:

1) Establishing the general identity of something known – this is A.
2) Establishing the special identity of something from a set – this is A'.
3) Establishing the identity when observing partly conflicting identity of two objects – A or B?
4) Axiomizing the observed identity – this defines A.
5) Axiomizing the unobserved or yet unknown identity – this is not A.

Gödel's first incompleteness theorem says: Any consistent formal system F within which a certain amount of elementary arithmetic can be carried out is incomplete - there are statements of the language of F which can neither be proved nor disproved in F. It does not deal with provability in absolute sense, but only concerns derivability in some formal systems. This is the fallacy. A formal system has five steps:

a) Frame a postulate based on observed facts.
b) Collect corroborative evidence by devising suitable experiments.
c) Prove negation of its opposite statement by suitable tests.
d) Test universality of application. If there are exceptions, they must be listed.
e) Prove other contrary statements wrong through sharing and analysis.

Gödel's first theorem fails this test. Exclusion of some axioms or comparison of the non-comparable through generalization or extension puts a limitation on our knowledge derived from such statement or is a violation of physical principles. This leads to paradoxes. If we investigate further, the paradox vanishes.

Gödel started with Liar's Paradox: "I'm lying" or "This Theorem is false". If it's true, I'm not lying or the theorem is false. If it's false, I'm lying or the theorem is true. Such conflict arises only if one is talking to oneself. If we make a general statement like that, there is no contradiction. I can lie to someone and later admit it. Or after examining some theorem, I can reject it. He assumed that every non-trivial formal system is incomplete because all questions cannot be answered by using a certain set of axioms. This itself is incomplete, as he takes only some part.

It is said: in the statement: "This Theorem is false", "This Theorem" is a place-holder. But what is a place holder? It is part of the whole - like a word in a sentence - not the full sentence. We consider only part and then say it is incomplete!

His second incompleteness theorem concerns the limits of consistency proofs - the provability or derivability - relative to some formal system. It says: for any consistent system F within which a certain amount of elementary arithmetic can be carried out, the consistency of F cannot be proved in F itself. It does not say anything about whether, for a particular theory T satisfying the conditions of the theorem, the statement "T is consistent" can be proved - shown to be true by a conclusive argument or by a generally acceptable proof. Again, leaving out one part!

PHYSICS & MATHS:

Gödel said: as long as a logical system is complicated enough to include addition and multiplication, then the logical system is incomplete - there are things you can't prove true or false. The second theorem says: inside of a consistent logical system (without contradictions), the consistency of the system itself is unprovable - it can't be proved that math does not have contradictions. Both these are contrary to the principle of logical consistency that validates math. It is a mistaken notion that math tries to prove that statements are true or false based on axioms (initial assertions) and definitions. It is a proven quantitative description of Nature that is invariant in time and space.

Gödel's first problem was the continuum hypothesis: "Are the real numbers the smallest uncountable infinity?" He said it is impossible to prove or disprove that the real numbers have the smallest uncountable cardinality. His second problem: Prove the axioms of arithmetic are consistent. The second incompleteness theorem "within your mathematical system, you cannot prove that you can't have contradictions" violates the basic principles of math – logical consistency. He says: if we've proven the statement "there are no contradictions in the system", the system cannot be consistent. Since the system is complicated enough to include arithmetic, therefore it must have contradictions in the system! Since we've proven <u>there are and are not contradictions</u> in the system, the system is inconsistent! If it is proved that there are no contradictions, then the system does have contradictions! OMG!

All these arise because the terms number, Mathematics or Arithmetic has not been precisely defined. Peano arithmetic or any subsequent "Mathematics or Arithmetic" are mathematically incorrect. Richard's paradox is used to distinguish between math and meta-math – how math proofs are created or the correctness of axioms. There lies the problem of definability. They don't use universally acceptable definition of math. The Greek μάθημα means knowledge, study, learning. The Sanskrit word Ganitam (गणितम्) means counting by differentiation, because Mathematics is the ordered accumulation and reduction in numbers of the same class (linear or vector) or partially similar class (nonlinear or set) of objects. Even Arithmetic, from the Greek ἀριθμός – number, and τική or τέχνη, - art, mean the same thing.

