A contribution to the Knowledge of antimatter

(Preliminary communication)

by

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SUMMARY

There are two kinds of matter: the common matter and the antimatter. The nuclei of the atom of the common matter are built (configurated) of subparticles, moving inside the atomic nucleus at velocities of $v < c$. In comparison with that the atomic nuclei of the antimatter are built (configurated) of subparticles moving inside the atomic anti-nuclei at a higher velocity $w > c$ (than the velocity of light is); such anti-subparticles are denoted as *contrary matter*. When a collosion of the common matter and the contrary matter/consequently the antimatter too/happens, both have to annihilate. Now it will be shown, the antimatter to possess also a negative mass (substance) and that assumption to be in keeping with the special theory of relativity. By that it is shown the highst possible velocity of the contrary matter in the frame of the special theory of relativity to be $w \leqslant c \cdot \sqrt{2}$. Because the ether particles have got a velocity of $c \cdot \sqrt{2}$, the theory is proving that we are going to believe, *as if* the ether particles would rest (= be at a standstill) with regard to us. All optical (electromagnetic) events on earth will happen, *as if* the earth rested, for what reason the ether is not going to put up any resistance.

Quite recently has been discovered experimentally the s. c. «antimatter». However, it is known when matter and antimatter are colliding, both are losing their existence, i. e. they are annihilating. Of course, we know extremely little about the antimatter and we wish to illustrate this problem from another angle here.

1. As soon as we presume a critical velocity c (f. i. the velocity

of light), we come by the following formula even without the theory of relativity (see Lit. 1), p. 185-186):

$$m = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}} \qquad [1]$$

where m_0 stands for the s. c. rest mass and v stands for the mass velocity m. Thus we get the following small *table I*:

$v = 0$	$\frac{3}{5} \cdot c$	c	$c \cdot \sqrt{2}$	$\frac{5}{3} \cdot c$	$\infty \cdot c$	
$m = m_0$	$\frac{5}{4} \cdot m_0$	∞,	$i\infty$	im_0	$\frac{3}{4} \cdot im_0$	0
	real			imaginary		

where i is $= \sqrt{-1}$. Thus we see the velocity of the common matter has always to be $v \leqslant c$, because otherwise it would *disappear* for us, i. e. it would be imaginary.

Now we go on for one step and we are going to presume the existence of a *matter of another kind*, being on the contrary imaginary for smaller velocities $w \leqslant c$ and being real for greater velocities $w \geqslant c$. Thus we may generally write:

$$m' = \frac{i m_0'}{\sqrt{1 - \frac{w^2}{c^2}}} = \frac{i m_0'}{i \cdot \sqrt{\frac{w^2}{c^2} - 1}} = \frac{m_0'}{\sqrt{\frac{w^2}{c^2} - 1}}; \qquad [2]$$

here we immediately notice m' is getting always real only for $w \geqslant c$. From [2] we are getting the following *table II*:

$w = 0$	$\frac{3}{5} \cdot c$	c	$c \cdot \sqrt{2}$	$\frac{5}{3} \cdot c$	$\infty \cdot c$	
$m' = i m_0'$	$\frac{5}{4} \cdot i m_0'$	$i\infty$,	∞	m_0'	$\frac{3}{4} \cdot m_0'$	0
	imaginary			real		

It is interesting to mention that for $w = c \cdot \sqrt{2}$ the mass m' will be equal to the rest mass m_0'. Thus the velocity $c \cdot \sqrt{2}$ is an

«excellent» one, we are still going to speak about, and it is important quite a number of authors to have found this velocity for ether particles. When a matter becomes imaginary, then it completely «disappears» for us and its energy is being taken over by the subsoil of the world, i. e. by the world ether, from which it may — under favourable circumstances — as real matter come into being again.

We shall denote shortly the matter of the other kind as *opposite matter* (in Latin: *materia opposita seu contraria* or shorter *contra-materia*; in English: *opposite or contrary matter*; in Croatian: *protumaterija*). We shall soon see, why we have been forced to choose this term.

