Emphasis I

In real bodies with volume $V > 0$, there is always transverse gravitational force.

Emphasis II

The two cases *A* and *B* described here make it apparent that when a body is approximated into a point (mass with a volume zero *V* = 0) the influence of the shape of the body upon the force cannot be taken into account, for instance in case *A* the force has a transverse component, which may be of great significance in some cases, as it is in case *A*.

Emphasis III

These two examples also confirm the claim that the notion of mass is an abstracted notion of the notion of quantity of matter, since in both positions the two bodies have identical quantities of matter, and under condition (7.3-41) the gravitational forces are identical in values, but when taking into account their positions relative to the body that attracts them, i.e. with accounting for their real volumes, their gravitational forces are different.

Second case. Attraction of two spherical bodies

The gravitational force between two bodies *A* and *B* with masses $m_A > 0$; $m_B > 0$; $V_A > 0$; $V_B > 0$, even when both of them are perfect spheres, but body *A* is approximated into a point, Newton's law (7.3-1) holds true only, for instance, for body *A* and one point on body *B* with density of mass ρ. If we seek the force between body *A* and the whole body *B*, then according to Fig. 7.3.2, we should integrate for the whole volume of body *B,* while assuming that body *A* has volume $V = 0$, and body *B*, that it has a radius $R_B = r_0$.

Under these conditions, the gravitational force between the spherical homogenous bodies *A* and *B* in Fig. 7.3.2 is

$$\vec{F}_{xyz} = -m_A.\gamma.\rho \iiint_{-r_0}^{r_0} \frac{(H+z)\left(x^2+y^2\right)^{1/2}.\mathrm{d}x.\mathrm{d}y.\mathrm{d}z}{\left[x^2+y^2+(H+z)^2\right]^{3/2}} \neq -F_G; \tag{7.3-49}$$

where: $\vec{F}_G$ is the gravitational force under the conditions of (7.3-1).

Therefore, force F_{XYZ} from (7.3-49) is always different from F_G (7.3-1) or, in other words, the force between two real planets even if they are perfect spheres (and they can never be perfect spheres) does not correspond to Coulomb's potential, but is always different from that with a point-like volume $V = 0$ of both bodies, such is F_G.

As a result of (7.3-41), Newton assumed that when

$$\text{a) } H \gg R_A; \text{ b) } H \gg R_B; \tag{7.3-50}$$

the calculation of the gravitational forces between two objects (bodies) *A* and *B* should be done according to (7.3-42), where $H = r$ is the distances between the centers of their gravities, whereby in this case the error can practically be ignored

This force $\vec{F}_{xyz}$ has projections:

a) upon axis *z* it is

$$\mathrm{d}F'_{xyz} = -\mathrm{d}F_{xyz}.\cos\alpha(H.z.r) = -\mathrm{d}F_{xyz}.\frac{H+z}{r}; \tag{7.3-51}$$

b) upon an area, parallel to the plane, outlined by axis *x* and *y*, but at distance *z* from them (from *O'*) and it is

$$\mathrm{d}F''_{xyz} = -\mathrm{d}F_{xyz}.\sin\alpha(H.z.r) = -\mathrm{d}F_{xyz}.\frac{\left(x^2+y^2\right)^{1/2}}{\left(x^2+y^2+z^2\right)^{3/2}}; \tag{7.3-52}$$

This force exercises pressure upon the layer under it of body B.

