%\begin{abstract}

In this article basic TGD inspired ideas about genetic code are
discussed.

{\it 1. Genetic and memetic code from the model of abstraction
process}

The basic numbers of genetic code are probably not accidental. This
led
for more than two decades ago to an attempt to construct a model
for
abstraction process reproducing the basic numbers of the genetic
code. The
simplest model for an abstraction process is based on a repeated
formation
of statements about statements starting from two basic statements.
If one
drops at each step of the construction the statement corresponding
to empty
set in the set theoretic realization of Boolean algebra, one obtains
a
hierarchy allowing to understand the basic numbers of genetic code,
including the number of amino-acids. What one obtains is so called
Combinatorial Hierarchy consisting of the Mersenne numbers
$2,M(1)=3,7$
,$127,2^{127}-1,..$ constructed using the rule
$M(n+1)=M_{M(n)}=2^{M(n)}-1$. The explicitly listed ones are known
to be
primes. Combinatorial Hierarchy emerges from a model of abstraction
process
as subsequent transitions from level to meta level by forming
Boolean
statements about Boolean statements of level n and dropping one
statement away.

The infinite hierarchy of possible genetic codes suggests the
possibility
of an infinite hierarchy of increasingly complex life-forms. The
natural
question is whether a counterpart of the genetic code could make
sense for
our ideas, memes. Combinatorial Hierarchy model for abstraction
process
predicts that memetic code should correspond to the level M_{127}
of the
hierarchy. This leads to a precise realization of the memetic code
in terms
of binary sequences. Codewords, counterparts of mRNA, correspond to
126-bit
sequences. Also almost-127-bit code with $2^{127}-1$ codons is
possible.

{\it 2. Frequency and pulse representations of codes}

p-Adic length scale hypothesis and identification of codes as special cases
of a hierarchy of p-adic cognitive codes allows quantitative predictions.
The most general assumption assigns to any prime $p\simeq 2^k$, k
integer, a hierarchy of cognitive codes with codeword having a duration
equal to n-ary p-adic time scale $T_p(n)$ such that the number of bits is
factor k_1 of k. Codewords could be realized either as k_1 harmonics
of the fundamental frequency $f_p(n)= 1/T_p(n)$ or as temporal sequences of
bits of duration $\tau=T_p(n)/k_1$ represented as pulses of maximal
duration τ. Pulse-frequency dichotomy corresponds to dichotomies like
particle-wave, nerve pulse-EEG, and talking left brain-singing right brain.

Genetic code would correspond to $k=2^7-1=127$ and have 6 bits (64 DNA
triplets). These codewords could be realized dynamically as temporal field
patterns. For genetic code primes $p\simeq 2^k$, $k=6\times n$ define
candidates for the duration of the genetic code word if all factors of k
are assumed to define a possible number of bits of the code word. The time
scales come as powers of 8 so that they cover the entire range of
biologically relevant time scales down to CP_2 length scale, and genetic
code could appear as fractally scaled versions unlike memetic code and
perhaps also outside the biological context. $k=2\times 126=2\times 6\times
21=252$ allows the representation of both 126-bit memetic codeword, 6-bit
genetic codeword, and almost-7-bit genetic code word. For pulse
representation genetic codon would have a duration of 50 ms whereas the
bit would have duration of 8.3 ms so that the realization using nerve pulse
patterns is in principle possible. Frequency representation would be
realized as 6 first harmonics of the fundamental frequency $f_1
=2^{n}\times 20$ Hz, where $f_1=20$ Hz defines the lower end of audible
frequency range and also the rate for the translation of mRNA triplets to

amino—acids. 126—bit memetic code allows a representation as sequence of
21 nerve pulses of duration 2.4 ms each of them accompanied by 6—bit
genetic codon realized at the microtubular level (this representation of
genetic code has been suggested by Koruga).

The secondary p—adic time scale associated with M_{127} is .1 seconds and
defines the duration of the almost 127—bit memetic codeword. For frequency
representation is realized as 127 first harmonics of $f_1=10$ Hz and the
duration of the bit for pulse representation is .8 ms which is shorter than
the duration of nerve pulse. The duration .1 seconds of code word might be
identified as the minimal duration of cortical mental images, and the so
called features introduced by Walter Freeman could define pulse
representation of memetic code words of 127 bits. The highest frequency in
the frequency representation is 1270 Hz and could define the frequency
responsible for synchronous neuronal firing known to be about 1 kHz.
Various numerical co—incidences suggest that language corresponds to a
particular realization of memetic and genetic codes closely related to
their realization at DNA level.

{\it 3. Model for the evolution of genetic code from the symmetries of the
code}

TGD leads to a model for the evolution of the genetic code motivated by the
observation that the genetic code possesses an exact A—G and almost exact
T—C permutation symmetry with respect to the third nucleotide of the DNA
triplet. This leads to the hypothesis that genetic code has evolved as a
fusion of doublet and singlet codes accompanied by a small breaking of the
product symmetry. The hypothesis is highly predictive, and it is possible
to reproduce genetic code and its variants by this mechanism in a natural
manner. The mechanism has deep implications for the models of the

bio-chemical evolution before genetic code: in particular a detailed
model
for the evolution of genetic code and pre-biotic evolution emerges.

