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Combinatorial Heredity System, Homology of Genotypes and Unitary Symmetry of Genotypes and Phenotypes

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Abstract:

Nature is conservative in two major hypostases. The first is the combination of elements of one level of development of matter with the formation of a set of objects of the next, more complex, level of development of matter, which, in turn, is the initial set of elements for forming compounds of the next, more complex, level of matter development.

This process with small transformations of a homeostatic character occurs in all natural and civilizational areas - from quarks to philology.

The second basic, conservative hypostasis of Nature is the parallelism of general regularities, manifested in the formation of each of the levels of development of matter, i.e. Such features as homology (gradualness), hierarchy of interactions of elements in complex objects, normal distribution, symmetry, periodicity, etc. are repeated in a number of details and in physical objects and processes, and in chemical objects and processes, and in biological processes ... And even in philology and economics.

In my previous articles, I showed how these properties of natural phenomena manifest themselves in physics, chemistry, pharmacology and medicine. In this article I am trying to create a combinatorial system of heredity and to show the advantages of implementing my ideas about Unitary symmetry in Genetics

> If **Gregor Johann Mendel**, being a teacher of mathematics and physics, would have become acquainted with the works of the ancient Indian physician Sushruta (6th century BCE) or, at worst, would have read the book "De Arte Combinatoria" (publ. 1690) of

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> Gottfried Wilhelm (Von) Leibniz and penetrated into the physical essence of the systematic in 1869 systematics of chemical elements of Julius Lothar Meyer and Dmitri Mendeleev...
>
> If chemists, biologists, physicians and educators understood, ...

... then in 1856 **Gregor** would understand that behind each phenotypic manifestation of the image of the object (physical property) follows a certain structural unit (in chemistry - a combination of nuclei and electrons).

... then **Gregor** would understand that different phenotypes most likely correspond to different structural units (later called Genes). In addition, if the structural units are different, but have the same biochemical nature, then these structural units themselves are complex objects.

... then **Gregor** would understand that only the combinations of smaller structural units, later called codons, can be the different structural units of one biochemical nature (different versions of one Gene are alleles).

Of course, **Gregor Johann Mendel** could not have any idea of the hierarchy of interactions between codons and histones. Therefore, the building of Genetics, he began to build "from the second floor," before he reached the Great **Ernest Rutherford**, who later postulated that **all sciences are divided into physics and collecting stamps**.

Many scientists do not understand this until now. Therefore, they build the Interdisciplinary Paradigm on the basis of phenomenological unification, for example, biology and chemistry in biochemistry, ignoring **the Main Conservative Paradigm of Nature - Unitary Symmetry of Combinative Objects of Nature**.

Chemists of past years have been fascinated by alchemy and the pursuit of discoveries of new chemical elements and have not yet thought about their taxonomy.

About biologists and physicians and can not speak. They in their knowledge were and remain very far from the physical interpretations of their practical work. Not to mention combinatorics and group theory.

n this article I show how the Universal Paradigm of Nature (Unitarian Symmetry of Combinatorial Objects of Nature), which is postulated by me and adapted to different discrete objects [1, 2, 3, 4, 5, 6, 7, 8, 9] helps to build a physical foundation for Genetics and, in particular, for the Laws of Mendel.

1. Discrete Objects. Combinations of Discrete Objects. Discrete Objects of Genetics. Homology in Genetics. Unitary Symmetry in Genetics

Definitions:

Discrete objects are all objects of animate and inanimate nature. Some of them are easily observed with the help of modern identification tools: from the collider to the microscope. The other part exists virtually,

most often in our imagination, for example, a mixture of pure substances (air, water ....), a mixture of monochromatic electromagnetic waves...

The combination of a finite number of discrete objects leads to the formation of a set of combinations. Combinations can be with repetitions of individual elements, as in the formation of nuclei from protons and neutrons, and with permutations of individual elements, as can be observed in complex organic molecules called Isomers.

Discrete elements in Genetics are nitrogenous bases, the combination of which leads to the formation of codons, it is a combination of codons with the formation of genes (alleles), this is a combination of genes when crossing.

Many combinations form a family of homology series. Homological series can be series of substitution, as in the case of codons. Or by accession series, as with the increase in the number of genes in chromosomes.