The notations of the integrals $\mathrm{d}F'_{xyz}$ and $\mathrm{d}F''_{xyz}$ are

$$\mathrm{d}F'_{xyz} = -m_0.\rho.\gamma \iiint_{-r_0}^{+r_0} \frac{\left(x^2+y^2\right).\mathrm{d}x.\mathrm{d}y.\mathrm{d}z}{\left[(H+z)^2+x^2+y^2\right]^{3/2}}; \tag{7.3-53}$$

$$\mathrm{d}F''_{xyz} = -m_0.\rho.\gamma \iint\limits_{-r_0}^{+r_0} \frac{\left(x^2+y^2\right)^{1/2}.(H+z).\mathrm{d}x.\mathrm{d}y.\mathrm{d}z}{\left[(H+z)^2+x^2+y^2\right]^{3/2}}; \tag{7.3-54}$$

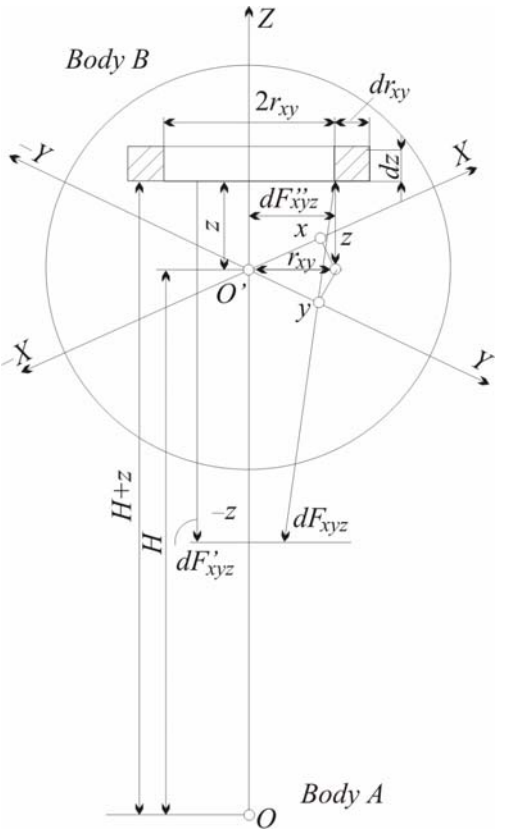

Fig. 7.3.2.

Until present time, integrals for this case have not been notated or solved. But they show that:

1) ***AS A MATTER OF FACT, THE GRAVITATIONAL FORCES IN REAL BODIES WITH VOLUME V > 0 (THESE ARE ALL BODIES) ARE SUBJECTED NOT ONLY TO ATTRACTION, BUT ALSO TO PRESSURE IN DIRECTION PERPENDICULAR TO THE AXIS, WHICH CONNECTS THE CENTERS OF THE ATTRACTION AND THE ATTRACTING BODY.***

2) ***THE GRAVITATIONAL FORCES OF ATTRACTION COMPUTED BY THE SIMPLIFIED METHOD BY IGNORING THEIR VOLUME*** $(V=0)$***, ARE ALWAYS MORE OR LESS DIFFERENT FROM THE REAL ONES. I.E. THE FORCE OF ATTRACTION OF THE BODIES WHEN THEIR VOLUME DIFFERENT FROM ZERO*** $(V>0)$ ***IS, STRICTLY SPEAKING, NEVER PROPORTIONAL TO*** r^2***, BUT ALWAYS IS***

$$\text{a) } r^{-2\pm\alpha};\ \text{b) } (0<\alpha\ll 1); \tag{7.3-55}$$

3. AND THIS FACT, ACCORDING TO BERTAN'S THEOREM* MAKES IT CLEAR THAT THE ORBITS OF THE PLANETS ARE NEVER CLOSED ELLIPSES, BUT ARE ALWAYS OPEN IN THE FORM OF A ROSETTE.

* N. I. Zhirovski. Klasicheskaya mehanika (Classical Mechanics). Publ. by Prosveshchenie. M. 1980. (p. 111)

7.4. THERE IS NOT AND THERE CANNOT BE A PRINCIPLE OF EQUIVALENCE

7.4.1. General formulations

The principle of equivalence states: when the gravitational field in an area of space, in which it can be considered homogenous and constant in time, it is in its manifestation identical to an accelerated reference system, i.e. inertial and gravitational force are equivalent, or identical.