{\it 4. Mapping memetic code to 169-bit micro-tubular code}

169-bit micro-tubular code words is excellent candidate for a
representation of long term memories as a temporal list   of
activated
memes. The model for the mapping of memetic code to 169-bit
microtubular
code is dictated by the general ideas about realization of
intentions and
p-adic cognitive codes. When combined with general number
theoretical
arguments and physical considerations the model becomes highly
unique. The
prediction for the intronic representation of the memetic codon
involving 9
DNA triplets as parity bits is readily testable, and also the
prediction
for the microtubular electric field pattern is in principle
testable.

{\it 5. Genes, memes, and universal language}

Also static representations of the memetic code are possible and
intronic
DNA could provide representation of memetic codewords as sequences
of 21
DNA triplets. At DNA level memes and genes should relate like
computer
software and hardware. In the case of language the rules producing a
given
linguistic expression can be seen as the high level software, main
programs,   whereas words can be seen as hardware-like lower level
subprograms. This leads to the idea that memetic codewords define
the basic
program modules producing linguistic expressions by activating genes
which
express themselves in terms of field patterns generating nerv pulse
patterns generating words or word sequences very much analogous to
proteins.

Time mirror mechanism and the structure of the computer language
LISP
inspire a concrete model for memes as intronic programs initiated
from
magnetic body and calling genes as subprograms in turn calling other
genes
as subprograms and generating at the lowest level field patterns
generating

nerve pulses patterns giving rise to the motor action producing
speech.
Phonemes could directly correspond to DNA triplets and define the
basic
building blocks of language having as such no meaning. If this view
is
correct, the development of spoken and written language would mean
basically the emergence of a higher level of intentionality, which
utilizes
an already existing repertoire of memes expressed in many other
manners.
This would in turn suggest that animals and even plants possess some
kind
of languages realized at cellular level, and that even inter-species
communications using common memetic grammar and genetic vocabulary.

{\it 6. Corals and men}

A strong support for the idea of interspecies communications come
from the
sensational finding that the genome of corals, known to be the most
primitive animals having nervous system, share a large number of
common
genes with vertebrates whereas they share much less common genes
with
flies and worms. This finding challenges profoundly the existing
view about
the evolution of animals and adds a further mystery to the halo of
mysteries surrounding Cambrian explosion.

Since corals are usually regarded as relatively simple creatures,
the most
obvious questions concern the function of the complex genome. The
TGD
inspired answer is that the common genes provide a common vocabulary
making
possible communications between corals and vertebrates such as
fishes. The
genes express themselves in terms of electromagnetic field patterns
and
cyclotron transitions of Ca_{++} ions giving rise to primitive EEG
are
crucially involved. The calcium containing skeleton possessed by
both
corals and vertebrates could amplify the field patterns
representing genes
and make possible interspecies communications.

Coral reefs can be also seen as super organisms with cells replaced
by
double cell layers forming the corals. This forces to consider the
possibility that coral reefs are super-organisms perhaps even
possessing

super-neural system consisting of super-neurons defined by
differentiated
corals. Accordingly, in TGD Universe coral reefs could be seen as
descendants of higher level intra-terrestrial life forms which
boosted
Cambrian explosion by horizontal transfer of genes to much simpler
life
forms and providing also them with a nervous system.

{\it 7. Does ontogeny recapitulate also the future phylogeny at the
level
of genes and memes?}

Ontogeny recapitulates phylogeny means that the morphogenesis of the
embryo
repeats the evolutionary steps leading to the organism. One might
ask
whether and how this process is realized at the level of genes and
memes
(introns expressing themselves electromagnetically): this could
provide
further understanding of the mysterious \blockquote{junk DNA}.
Combining this
question with some recent puzzling findings leads to a rather
radical
revision of the view about evolution proceeding through random
mutations.

\begin{enumerate}

\item The second strange finding besides coral genome reported in
New
Scientist (5 June, 2004) was that the removal of large portions of
conserved intronic DNA from mice has no detectable effects on the
basic
biological functions. Conserved parts of DNA are usually thought as
being
an outcome of a long selection process and far from genetic trash.
This
could be understood if the conserved introns have been radiated from
corals
and the selection process has occurred already before the Cambrian
explosion induced by the emergence of the corals and leading to the
sudden
emergence of new highly developed life forms. That mouse introns
did not
have any identifiable function could mean that they are still
waiting for
time to become ripe for their expression.

\item A third strange discovery relates to morphogenesis and is

known as Ciba
Geigy effect. Chemists Guido Ebner and Guido Schuerch exposed germs,
seeds, and eggs to an electric field with strength in the range .5-2 kV/m.
For instance, the resulting trouts appeared to resemble their ancient
predecessors. The leaves of certain plants represented a series of
snapshots from evolution with the oldest leaves dating back to 300 million
years. This suggests that the memone and genome represent ontogeny
recapitulates phylogeny principle quite concretely, and that static
electric fields could provide the practical manner to activate and study
the ancient morphologies. Even partial transmutation of life forms to each
other might be possible (beautiful swan to ugly duckling at least!). The
activation of morphologies not yet realized is probably more difficult:
new memetic programs require new genetic hardware.
\end{enumerate}

The resulting vision about evolution of higher organisms would be as the
activation of conserved memes and genes basically inherited from corals
rather than by the emergence of new genes by random mutations. Very much
like learning new features of a text processing program.   The explosive
evolution of human civilization could correspond to a rapid shift of the
activated portion of memone and genome. The fact that 95 per cent of our
DNA consists of introns suggests that an enormous evolutionary potential
exists also at the level of personal evolution during single life cycle.
TGD view about space-time as a 4-dimensional living organism would mean
that this personal evolution continues after the biological death since the
4-body of geometric past does not disappear in the biological death.

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