2. Now we shall examine what is going to happen, when matter and opposite matter are colliding. Because I have already in 1930 laid down the collision laws in the special theory of relativity /see Lit. 4) and 2), pp. 283-287/, it will be easy to settle finally this question now. When two small masses — matter and opposite matter — are mutually influencing each other, then there will be:

$$\frac{d}{dt}(m v) = -\frac{d}{dt}(m' w) \qquad [3]$$

from which we are, what everybody knows, getting:

$$\frac{m_0 v_2}{\sqrt{1-\frac{v_2^2}{c^2}}} + \frac{m_0' w_2}{\sqrt{\frac{w_2^2}{c^2}-1}} = \frac{m_0 v_1}{\sqrt{1-\frac{v_1^2}{c^2}}} + \frac{m_0' w_1}{\sqrt{\frac{w_1^2}{c^2}-1}} \qquad [4]$$

where we have denoted two successive moments with the indices 1 and 2. When a non-elastic collision comes about, there is the following condition:

$$v_2 = w_2 \qquad [5]$$

however, because there should be $v_2 \leqslant c$ and $w_2 \geqslant c$, so it is only that way possible

$$v_2 = w_2 = c \qquad [6]$$

to turn out. Thus we see that *when an unelastic collision of matter and opposite matter comes about, both will be annihilating*, i. e. they will turn into «light» (electromagnetic waves). Thereby it possibly could happen, a certain number of subparticles of the matter to get a higher velocity than the velocity of light c is and likewise it possibly could happen a certain number of subparticles of the opposite matter (contrary matter) to take a lower velocity than c is; by that those subparticles of the matter and opposite matter are becoming imaginary for us and they will immediately disappear for us in the world ether, giving up to it a part of their energy as a latent and hidden energy. From [6] and [4] ensues that because of [5],

$$\lim_{v_2 \to c} \sqrt{1 - \frac{v^2_2}{c_2}} = \lim_{w_2 \to c} \sqrt{\frac{w^2_2}{c^2} - 1} = \lim_{\gamma \to 0} \Delta\gamma = d\gamma$$

to be equal to

$$m'_0 = -m_0 \qquad [6a]$$

i. e. the opposite matter to have a *negative* mass /substance/, being thus *entirely different* from the common mass. In this connection I must point out I have already earlier shown the rest mass of a photon m^0, to amount to $1{,}682 \cdot 10^{-44}$, /see Lit. 5) and 10)/. Hence we may immediately infer, *the world ether in its lowest (latent) possible state to be "imaginary" for us and not to offer any resistance to the heavenly bodies.* However, hence it does not ensue the world ether not to exist. Only *on activation the world ether* is becoming «real» and such processes on the moving earth will happen, *as if* the earth carried along the world ether in its surroundings, or *as if* the earth would «rest» in the outer space. Herewith everything we have told in our former contributions /see Lit. 3)/ on the world's subsoil, on the world ether, is getting more understandable. Now we may continue answering to the question, how the antimatter has been built (configurated). That is to say, every particle of the antimatter is composed of quite a number of subparticles, having been built from opposite matter /contrary matter/, and those subparticles are moving *in every* particle of the antimatter at velocities being higher than the velocity of light c. In comparison with that the elementary particles of the common matter are composed

of an enormous number of subparticles, moving inside at velocities being smaller than the velocity of light. In 1929 we have already spoken in detail on the configuration of the common matter and we have developed a far-reaching mathematical theory /see Lit. 5)/, where we have shown among the rest, why an electron is steady. Therefrom we see, we shall not get any settling in the actual macro- and micro-physics without a certain number of new ideas /see Lit. 10)/.