Taking into consideration the presented above that inertial forces are an expression of the law of conservation of mass and energy of bodies with a quantity of matter, or mass m, it follows that gravitational fields even at a minimal distance dr between two points A and B from the equipotential surface of the gravitational field of one body are not equal because they are not parallel and that the gravitational field, apart from force of attraction between the centers of two bodies, generates a transverse force of pressure upon the body, while the inertial force does not have such a component, since it is always directed opposite to the acceleration. This leads to the categorical inference that:

1. IN REALITY, IN NATURE, IN A SMALL OR LARGE SPACE, THERE ARE NO UNIFORM GRAVITATIONAL FIELDS; MOREOVER, THERE ARE TRANSVERSE GRAVITATIONAL FORCES, DUE TO WHICH FACTS THERE IS NOT AND THERE CANNOT BE A PRINCIPLE OF EQUIVALENCE BETWEEN GRAVITATION AND INERTIAL FORCE.

2. OWING TO THE IMPOSSIBILITY OF THERE BEING UNIFORM GRAVITATIONAL FIELD, AND HENCE ALSO THE IMPOSSIBILITY OF THERE REALLY BEING A PRINCIPLE OF EQUIVALENCE, ALL INFERENCES, WHICH ARE CONSEQUENCES OF EINSTEIN'S THEORY OF GRAVITATION WHICH RESULT FROM THE UNREAL PRINCIPLE OF EQUIVALENCE SHOULD BE DROPPED OFF .

7.4.2. There is no uniform gravitational field

First case

Point-like source of GF.

Case A. Two points *A* and *B* are upon gravitational equipotential surface at distance Δr_{AB}.

Under these conditions, on a spherical equipotential surface, the distances of r_A and r_B are equal in absolute value

$$\left|\vec{r}_A\right| = \left|\vec{r}_B\right|, \tag{7.4-1}$$

whence it follows that GF in points *A* and *B* are also equal by absolute value

$$\text{a)}\ \left|\vec{G}_A\right| = \left|-\frac{m_0.\gamma.\vec{r}_{0A}}{r_A^2}\right| = \left|\vec{G}_B\right| = \left|-\frac{m_0.\gamma.\vec{r}_{0B}}{r_B^2}\right| \rightarrow\ \text{b)}\ \left|\vec{G}_A\right| = \left|\vec{G}_B\right|. \tag{7.4-2}$$

But angle $\Delta\varphi_{AB}$ between $\vec{G}_A$ and $\vec{G}_B$ is different from zero: ***the single vectors $\vec{r}_{0A}$ and $\vec{r}_{0B}$ are equal in absolute values, but are not parallel, i.e***.

$$\Delta\varphi_{AB} \neq 0, \tag{7.4-3}$$

since they lie on radiuses $\vec{r}$, which run respectively through the center of gravity and points *A* and *B*, which are at distance

$$\Delta r_{AB} \rightarrow \mathrm{d}\, r_{AB} > 0; \tag{7.4-4}$$

Therefore, the vectors of intensities $\vec{G}_A$ and $\vec{G}_B$ of the gravitational fields are not identical to each other, although they are equal in absolute values, since they are not parallel. I.e. **GF is not uniform even on equipotential gravitational surface and at a minimal distance** $\vec{r}\ \ \Delta r_{AB} \rightarrow \mathrm{d}\, r_{AB} > 0$.