Symmetry manifests itself in the implementation of some real actions (reflection, rotation, transfer ....) above the object, after which the "movable" object after these operations (symmetry operations, studied by the Theory of Groups of Symmetry Operations) coincides with the original object. Symmetry operations can be performed both in the space of geometric parameters (in this case Symmetry is called "Geometric Symmetry"), and in the space of physical parameters. The latter is called "Unitary Symmetry" in the theory of elementary particles. I extended the ideas about Unitarian symmetry to nuclei, atoms, molecules, codons, mixtures and genes and called it Parametric Symmetry.

The physical parameter in genetics is the phenotype.

The main advantage of unitary symmetry is the manifestation of the remaining differences in the physical parameters of two-link segments of homological series. The system of equations for these differences allows us to find by their small number all the physical parameters of the family of combinatorial objects that form their entire system of homological series.

That is, PREDICT!

1a. Codons

What are the discrete objects in Genetics? First of all, these are nitrogenous bases. The building blocks of DNA and RNA are the set of five nitrogenous bases. These nitrogenous bases are adenine (A), uracil (U), guanine (G), thymine (T), and cytosine (C).

The standard direct combinatorial problem, which Mother Nature applies in practice, involves choosing combinatorial operations to build a higher level of organization of matter. Nature for some reason always

chooses combinations with repetitions. In the case of complex molecules Mother - Nature "indulges" with combinations with repetitions and permutations.

Geneticists initially solved the reverse combinatorial problem - they were looking for combinatorial operations to match such a set of nitrogenous bases that would overlap the synthesis of 20 amino acids. Such a combinatorial operation turned out to be "Combinations with repetitions and permutations."

The complete set and the codon homology structure is presented in Fig. 1 and Fig. 2.

