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A PROGRAM OF UNIFIED THEORY.

Dedicated to Professor Akitsugu Kawaguchi on the occasion of his 70th birthday.

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§1. Trying to build a most unified picture of physical reality one may ask whether this will consist of the relativistic quantum theory of elementary (or sub-elementary) particles plus somehow independent theory of gravitation, astrophysics and cosmology or both parts will be more deeply interrelated. To answer this difficult question in the best fashion of 70' of our century one needs before all the refined investigation of General Relativity (GR), and its reasonable generalizations. In this respect a great tribute must be paid to beautiful well known work of Professor Akitsugu Kawaguchi who has clarified many questions of GR.

Together with J. A. Wheeler, A. Salam, M. A. Markov and some others, although on different grounds, we believe that no theory of ordinary matter (for which we continue to advocate with Heisenberg-Duerr the non-linear spinor basis) is possible without account of gravitation-cosmology, and we may point here on some ideas in this direction.

§2. **Non-linear spinor theory.** The starting point is Dirac (Weyl) equation supplemented by some non-linear term of the ψ^3 type proposed in our earlier work (Ivanenko, Brodsky) $\gamma^\nu\partial_\nu\psi + \lambda(\psi^3) = 0$. This is genuine, primordial non-linearity like the cases of Einstein General Relativity or Born-Infeld model of electrodynamics, as contrasted with induced non-linearities (e.g. also of ψ^3 type) arising by means of quantum vacuum effects (virtual mutual transmutations of all interacting fields). It is instructive to compare our treatment with that of Heisenberg. Heisenberg-Duerr choose basic field operator as spinor-isospinor and pseudo-vector type of all possible 5 forms of (Ivanenko-Brodsky) non-linearities; are using new (rather cumbersome) Tamm-Dancoff approximation method for calculations, introduce indefinite metric in Hilbert space and ground state (vacuum) degeneracy in respect to isospin; a specific form of propagator is constructed and a (rather artificial) spurion model is invented to explain the strangeness. One has the propagator (removing infinities):

$$G = (\sigma p)\left[-\frac{1}{p^2 + m^2 - i\varepsilon} + \frac{1}{p^2 - i\varepsilon} + \frac{m^2}{(p^2 - i\varepsilon)^2}\right]. \tag{1}$$

Then one gets the following chief results:

1. The (average) mass of Baryon as expressed by self interaction constant $ml = 5{,}8$.

2. The masses of baryonic octet are semi-qualitatively good but the masses of 0^- mesons worsier (up to factor 1/2)

Λ: 1,09(1,19)
π: 0,27(0,15) . (empirical values in parantheses)

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3. Sommerfeld's fine structure constant is obtained (but by means of using some empirical values) in semi-quantitative agreement.

We have tried, chiefly due to investigations of A. I. Naumov and younger collaborators to construct somewhat more convincing version by retaining our ψ^3 non-linear term and conserving Heisenberg important suggestions of indefinite metric and vacuum degeneracy, but

1) showing first the possibility of applying a modified perturbation theory in degenerate vacuum case, 2) introducing a more satisfactory propagator, 3) admitting unitary symmetry from the start, i.e. roughly speaking trying to build the theory of non-linear quarks.

1) Lagrangian is reconstructed in the form permitting to include all symmetry breaking effects in zeroth approximation

$$(2)\qquad L = L_0 + L_{\text{int}} = (L_0 + L_{\text{brok}}) + (L_{\text{int}} - L_{\text{brok}}) = L_0' + L_{\text{int}}' .$$

This yields for γ_5-invariant model with $L_{\text{brok}} = m\bar{\psi}\psi$ the mass value from equation

$$(2)\ \text{a)}\qquad m^2 \ln(1 + p_0^2/m^2) = p_0^2 + (16\pi^2/3l^2) \quad (P_0\text{—cut off impulse}) .$$

Convincing is the checking of our perturbation method as yet with old, Heisenberg propagator, which yields even better hadronic masses, e.g.