Mathematics is the quantitative aspect of Nature - accumulation and reduction of numbers linearly (addition/subtraction) or non-linearly (multiplication/division). A computer program basically does this. But when math is applied to physics, it is different. In pure math, 2+1=3. But in physics or biology, the result depends on the interactive potential of the objects involved. It can yield three different types of results. For example, 2 atoms of hydrogen and 1 atom of oxygen makes one molecule of water, where the nature of both atoms cease to exist. It is not a simple combination of 3 atoms. You cannot do any sum involving these atoms by simply mixing them up. A specific arrangement with a threshold temperature is necessary for them to interact. The equality sign in physics comes with conditions. In HCl, the situation is different. The atoms retain their character while becoming a third molecule. In biology, DNA in the sperm and the egg retain their character while producing something similar. This is because, <u>numbers are scalar quantities</u>, whereas <u>physics and biology deal with interactive potential, which involve vectors also</u>.

Mathematics is the science of scaling up or down the numbers of the same or partially similar class. We can't add 5 apples and 4 oranges. But we can add them after classifying them as fruits. But in Gödel's abstract format, there is no restriction on different classes getting clubbed up together without being defined as a group, which is not permitted in math. The modern concept of groups is abstract - a finite or infinite set of elements together with a binary operation that satisfy the properties of closure, associativity, identity and inverse property. It is not scalar – hence can't form a class. This gives rise to incompleteness.

The Church-Turing thesis: The arithmetic of a Turing Machine is not provable within the system and is subject to incompleteness, is also not correct for the same reason. The computability of a problem is closely linked to the existence of an algorithm to solve the problem. In computability theory, the halting problem is the problem of determining, from a description of an arbitrary computer program and an input, whether the program will finish running, or continue to run forever. Halting problem is hard because it is not solvable algorithmically even in principle. There are other hard problems that are solvable in principle but they are near impossible to solve. These types of problems are called Non-deterministic Polynomial (NP) problems. They arise because of the extension of scalar properties to non-scalar operations.

Napier was among the first to confuse "multiplication and division" of numbers as "equivalent to addition and subtraction". Shulba Sootra, the first ever treatises on mathematics written thousands of years BC, makes a distinction between these based on linearity.

In linear accumulation or reduction, we scale up or down the number by 1 at each step. If we arrange apples in 6 rows with 5 apples in each row, we can count them linearly 1 by 1 to reach the result 30. If we multiply 5 into 6, we also reach the same result. However, there is a big difference in both cases. In the case of multiplication, "row" and "apples" are common to both the terms "apples in 6 rows" and "5 apples in each row", each of which are counted in addition. We apply multiplication between the partially dissimilar parts which is not permitted in addition. This brings in nonlinearity. This is self-referential, but can explain and prove everything connected to it – hence, not incomplete. The importance of this can be seen in multiplication and division by zero.

NUMBER DEFINED.

<u>Number is a scalar quantity</u> of every object by which we <u>differentiate between similars irrespective of its dimension and volume</u>. Being scalar, it must be confined - its dimensions fully perceptible at "here-now" to differentiate it from others. If there's nothing similar at here-now, the number associated with the object is one. If there are similars, the number is many. Our sense organs/measuring instruments are capable of measuring the presence/absence of only 1 at a time [1, 0]. Many is a collection of successive one's. Based on the sequential perception of one's, many can be 2, 3, 4….n. In a fraction, the denominator represents totality of "new" one's (with different dimension or volume), out of which some (numerator) are taken. The same is true for decimals, where the denominator changes in a specific order of ten.

In modern number theory, a solution consisting only of integers is sought in these equations. The equations have many solutions among real numbers, but only few among integers. An integer is a whole number – a thing complete in itself – which is not a fraction. But a fraction is a ratio between integers only. Decimals are nothing but fractions of a special type.

<u>Zero is the absence of one or many at here-now</u> that is known to exist elsewhere (else we will not know about its absence). <u>It is not a very small quantity</u>, because even that quantity is present at here-now. Infinity is not a very big number. For every n, there is n+1. Infinity is like one - without similars - with one difference. Whereas the physical dimensions of one is fully discernible from others, the <u>dimensions of infinity are not discernible</u> - infinity goes beyond "here-now". There are only <u>four infinities that coexist</u>: time, space, coordinates and information.