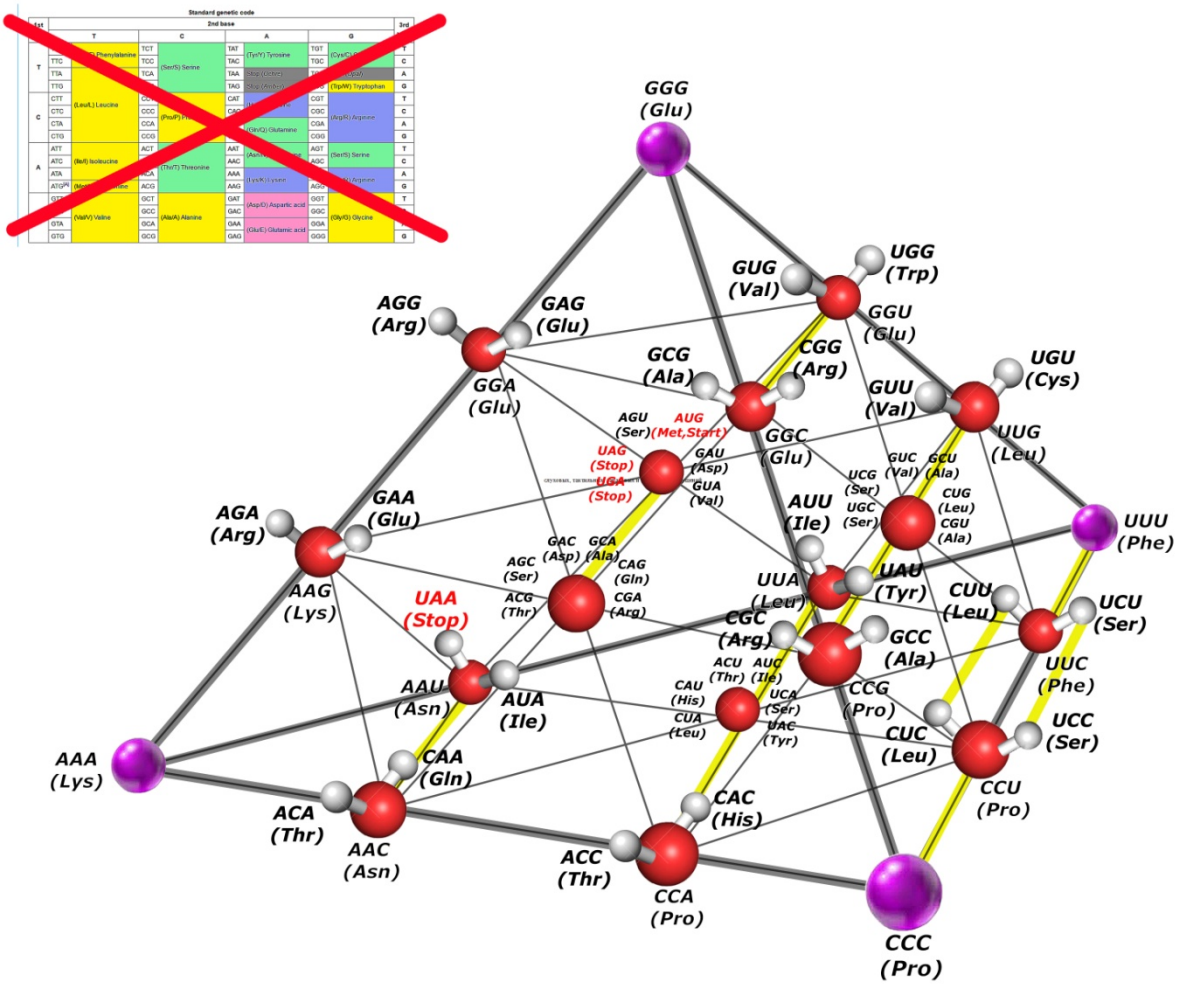

Fig.1. Combinatorial codons system of homologous series. Codons, specify which amino acid (in brackets) will be added next during protein synthesis. Yellow lines show the "related" transitions from one codon to another codon while replacing (C - U).

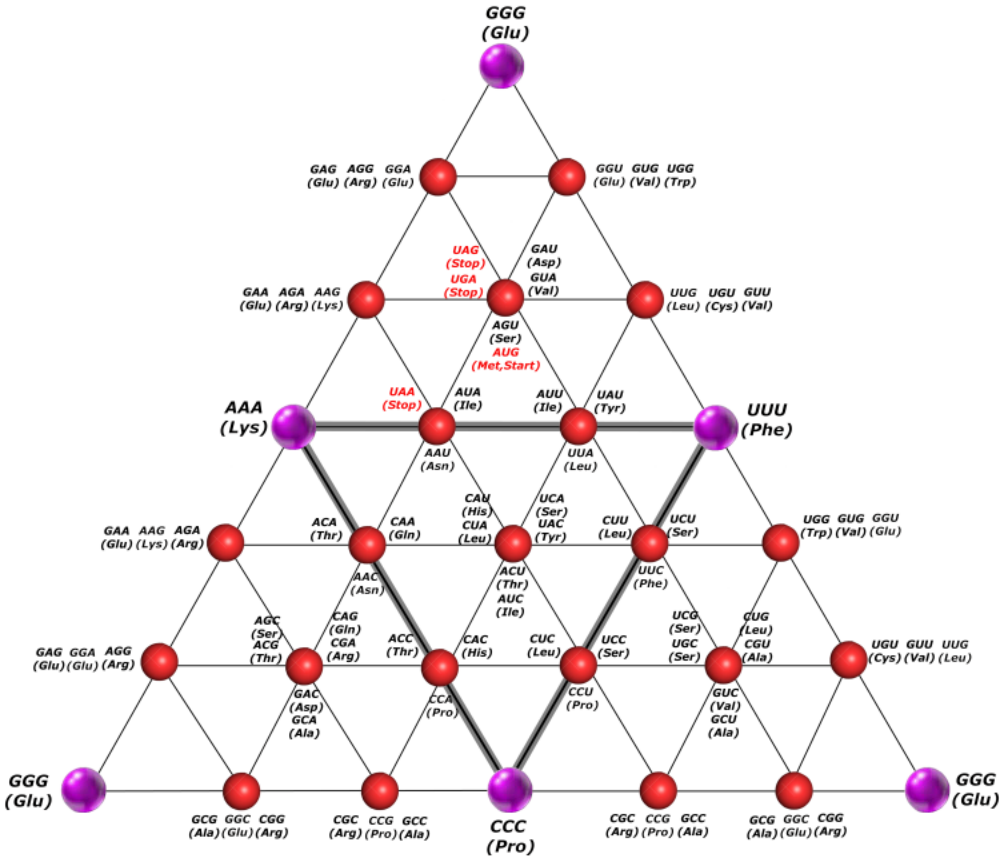

Fig.2. Sweep of triangular pyramid homologous series of codons.

Given the above paradigm, the well-known archaic RNA codon table [8] should be replaced by the structure shown in Fig. 1 and Fig.2.

A combination of 64 codons in (n) forms a gene that specifies a sequence of either a specific polypeptide or a functional RNA. So-called Alleles are formed, which correspond to a certain feature of the organism, transmitted from parents to offspring during reproduction.

This representation of the genetic code allows predicting the results of mutations and the evolution of organisms. For more details, see [9].