3. Having presumed the opposite matter to move at a higher velocity w than the critical velocity c does, i. e. $w \geqslant c$, we may immediately put the question, whether the special theory of relativity is fit for such an extension. We have already earlier evolved the *common* and *co-variant* transformation equation of the special theory of relativity /see Lit. 6) and 9)/; it reads:

$$\left.\begin{aligned} x &= x' \cdot \sqrt{1+\frac{b^2}{c^2}} + b \cdot t' \qquad y = y', \\ t &= t' \sqrt{1+\frac{b^2}{c^2}} + \frac{b}{c^2} \cdot x', \qquad z = z', \end{aligned}\right\} \qquad [7]$$

where c stands for the light velocity in the vacuum (a universal constant value). The inversion of these transformation equations reads:

$$\left.\begin{aligned} x' &= x \cdot \sqrt{1+\frac{b^2}{c^2}} - b \cdot t, \qquad y' = y, \\ t' &= t \sqrt{1+\frac{b^2}{c^2}} - \frac{b}{c^2} \cdot x, \qquad z' = z, \end{aligned}\right\} \qquad [8]$$

where b means a function. f. i. at a uniform translation with a constant velocity $v \ll c$, we could put *quite arbitrarily*:

$$b = \frac{v}{\sqrt{1-\frac{v^2}{c^2}}} \quad \text{and therefore} \quad \sqrt{1+\frac{b^2}{c^2}} = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}} \qquad [9]_{1,2}$$

and we shall immediately get the well-known Lorentz transformations. Because the ratio:

$$m = m_0 \cdot \sqrt{1 + \frac{b^2}{c^2}} \qquad [10]$$

is existing here, where m_0 stands for the rest mass, we must put for the opposite matter in keeping with [2]:

$$\sqrt{1 + \frac{b^2}{c^2}} = \frac{1}{\sqrt{\frac{w^2}{c^2} - 1}}, \qquad (w \geq c). \qquad [11]$$

Hence follows:

$$b = \frac{\mathfrak{C}}{\sqrt{\frac{w^2}{c^2} - 1}}, \qquad \mathfrak{C} = c \cdot \sqrt{2 - \frac{w^2}{c^2}}, \qquad [12]_{1,2}$$

so we get the following small *table III*:

$w = 0$		c	$c \cdot \sqrt{2}$	$\infty \cdot c$
$b = i \cdot c \cdot \sqrt{2}$	∞		0	imaginary/indefinite
$\mathfrak{C} =$	$c \cdot \sqrt{2}$	c	0	$i \cdot \infty \cdot c$

When we are examining a system S′ moving at an overlight velocity $w \geqslant c$, then our system S is being connected with it by the following transformation equations [13]; that is to say, because of [11] and [12], [7] will read:

$$\left.\begin{aligned} x &= \frac{x' + \mathfrak{C} \cdot t'}{\sqrt{\frac{w^2}{c^2} - 1}}, \qquad y = y', \\ t &= \frac{t' + \frac{\mathfrak{C}}{c^2} \cdot x'}{\sqrt{\frac{w^2}{c^2} - 1}}, \qquad z = z', \qquad \mathfrak{C} = c \cdot \sqrt{2 - \frac{w^2}{c^2}} \end{aligned}\right\} \qquad [13]$$

and the inversion of these transformation equations will run:

$$\left.\begin{aligned} x' &= \frac{x - \mathfrak{C}\,t}{\sqrt{\frac{w^2}{c^2} - 1}}, \qquad y' = y \\ t' &= \frac{t - \frac{\mathfrak{C}}{c^2} \cdot x}{\sqrt{\frac{w^2}{c^2} - 1}}, \qquad z' = z, \qquad \mathfrak{C} = c \cdot \sqrt{2 - \frac{w^2}{c^2}} \end{aligned}\right\} \qquad [14]$$

Hence follows we shall think, *as if* the system S′ would move at the apparent velocity $\mathfrak{C} < c$, this velocity being in the limits of the $(0, c)$ values; thus the *table III* shows distinctly that w may take *only* the following values in the frame of the special relativity theory:

$$c \leqslant w \leqslant c \cdot \sqrt{2} \qquad [15]$$

and we have already earlier proven in article 1 that for $w = c$ will immediately stand $m' = \infty$ and for $w = c \cdot \sqrt{2}$, because of [2] and [10] and [11], there is $m' = m'_0$ (rest mass). From [13] immediately follows for $t' = 0$ that

$$x' = x \cdot \sqrt{\frac{w^2}{c^2} - 1} \qquad [16]$$

we shall have a *contraction of lengths* between (0, 1).