Positive and negative in math and physics are related to accumulation/creation and reduction/ confinement. There can't be negative infinity to positive infinity through zero, as it will show one beginning or end of infinity at the zero point, which is non-existent at here-now – hence not perceptible. No math is possible with infinity, as all operations involving it will have indiscernible dimensions. History shows that whenever infinity appears in any theoretical model, it points to some fundamentally different and novel phenomena. There are many examples. Infinity is not a real number and can't be counted. There is nothing like "the smallest uncountable infinity".

Renormalization is mathematically void. Hence we land in problems like the hierarchy problem where the fundamental value of some physical parameter, such as a coupling constant or mass is vastly different from its value measured in an experiment. Another example is the cosmological constant problem or vacuum catastrophe, which is the disagreement between the observed values of vacuum energy density (the small value of the cosmological constant) and theoretical large value of zero-point energy suggested by quantum field theory. They differ by a factor of at least 10^{107} and is dubbed the biggest mismatch in history. Even after certain adjustments, the error couldn't be reduced to below 10^{55}. This should rule out vacuum energy or modified cosmological constant as a solution to dark energy problem!

All of math is done at here-now. Since zero is not at here-now, no mathematical operation is possible involving zero except for non-linear accumulation (multiplication). We can go out of here-now. Since this extends the number partly into "not at here-now", the dimensions of the result can't be known fully – no longer confined. Hence, the result is no number – zero –SHOONYA - vacuum. But division by zero stands on a different footing. If we divide 21 by 5, then we take out bunches of 5 from the lot of 21. When the lot becomes empty or the remainder is below the divisor (5) so that we can't take a bunch further, the number of bunches of 5 and the remainder are counted. That gives the result of division as 4 and remainder 1. We can't halt the operation midway and declare result 3 and remainder 6. In case of division by zero, we take out bunches of zero (which is impossible). At no stage the lot becomes zero or less than zero. Thus, the operation is not complete and result of division can't be known. In any stage, the number remains same. Division by zero is mathematically void - it leaves the number unchanged.

This is linear reduction. If we go by non-linear reduction, we find the number extending partly into "not at here-now". This is called "KHAHARA" or indeterminate. This is wrongly confused in modern math as infinity. If we multiply such a KHAHARA by zero, the opposing operations cancel each other and the original number is regained. Hence <u>if a number is first divided and then multiplied by zero, the number regains itself</u>.

If we evaluate 5(4 + 3), we can do it in two ways: first add 4 and 3 and multiply the result by 5. Or we can multiply both 4 and 3 separately with 5 and then add the products. In both cases, we get the same answer 35. This is the distributive law. Now consider √(16+9). If we find the square roots of 16 and 9 separately and then add, it will be 4+3=7. But the correct answer is the square roots of (16+9) or √25 = 5. Why this difference?

While multiplication can be non-linear accumulation, squaring is not so. It is related to two dimensional area and cube is related to volume. Under mutual transformation of the dimensions, the structure of the object remains invariant. We "see" through electromagnetic radiation where the electric field, the magnetic field and their direction of motion are mutually perpendicular. Hence we have three mutually perpendicular dimensions. As I had shown in an earlier essay here, these can be resolved into 10 physical dimensions. For the same reason, $x^2 + 1 = 0$ is not a valid equation, as it implies $x^2 = -1$ and square of any number can never have negative sign. However, since -1 is a valid number with mutually exclusive connotations, it can be used in some applications.

LIMITING LIMIT.

The tenth on Hilbert's famous list of important open problem in mathematics: Determination of the solvability of a Diophantine equation - focusses on whether the equation is solvable in rational integers. Consider any equation with one or more variables and with integer coefficients, which involves only addition and multiplication, such as $x^2 + y^2 = 2$. Here the only solution is x = y. Because, as shown above, all numbers must be integers or ratio of integers. Since 2 = 1+1, each of the terms must be 1. If each one is a different class, we can't do the sum. The so-called Matiyasevich's solution fails this test. By ignoring the class while going for sets, the statement is inherently incomplete.