$$\pi:\ 0{,}13(0{,}15)\ ; \quad \eta:\ 0{,}58(0{,}58) \quad \text{etc} .$$

2) The new proposed propagator, corresponding to field operator taking account not only of physical states but also of ghost states of vanishing norm and of dipole states

$$(3)\qquad \psi = f(x) + a_1 Z(x) + a_2 d(x) ,$$

$$(4)\qquad G = -\frac{\hat{p} + im}{p^2 + m^2 - i\varepsilon} + \frac{\hat{p} + im}{p^2 + \mu^2 - i\varepsilon} + \frac{2\mu(\mu - m)(\hat{p} + i\mu)}{(p^2 + \mu^2 - i\varepsilon)^2} .$$

Analysing now the amplitude of nucleon-nucleon scattering and applying self-consistency condition of equality of the mass of physical particle and m value in propagator we get

$$(5)\qquad ml = 7{,}4 , \qquad \mu = 1{,}1m .$$

Moreover, from the requirement of a pole at the vanishing square of transferred impulse (existence of photons!) we obtain for fine structure constant (Naumov-Nguyen Ngoc Giao)

$$\alpha = 1/115 .$$

We may consider this last result as satisfactory, being obtained by a rather clear method, moreover without any use of empirical values and permitting further refinements.

3) Let us account $SU(3)$ symmetry from the beginning and choose vector non-linearity for our massless-quarks pramatter, which (vector) type is suggested by some group arguments (Marshak-Mukunda) and leads also to better empirical values of masses. Considering vacuum state as chirality degenerate, also degenerate in respect to isospin we get for the Λ-quark the mass which is at some 17% heavier then other quark masses in nice agreement with phenomenological evaluations.

Let us consider now scattering of quark and antiquark $q + \bar{q} \to q + \bar{q}$ and scattering of three quarks recalling that mesons and baryons are built from quark and antiquark or correspondingly 3 quarks, then analysing carefully the scattering amplitudes also crossing symmetric amplitudes one gets the desired hadronic masses, e.g.

	theor.	exp.
π	1	1
η	4,2	4
K^*	7,1	6,5
N	8	7
Λ	10	8
Σ	11	9
Δ	9	9
Ω	12	12

Also these results can be considered as satisfactory in the present days any-how preliminary, exploratory state of the non-linear theory; we may remark that vector mesons seemed to be not obtained in Heisenberg formalism with any degree of reliability; the decuplet baryonic masses are calculated by us in non-linear spinor theory for the first time (Naumov-Nguen Ngoc Giao).

Without entering in details we draw attention to possibility of constructing non-linear spinor equations applying the formalism of non-linear representations of some internal symmetries. Putting for the transformations of internal group

$$\psi_{a\lambda} \to \tilde{\psi}_{a\lambda} = \psi_{a\lambda} + \delta t_\mu T^\mu_{ab}(f)\psi_{b\lambda}(x) , \tag{6}$$

where f—invariants of transformations, for example $f = \bar{\psi}\tau\psi$, $T(f)$—generators of internal group satisfying commutation relations generalizing the linear case. In simple case e.g. of $SU(2)$ group one gets some essentially non-linear solutions for T

$$\begin{aligned} T^\pm &= \pm \frac{i\alpha}{4\xi\sqrt{4\xi+\alpha}} e^{\pm i\kappa}(f_2\tau^1 - f_1\tau^2) - \frac{\sqrt{\xi}}{\sqrt{4\xi+\alpha}}(\tau^1 \pm i\tau^2) , \\ \xi &= f_1^2 + f_2^2 , \qquad \kappa = \arcsin \frac{f_2}{\sqrt{f_1^2 + f_2^2}} . \end{aligned} \tag{7}$$