1b. Genes, alleles and phenotypic traits

A gene is a locus (or region) of DNA which is made up of nucleotides and is the molecular unit of heredity From the point of view of combinatorics, the gene is a discrete object, to which one or other combinatorial operations can be applied to obtain all possible combinations (with permutations or without them).

Denote the parent alleles as ***A*** and ***a***. Their combination of two to two with repetitions leads to a simple set of genotypes:

AA - Aa (aA) - aa,

which is inherited in the first generation (monohybrid cross) and which correspond to certain visual characteristics successors (coloring progeny form of organic element, ...) and covert features progeny (especially metabolism, behavioral, ...). These features are called the phenotype (see Fig. 3)

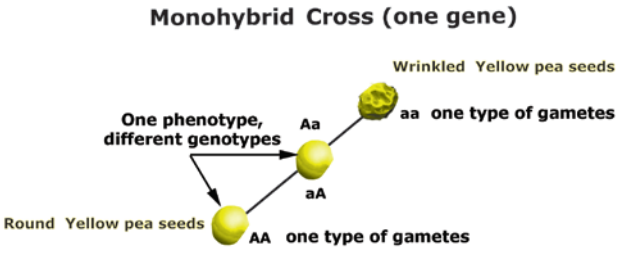

Fig.3. Genotypes and phenotypes when monohybrid cross.

If we associate the combinatorial composition with the physical property (the precursor premise of special, unitary symmetry), then it is obvious that the descendants ***AA*** and ***aa*** of the phenotype must differ from the descendant with the genotype ***Aa***. **This phenomenon was observed by Mendel**.

Thus, the Law of Segregation states that every individual organism contains two alleles for each trait, and that these alleles segregate (separate) during meiosis such that each gamete contains only one of the alleles. An offspring thus receives a pair of alleles for a trait by inheriting homologous chromosomes from the parent organisms: one allele for each trait from each parent [10].

And this - <u>the First Law of Mendel</u> - is a simple consequence of the combination of discrete objects with repetitions and permutations.

Let us pass to the consideration of dihybrid crosses. Consider the parental genotypes ***AABB*** and ***aabb***.

Since each gene "works" separately, the transitions ***AA - aa*** и ***BB - bb*** Form the homologies as shown in Fig. 4

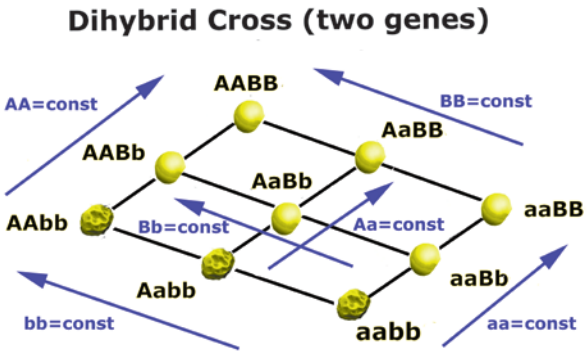

Fig. 4. Set and System of homologous series of genotypes and phenotypes in dihybrid cross. The blue arrows show the substitution directions in the genes in monohybrid homologies (when fixing a particular gene, for example AA = const).

If we denote the phenotypes by letters (behind which the numerical value of the value of the phenotypic characteristic would be hidden): R (round), W (wrinkled), G (green), then we can write the conservation laws:

R (AABb) - R (AABB) = R (AaBb) - R (AaBB) = R (aaBb) - R (aaBB)