Now, let us consider a general term $a_n = 1/n$, where all elements of n belongs to the same class. As we go up starting from n=1, the value becomes smaller and smaller: 1, ½, 1/3, ¼, 1/5 …. We can go as close to the actual value as we want. However, even for a very big value for n, the fraction will never be 0. It only gets smaller and smaller. Since we can't go on infinitely, we have to set a limit somewhere.

The notation: limit $n \to \infty$, 1/n=0, is not a valid statement, as 0 is not a small number as shown above.

Suppose we take $a_n = (2n+1)/3n+4)$.
For successive values of n starting from 1. We get 3/7, ½, 7/13, 9/16, 11/19…
For any value of n, the function never exceeds 2/3, which can be deduced by dividing the numerator and the denominator by n. In (2+1/n)/(3+4/n) both 1/n and 4/n become negligible as n becomes big and the result tends to 2/3. Since we can't go on indefinitely, we have to take it as a limit. Such functions are called ASANNAMOOLA – limiting the limit by ancient Indian mathematicians.

But suppose we chose a function $a_n = (2n^2 +1)/3n+4)$.
Here the value diverges as 3/7, 9/10, 19/13, 33/16, 51/19…. without a limit.
This shows that squaring a number is not the same as multiplying the number by itself. Multiplication is non-linear accumulation of discrete scalar numbers. Squaring is about analog area of two dimensional fields. The area can remain constant while the dimensions change in an ordered manner (60 can be 12 x 5 or 10 x 6 or 30 x 2)) making it behave like a vector. But it is not permissible in scalar mathematics.

For example, in relativity wherever speed comparable to light is involved, like that of a free electron or photon, the Lorentz factors limit the output. There is always length, mass or time correction. But there is no such correcting or limiting factor in math with numbers. Thus, the mathematical limit violates the principle of relativistic invariance for high velocities and can't be used in physics!

Now take the example of (1+1/n).
As the value of n increases, the value of 1/n decreases. For very large value for n, 1/n becomes negligible and can be ignored. We can treat (1+1/n) as 1. Since 1 raised to any power remains 1 only, the value for $(1+1/n)^n$ for all values of n will approach 1.
Look at it from a different angle. For any value of n higher than 1, if n is raised to increasing powers, it becomes larger and larger. For successive values of n, we get the values of
$(1+1/n)^n$ as 2, 9/4, 64/27, 625/256, 7776/3125, …
For a very large value of n, the result will be a very big number. Such contradictory results appear because we forgot to consider the linearity. 1 is confined and without similars. For this purpose, it cannot be raised to any power. "Many" have extensions – hence, non-linear. Hence it can be raised to higher powers. This brings into picture combinatorics with recursive algorithms.

Skolem's 1923 paper on primitive recursive arithmetic (PRA), which defines the value of a function by using other values of the same function, was about number theory and the essential role of logic in it. A method that calls itself is known as a recursive method. Any object in between them would be reflected recursively like two parallel mirrors facing each other. Recursion is the process which comes into existence when a function calls a copy of itself to work on a smaller problem for repeated application of a rule, definition, or procedure to successive results. It is applied for sorting, searching and traversal problems. In computer science, it involves a program or routine of which a part requires the application of the whole, so that its explicit interpretation requires in general many successive executions.

Thousands of years ago, Boudhayana in his Shulba Sootram has described the theorem later known after Pythagoras. Pingala and Kashyapa of antiquity used combinatorics with recursive algorithms called CHITYUTTARA (recursive matrix - so-called Pascal's differential triangle). Bharata rotated it as a right angled triangle, known as MERU PRASTARA. The "chakravaala" (cyclic) method for solving the indeterminate equations of the second order, the basic calculus based on "Aasannamoola" (limit), "chityuttara" and "circling the square" methods were known in India, thousands of years before Newton or Leibnitz came across calculus.

Their methods:
$(1 + 1)^2 = 1^2 + 2 \times 1 \times 1 + 1^2 = 1 + 2 + 1 = 4.$
$(1 + 1)^3 = 1^3 + 3 \times 1^2 \times 1 + 3 \times 1 \times 1^2 + 1^3 = 1 + 3 + 3 + 1 = 8.$
$(a + b)^4 = a^4 + 4\,a^3\,b + 6\,a^2\,b^2 + 4\,a\,b^3 + b^4$, etc.
$(103)^4 = (100 + 3)^4 = 1 \times (100)^4 \times 3^{\circ} + 4 \times (100)^3 \times 3 + 6 \times (100)^2 \times 3^2 + 4 \times 100 \times 3^3 + 1 \times 3^4$
$= 100000000 + 12000000 + 540000 + 10800 + 81 = 112550881.$

After 17th century, mathematics has gone haywire.