Then defining the corresponding covariant (better to say: self-compensating or non-linear) derivative, which transforms as

$$D_\nu\psi \to \tilde{D}_\nu\psi = D_\nu\psi + \delta t_\mu T^{(\mu)} D_\nu\psi , \tag{8}$$

we get a strongly non-linear, somehow complicated construction for this derivative

$$D_\nu\psi = \partial_\nu\psi + \tfrac{1}{2}i(f_1^2 + f_2^2)^{-1}[(f_1\partial_\nu f_2 - f_2\partial_\nu f_1)\tau^3 - \cdots]\psi , \tag{9}$$

and with A. Smirnov the corresponding non-linear equation

$$i\gamma D\psi + \phi\psi = 0 \quad (\phi\text{-arbitrary function of invariants}) \tag{10}$$

invariant under Lorentz x $SU(2)$ transformations.

Fusion of non-linear quark equations. Let us now proceed with a rough approximative but unexpectedly quick method of dealing with non-linear quarks by admitting a basic equation with quark mass already included (not massless quarkian pra-matter)

(11) $(\gamma p)\psi + m\psi - l^2(\bar{\psi}\psi)\psi = 0$ (Nambu's triplets scheme understood)

and applying a generalized fusion condition

$$\partial(\varphi\psi)/\partial x = 2\partial\varphi/\partial x \cdot \psi \tag{12}$$

with meson and baryon operators

(13) $\mu_A^B = \frac{1}{2}\lambda_0^{\,2}\langle T\psi_A\bar{\psi}^\beta\rangle, \qquad \psi_{ABC} = \lambda_0^{\,3}\langle T\psi_A\psi_B\psi_C\rangle/3!$ (T-symmetryzing operator).

Then one gets, with Kurdgelaidze, equations of hadrons, generalizing Bargman-Wigner and Yang-Mills equations; e.g. for baryons

$$\begin{aligned}(\gamma p)_A^{A'}\psi_{A'BC} &+ m\psi_{ABC}\\ &= (l/\lambda_0)^2(M_A^D\psi_{DBC} + M_B^D\psi_{ADC} + M_C^D\psi_{ABD} - 3M_D^D\psi_{ABC})/10\,.\end{aligned} \tag{14}$$

Moreover one gets also in the same manner the description of quarks interactions with mesons. Now we are able to calculate all hadronic magnetic moments and coupling constants, in some cases reconstructing, by easier calculations the previous results but also predicting many new ones up to properties of Ω particle. E.g. we get

$$g^{\mathrm{scalar}}_{\bar{q}_1\pi^\circ q_1} = -g^{\mathrm{sc}}_{\bar{q}_2\pi^\circ q_2}\,; \qquad \mu_{q_1} = \frac{2}{3} + \kappa_q\Big(\frac{1}{m_\rho} + \frac{1}{3m_\omega}\Big),$$

$$\begin{aligned}\mu_p &= 1 + \frac{\kappa_\rho}{3}\Big(\frac{5}{m_p} + \frac{1}{m_\omega}\Big); \qquad \mu_n = -\Big\{\frac{2}{3} + \frac{\kappa_n}{3}\Big(\frac{5}{m_p} - \frac{1}{m_\omega}\Big)\Big\},\\ \mu_{\Xi^\circ} &= -\Big\{\frac{2}{3} + \frac{\kappa_\Xi}{9}\Big(\frac{3}{m_p} + \frac{1}{m_\omega} + \frac{8}{m_\phi}\Big)\Big\}; \qquad \mu_\Lambda = -\Big(\frac{1}{3} + \frac{2}{3}\,\frac{\kappa_\Lambda}{m_\phi}\Big)\end{aligned} \tag{15}$$

(constructing magnetic moments either from quarks or getting them from baryonic equations). We believe that such a somehow bold method also deserves attention as essentially permitting rapidly reconstruct the consequences of algebraic group method and promising further non-linear corrections and this all with a single self-interaction constant.