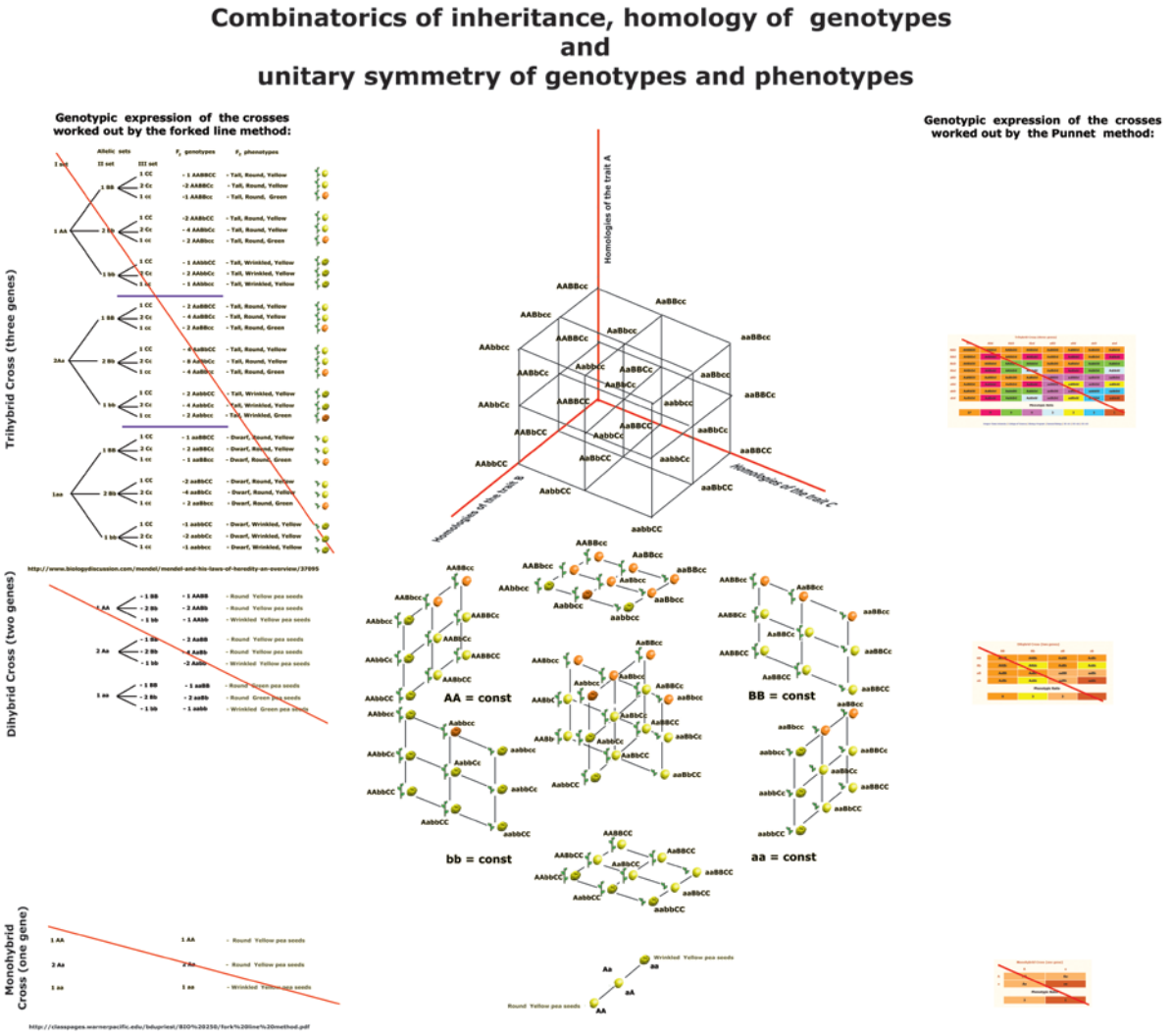

Fig. 5. System for Combinatorial inheritance example three-, two- and monohybrid cross peas. Unitary Symmetry of genotypes and phenotypes.

Combinatorial Symmetry System of genotypes and phenotypes creates the foundation of heredity, on which floors like Law of Dominance and Law of Independent Assortment are easily erected.

Widely used by geneticists and students Fork line and Punnet methods are archaic of the XIX century and should be abandoned (as well as in the case of the Periodic System of Chemical Elements - see my articles [11, 12, 13, 14, 15, 16, 17, 18, 19, 20]).

Combinatorial Symmetry System of genotypes and phenotypes is a concentrated tool for students in studying the laws of Mendel and constructing more complex polyhybrid hybridization schemes [14, 20].

2. Conclusion

Combinatorial system of inheritance is the symmetry foundation of Genetics. Like any other symmetry constructions - from sections in the theory of elementary particles, nuclear theory, chemical elements, molecules and mixtures [5] - Unitary symmetry of genotypes and phenotypes requires an analysis of the hierarchy of biochemical interactions within the cell. If we turn to Parallelism with nuclei and electrons, then the interaction of the gene apparatus and histones can be an expedient direction of research.

Acknowledgments

The first studies in this direction were published at the beginning of the 80s. A theoretical analysis of unitary symmetry was first published by me together with Vladimir Lyakhovskii in [1]. I express my deep appreciation all collaborators for a very useful discussion.

The author expresses his gratitude to Prof. A.S Chunaev. We corresponded and discussed with him over the years.

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