For $x' = 0$ follows from [13] a *dilatation of time*

$$t' = t \cdot \sqrt{\frac{w^2}{c^2} - 1} \qquad [17]$$

that is to say a *time narcosis*. We should namely not forget that

$$0 \leq \sqrt{\frac{w^2}{c^2} - 1} \leq 1 \quad .$$

is for $w = c$ to $w = c \cdot \sqrt{2}$. However, the same will apply for the observer in S′ and from [14] follows for $t = 0$ immediately

$$x = x' \cdot \sqrt{\frac{w^2}{c^2} - 1}$$

or rather for $x = 0$ there will be

$$t = t' \cdot \sqrt{\frac{w^2}{c^2} - 1},$$

therefore a complete relativity.

4. Should the two systems S and S′ meet in time, when from 0 is being transmitted a light signal to all sides, i. e. its Fresnel zone is taking the form

$$x^2 + y^2 + z^2 = c^2 t^2 \qquad [18]$$

then for the observer in S′, on the institution of [13], will be

$$x'^2 \cdot \left(1 - \frac{\mathfrak{C}^2}{c^2}\right) + (y'^2 + z'^2) \cdot \left(\frac{w^2}{c^2} - 1\right) = c^2 t'^2 \cdot \left(1 - \frac{\mathfrak{C}^2}{c^2}\right); \qquad [19]$$

for here, because of $[12]_2$,

$$1 - \frac{\mathfrak{C}^2}{c^2} = \frac{w^2}{c^2} - 1 \qquad [20]$$

is, thus [19] will change into the equation

$$x'^2 + y'^2 + z'^2 = c^2 t'^2 \qquad [21]$$

i. e. the observer in S′ will also think this spherical wave in S to be a spherical wave and *vice versa*. In connection with that we should never forget the velocity of the opposite matter through *vim legis* [15] can never surpass the value $c \cdot \sqrt{2}$, because otherwise b and $\mathfrak{C}$ would be imaginary.

Thus we have given an *improvement* of the relativity theory, what *should be interesting from the point of view of natural philosophy.*

As we have proven, the existence of the opposite matter to be possible also in classical as well as relativistic physics, with just a fundamental difference existing here; in classical physics the opposite matter may move at any velocity $w > c$, whereas in relativistic physics its velocity of movement is limited: it cannot surpass the value of $c \cdot \sqrt{2}$, because otherwise it would disappear /be imaginary/ for us. *Thus here exists the possibility to decide which physics to be the right one.*

Because there is for $w = c \cdot \sqrt{2}$ immediately $\mathfrak{C} = 0$, it will ensue from [13] and [14] that it will appear to us, *as if the world ether particles would be resting /= being at a standstill/ compared to us.* In the opposite matter the velocity $w = c \cdot \sqrt{2}$ will be the same factor, as the rest $/v = 0/$ is in the common matter. Optical processes are going to happen as if we would rest. The antimatter, whose particles are made of opposite matter, may move at the habitual velocities $v < c$.

As yet we don't even know, how physics of tomorrow will develop. Serious experiments have been already made to solve that problem /see Lit. 7) and 8)/, but we need quite new thoughts to get out of that vicious circle.

/Annotation at the correction/: The idea of the existence of a *new* kind of matter, which may move only at the higher speed than light speed is, is not any more astonishing than the idea of the existence of a «faustian» world is, the time would be lapsing backward in (F. R. Stannard in London).

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