§ 3. **Gravidynamics.** *Affinors.* The complicated and all-embracing character of Einstein's gravidynamics always stimulated the revision of its postulates and induced eventual generalizations (not successful in the Einstein's own hands!). Not aiming to discuss the whole present day situation we limit here ourselves with pointing some necessary and some plausible generalizations.

Firstly we may draw attention to investigations of V. I. Rodichev, who stresses anew the impossibility of identifying a system of reference with coordinate system (A-transformations) or with tetrads field (B-group). In his opinion geometrical picture of a basis of reference system must be given by the field u of velocities represented by congruence of world lines. Another reference system is defined by its own field u' and transition can be fulfilled by means of an affinor

$$u' = \Omega u\,.$$

For two inertial systems of reference when both fields are constant, affinor is given by

$$\begin{aligned}\Omega_{ab} &= \delta_{ab} + (1-\alpha)^{-1}(u_a + u'_a)(u_b + u'_b) - 2u'_a u_b\,,\\ &(\alpha = u_a u'_a;\ \text{if}\ u_a = u'_a,\ \alpha = -1,\ u'_a = \Omega_{ab}u_b)\,.\end{aligned} \tag{16}$$

With X_4-axis directed like u and X_1 parallel to u_1 relative velocity one get conventional Lorentz matrix, so one sees a 3-fold-peculiar degeneracy: affinor components are components of matrix describing tetrad rotation, simultaneously coinciding with

$$\Omega_{ab} = \begin{Bmatrix} \delta_{kn} + \varkappa(v_k v_n/v^2) & iv_k \\ iv_k/c\sqrt{1-\beta^2} & 1/\sqrt{1-\beta^2} \end{Bmatrix} \quad \varkappa = 1/\sqrt{1-\beta^2} - 1 \quad k, n = 1, 2, 3 \tag{17}$$

coefficients of Lorentz transformation of galilean coordinates. We shall not dwell here on the interesting question of some kind of an "affinor-revision" (after "tetrad-revision") of General Relativity (GR).

Tetrads. It is well known that tetradic treatment of GR is anew very popular in connection of analysis of reference system notion, with hopes to clarify energy problem (Moeller, Rodichev, Treder, Schwinger, Ivanitskaia and others). We may insist once more that tetradic 'revision' of GR is necessary, as interaction of fermions with gravitation requires introduction of tetrads (Fock-Ivanenko coefficients, analysed in subsequent works of Schrödinger, Dirac, Wheeler, Bergmann, Hayashi, cf. reviews of Bade-Jehle, Fierz). In this way we are even led to propose tetrads $h^\alpha(a)$ and not the metrics $g_{\alpha\beta}$ as basic potentials, or field components of gravitation field. Even independently from fermionic matter (r.h. side of eqs.) tetradic formalism seems to lead to a generalization, not only to some useful reformulation of GR, as some supplementary condition is needed (Moeller, or Rodichev, or Schwinger types).

As to the energy problem we point on interesting investigation of Rodichev-Frolov, who starting from tetradic Lagrangian

$$L_G = \frac{1}{2G} h(\Delta_{abc}\Delta^{bac} - \Delta_{ab}{}^a \Delta_c{}^{bc}) \quad (\Delta_{abc}\text{—Ricci coefficients}) , \tag{18}$$

and using invariance under

$$\delta x^\sigma = h^\sigma(a)\Delta X(a) , \tag{19}$$

have obtained the energy expression. (Of course one could as well also begin with full scalar Lagrangian, analogue of R, not of G.) Imposing quasi-harmonic Rodichev's condition

$$\partial(hh^\sigma(a))/\partial x^\sigma = 0 ,$$

one gets the reasonable expression for the energy of gravitation field

$$t^\mu(a) = -2a'\{2\Delta(b, et)C(ea, b) - \tfrac{1}{2}\delta(at)R\}h^\mu(t) , \tag{20}$$
$$a' = c^4/8\pi\varkappa \quad (C\text{—a holonomy object})$$

(covariant under coordinate transformations but not covariant under orthogonal tetradic localised transformations i.e. those with variable parameters). A fine condition (very anschaulich when compared with analoguous electromagnetic case) for pure gravitation radiation field requiring isotropic character of t^μ (4) was proposed on these lines by Dozmorov

$$t^\mu(a)t_\mu(b) = 0 , \tag{21}$$

who verified directly that this condition is satisfied by existing wave solutions.