ON FIELDS & INTERACTIONS

Now we will discuss how incomplete description has led physics astray with few examples.

Time and space are non-physical mental constructs that arise from the concept of sequence and interval. The ordered sequence of interval between events are time and that of objects are space. We describe objects by markers. Since intervals have no markers, we describe time and space through alternative symbolism of the boundary events and objects respectively. Being infinities, they coexist as spacetime. For the same reason, they can't take part in interactions. Yet every object occupies space and every event takes place in time. Evolution is the change in objects while retaining its originality. When space contains motion, it is known as field. Time manifests as evolution of objects in six cyclic events: from being as cause to becoming as effect to growth due to addition of similars to transformation due to the addition of harmonious others to transmutation due to the opposite effect to change of form by disintegration. The cycle repeats. Spacetime geometry is the evolution of objects in space. Curvature is related to coordinates – not spacetime. Evolution of energy is seen in interaction.

A field is a region containing energy. The function of energy, which appears as force, is to move mass. Mass is the stress created by confined energy on the field. The forces can interact within the field to change the local structure. Forces can interact with each other also. This makes the one force appear many. Position is where opposing forces cancel each other. Such force is called potential, which, when disturbed, can cause a pair of variable equal and opposite motions. Its nature depends on the nature of the force that broke the equilibrium. The released net force is the kinetic energy. After the force reaches local equilibrium, the effect is called work. It has nothing to do with direction of displacement.

A particle is energy confined like in atoms. If energy affects a medium in such a way that the momentum caused by the density of the medium is transferred like in a wave, then the wave front or the tip is also called particle – like photons. For this reason, speed of light appears same in all inertial frames of reference, while it changes in fields of different density. Energy flows from low disturbance area to contain higher disturbance. This makes it a couple – one moving from a core "outwards" creating distance variables and the other "coming in" to contain it creating proximity variables. These are called charge. The motion content is determined by the interacting forces and particles present there. The nature of positive charge is to radiate out. The nature of negative charge is to confine the radiation. The universe has a medium (Cosmic Microwave Background) like the electron sea that confines the radiation emitted by protons (the tip where it is contained is called the electron. Hence its position can't be predicted). Electron is not a particle like proton, but is a tip like photon. The stress generated by the radiation at that point of electron sea is called electron mass.

The highly rated double slit or the recent triple slit experiments can't be performed with protons or neutrons. It can only be performed with electrons or photons, which are tips in the field transferring momentum only. Hence we see interference pattern. Using protons instead of electrons will prove the outcome and the mystery wrong. These are not exclusively quantum and can be seen in river channels.

Since two positive charges move out, their interaction leads to explosion. The interaction between two negative charges is harmless. If opposite charges interact partially, it leads to creation of a new particle. If they interact fully, it leads to growth of the same object like isotopes. Particles in the micro world, where the charge is a little less than unit negative charge are called protons. Where charge nature is the opposite, it is called neutrons (it is not charge neutral, but has a residual negative charge vide aps.org/pdf/10.1103/PhysRevD.25.2887 – the page has now been removed as it was inconvenient to modern theories). This is anti-matter (A report in the journal Nature volume 578, pages375–380(2020) says: the Lamb shift in anti-hydrogen are identical to those seen in hydrogen). The energy which propels these interactions is neutrinos.

When the forces interact with the field to change the local nature, it reveals in five different ways. When both have proximity variables, it is called strong nuclear interaction. When the bigger one has proximity and the other distance variables, it is called beta decay part of weak interaction. In the opposite case, it is electromagnetic interaction. When both have distance variables, it is called alpha decay. These four are intra-body in nature – arise from within the confinement. When two bodies interact in a field, their confinements makes them appear like point particles. Their accumulated density and its ratio with the density of the local field, positions them at the maximum permissible distance from a common point called barycenter. The force between them is called gravitation. The density ratio is called the gravitational constant. It is not a universal constant.

Scientific theories need review.