One may ask about the connection of this condition with algebraic classification?

In a very satisfactory way one can show that this condition leads indeed to the solutions of N-type-(or second degenerate type) which is also required by other criteria of Lichnerowicz, Bel, also of Maldybaieva's proposal, refined by Nikolaenko

$$\overline{\Box}\Omega_{\alpha\beta}=0\,. \tag{22}$$

$\overline{\Box}$—generalised d'Alembertian constructed by means of external differentiation and codifferentiation operators: $\overline{\Box}=d\delta+\delta d$ which is topologically and metrically self adjoint: $\Omega_{\alpha\beta}$ is the curvature tensor form built from the Riemann tensor.

Compensating fields. A powerful formalism of ‚compensating' (as we proposed to call them) fields was developed especially by Sakurai. Considering the internal space transformations with non-constant but localized parameters depending from space-time coordinates, necessitates the substitution of the ordinary derivative by a compensating one and introduction of corresponding fields (vector mesons). Not only photons were recognized as „compensons'' but it became clear that gravitation also can be considered as a kind of compensating field after one has localized-previously globally constant coefficients of Lorentz transformations (Utiyama, Brodsky-Ivanenko-Sokolik; Kibble, Frolov).

Introducing compensating derivative (in this case essentially conventional—covariant derivative)

$$Q_{|a}^{\;A}=h_a^{\sigma}Q_{,\sigma}^{\;A}-\Delta_a{}^{m}I_m{}^{A}{}_{B}Q^{B} \tag{23}$$

by means of generators $I_m{}^{A}{}_{B}$ and compensating fields h_a^{σ}, $\Delta_a{}^{m}$, which for Poincaré group coincide with tetrads and Ricci coefficients and building simplest Lagrangian one gets Einstein equations alongside with supplementary equation (after variation over Riccis)

$$K_{\alpha\beta}^{\mu}=\kappa(S_{\alpha\beta}{}^{\mu}+\delta_{[\alpha}^{\mu}S_{\beta]}{}^{\nu}{}_{\nu})\,, \tag{24}$$

where spin moment tensor (r.h. side) generates torsion (tensor at l.h. side). Lagrangian itself is the function of field tensor, which in our case coincides the with the Riemann curvature tensor:

$$F_{ab}{}^{m}=2h_{[a}^{\nu}\Delta_{b],\nu}^{m}+2\Delta_c{}^{m}h_{[\tau,\sigma]}^{c}h_a^{\sigma}h_b^{\tau}-C_n{}^{m}{}_{q}\Delta_a^{n}\Delta_b^{q}\,. \tag{25}$$

It was pointed that parallel displacement of spinors à la Fock-Ivanenko in the space endowed with torsion leads to non-linear ψ^3 type term in Dirac equation (Rodichev, Kibble, Peres), i.e. just of the type discussed above (Heisenberg-Brodsky-Ivanenko type equation). Quantization of torsions was investigated by Vladimirov. Anyhow one sees that torsionic generalization is suggested strongly, but not required, by tetradic and compensational treatment of gravitation. Recently Trautman and Ponomariov considered empirical implications of a simple concrete model of torsion (Copenhagen GR6 report, 1971).

Variable constant of gravitation. There were plenty of theories of non-geometrized gravitation as the spin 2 field. One of recent interesting version of Salam-Strathdee tried to use real f-mesons as carriers of such strong gravitation which even could play the role of cutting off factor.

We also tried with A. Papyrin to establish some useful evaluations for elementary particles physics by looking on solutions of Einstein-like equations with analogon of cosmological term (mass of f-meson!) for such strong gravity and investigating eventual tensor dominance generalizing the notion of vector dominance.

In recent years the discussion of scalar-tensor theory (STT) became fashionable in the hands of Jordan, Brans-Dicke reviving Dirac's amusing suggestion of a variable gravitation constant. Even the collapse problem was attacked in STT; some people indicate that nothing essentially new is gained here (Kip Thorne, Dukla); on the other side some authors believe that no collapse arises in STT and arbitrarily great star masses are permitted (Mnatsakanian who insisted especially on the pointlike behaviour of $r = 0$).

Whitout claiming to settle definitely the difficult collapse problem we may draw attention with G. E. Gorelik on some important points. First of all one easily proves the complete equivalence of two central symmetric solutions in STT: Heckmann's form using Schwarzschild type coordinates (where nothing like gravitational radius appears) and Brans-Dicke-Salmona form written in isotropic coordinates which explicitly exhibits gravitational radius. Now Geroch's notion of singular region is applied and its topological dimensionality investigated. Writing with Gorelik equations of geodesics and looking for their behaviour at small r one sees that two incomplete radial geodesics corresponding to different angles are not equivalent in Geroch sense, so that rather paradoxically the metrical "point" $r = 0$ represents a $(2+1)$-dimensional surface (space + time). In STT the singularity is "bare" not hidden behind horizon of events as in GR. We see that one must be cautious in trying to connect the—wrongly—presumed absence of collapse in STT with the apparent difference of two types of solutions, which really does not exist.

Another important conclusion can be drawn from the geodesics equations namely that the time needed to reach singularity by a falling particle judged by infinitely distant observers clock is finite $\Delta t \sim (\Delta r)^{2/3}$ in contrast to Schwarzschild GR case. Thus the observation of last steps of a star contraction must in principle permit to distinguish between STT and GR. This interesting consequence was obtained for positive values of dimensionless interaction constant connecting scalar and metrical fields in STT $\omega > 0$; for $\omega < 0$ and $|\omega| \gg 1$ one obtains the same $(2+1)$-dimensionality of singular surface, but test particle will need infinite time to reach the singularity. In this connection it is necessary to remark also that to pass from STT to General Relativity one needs not only the constancy of scalar field but also $|\omega| \to \infty$, so that the opinion of Kip Thorne about the Black Holes of STT as quite similar to conventional GR BH may be too simplified.

In connection with Dirac hypothesis we never forget (with Sagitov) the problem of Earth expansion, which can be partly due to diminishing gravitation and can eventually lead to such important phenomena as rifts (e.g. the Siberian part).

Quantum gravidynamics. We don't enter here into discussion of various difficult basic and technical problems of quantization of gravity (which is almost equivalent to quantization of space-time itself) and may draw attention only on two questions. First of these is connected with polarization of spinor vacuum by gravitation field which was already considered by us some time ago (Brodsky-Ivanenko). Using e.g. powerful Schwinger method one gets the supplement to Lagrangian, which expansion yields us the first correction which can be identified with cosmological term

$$L' = \frac{1}{32\pi^2 \tau_0^2} = \Lambda \quad (\tau_0\text{—cut off parameter})\,.$$

So we see the necessary appearance of cosmological term also of quantum character. Further terms lead to R^2 corrections, moreover the quantum gravidynamics seems to fall in the series of renormalizable theories (B. de Witt). The appearance of quadratic quantum scalar terms also is in harmony with classical suggestions about such generalization.

The most important quantum gravitation processes seem to be anticipated firstly as metrics fluctuations (Wheeler), which even seem to lead to drastic topological changes (Treder-Dautcourt) realising in a complicated fashion the hypothesis of discrete space-time (Ambarzumian-Ivanenko, Shild, Snyder, Koish, Finkelstein and others).

Secondly, there is a multitude of mutual transmutations of gravitons and quanta of ordinary matter (Ivanenko, developed by Sokolov, Vladimirov, Wheeler-Brill, Piir, Korkina and others) and production of gravitons by electromagnetic scattering etc. (de Sabbata, Halpern al,); all this is important for the analysis of Big Bang and first weeks of expansion (Zeldovich-Novikov) as well as for the evaluation of present day concentration of relict and newly produced gravitons (Bertotti, de Sabbata, Carmeli), not to speak about fundamental epistemological feature of transmutation of ordinary matter into apparently geometrized form of physical reality. Anyhow such gravitational transmutations help to unify all sides of physical reality.

§ 4. **Cosmology and Elementary particles.** On our hypothesis all cosmological asymmetries induce (or are reflected on) analogous asymmetries of vacuum-ground state, these latter leading via Goldstone theorem to real particles. The chief cosmological asymmetries are

1) Preponderance of baryons (protons over antiprotons etc.). If conservation of baryonic number B is absolute this does not lead to 'goldstons.' (But here one must be cautious remembering Wheeler's arguments for changing B at collapse and pointing in this respect to Brodsky-Ivanenko formalism of anomalous spinors.)

2) The Universe seems to possess great value of hypercharge and non-vanishing strangeness. Admitting our hypothesis one is led to violation of the unitary $SU(3)$ symmetry, with probably vector mesons playing the role of goldstons; strictly speaking the violators-goldstons-compensons are here ω and φ mesons, being mixture of octet and singlet, like the part played by photons as mixture of singlet and iso-triplet, leading to their role as goldstons-violators of $SU(2)$, and at the same time being corresponding compensons.

3) A fundamental asymmetry is given by Universe Friedman-Hubble expansion. Maybe in contracting Universe one would have preponderance of anti-baryons? (the same point of view was expressed by A. Sakharov). Kurdgelaidze tried to evaluate order of magnitude of the influence of effective cosmological force due to expansion by introducing the factor $(1 \pm F)$ $(F = \rho/\rho_{\text{crit}})$ in field operators and aiming in such way to explain the anomalous K° decays, pointing on the T-parity non-conservation.

4) The average non-vanishing curvature induces the departure from flatness in vacuum metrics, which leads to gravitons as corresponding goldstons (Heisenberg, Ivanenko, Philipps, Thirring, Treder).

5) The difference of proton vs. neutron concentration yielding non-vanishing cosmological isospin (I or I_3) induces degeneracy of vacuum and leads to protons as corresponding goldstons (and at the same time compensons). This last example

was thoroughly discussed by Heisenberg. To be quite clear we may emphasize once more that it seems not reasonable to limit oneself with connection of photons—as goldstons with a definite cosmological asymmetry in isospin; on the contrary it is attractive to assume that this specific connection is not an accidental one but that *all* cosmological asymmetries have their counterpart in vacuum degeneracies and corresponding particles as goldstons.

6) Conformal invariance seems to be of fundamental nature, but apparently broken in microworld by rest masses of particles, which on our view can be due to existence of cosmological term. Maybe electron is the corresponding goldston, possessing the smallest rest mass? Surely the conventional Goldstone theorem leads to massless bosons, but anyhow it must be generalized to cover the indefinite metrics of Hilbert space; possibly massless fermions neutrino are also goldstons (Heisenberg); the evident connection between goldstons and compensons points also on the possibility of non-vanishing mass at generalized goldstons.

7) We shall not discuss here the possibility of goldstons reflecting further plausible cosmological asymmetries due to leptons (non-vanishing leptonic number, non-vanishing spirality, muonic number). A curious possibility arizes with diminishing of an eventual anisotropy in the course of expansion which can lead to disappearance of some conservation laws as well as corresponding goldstons; (Diracs magnetic monopoles?).

In conclusion we may express a moderately optimistic hope that the attempts of building an unified theory based on non-linear spinor field and taking into account quantized gravitation and cosmology shall lead us to a deeper understanding of the Nature.

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