Case B. The pairs of points *A* and *A', B* and *B'* lie respectively along the same gravitational force lines, but each is at different distances from the center:

$$\text{a)}\ \Delta r_A = r_A - r_{A^1} \rightarrow \mathrm{d}\, r_A > 0;\ \text{b)}\ \Delta r_B = r_B - r_{B^1} \rightarrow \mathrm{d}\, r_B > 0. \tag{7.4-5}$$

Because of this the values $\left|\vec{G}_B\right| = \left|-\frac{m_0.\gamma.\vec{r}_{0B}}{r_B^2}\right|$; $\left|\vec{G}_{B^1}\right| = \left|-\frac{m_0.\gamma.\vec{r}_{0B}}{r_B^2}\right|$ of GF in each pair of points A and A', B and B' are different, since $\Delta r_A \neq \Delta r_{A^1}$ and $\Delta r_B \neq \Delta r_{B^1}$, i.e.

$$\text{a)}\ |G_A| = \left| -\frac{m_0.\gamma.\vec{r}_{0A}}{r_A^2} \right| \neq |G_{A'}| = \left| -\frac{m_0.\gamma.\vec{r}_{0A'}}{r_{A'}^2} \right|; \rightarrow \text{b)}\ |G_A| \neq |G_{A'}|; \tag{7.4-6}$$

$$\text{a)}\ |G_B| = \left| -\frac{m_0.\gamma.\vec{r}_{0B}}{r_B^2} \right| \neq |G_{B'}| = \left| -\frac{m_0.\gamma.\vec{r}_{0B'}}{r_{B'}^2} \right|; \rightarrow \text{b)}\ |G_B| \neq |G_{B'}|. \tag{7.4-7}$$

Because of the differences in the distances

$$\text{a)}\ \vec{r}_A \neq \vec{r}_{A'}; \vec{r}_B \neq \vec{r}_{B'}; \ \text{b)}\ \vec{r}_{0A} \neq \vec{r}_{0A'}; \vec{r}_B \neq \vec{r}_B^{\,'}; \tag{7.4-8}$$

and the angles

$$\text{a)}\ \Delta\varphi_{AA'} \neq 0; \ \text{b)}\ \Delta\varphi_{BB'} \neq 0; \tag{7.4-9}$$

it follows from (7.4-6), (7.4-7), (7.4-8) and (7.4-9) **THAT IN THIS CASE, TOO, IN TWO ADJACENT POINTS ALONG THE FORCE LINE THE VECTORS OF GF DO NOT HAVE EQUAL ABSOLUTE VALUES, AND THEREFORE GF IS NEVER UNIFORM.**

The analysis of the first and second cases, which comprise the whole possible diversity of adjacent GF, leads to the inference that **EVEN IN ELEMENTARY VOLUME** $\mathrm{d}V = \mathrm{d}r_{AB}.\mathrm{d}r_{AA'}.1$ **, THERE IS NOT AND THERE CANNOT BE A UNIFORM GRAVITATIONAL FIELD.**

7.4.3. Conclusion

The presented above makes it evident that

a) in the physical sense, in spatial objects, there is not and cannot be a uniform gravitational field;

b) from a physical viewpoint, there is nothing in common between inertial and gravitational forces apart from the fact that they are forces.

BECAUSE OF THIS, AN INFERENCE FOLLOWS THAT THERE IS NOT AND THERE CANNOT BE A PRINCIPLE OF EQUIVALENCE.

7.5. EXAMPLES IN SUPPORT OF THE ELECTROMAGNETIC ESSENCE OF THE GRAVITATIONAL FIELDS OF OBJECTS

7.5.1. Conversion of gravitational energy into kinetic (magnetic) and vice versa

The following situation is considered. Over the Earth, which has matter (mass) M_3, along its radius R_3, there are two point-like masses M_1 and M_2 at distances R_1 and R_2 relative to its center, which lie on the same radius.

The gravitational potentials on the surface of the Earth (R_3) and at points M_1 and M_2 are:

$$a)\ U_{G3} = -\frac{M_3.\gamma}{R_3}; \ b)\ U_{G1} = -\frac{M_3.\gamma}{R_1}; \ c)\ U_{G2} = -\frac{M_3.\gamma}{R_2}; \ d)\ R_2 > R_1; \tag{7.5-1}$$

The difference between the potentials of M_1 and M_2 is

$$\Delta U_{G21} = -M_3\left(\frac{1}{R_2} - \frac{1}{R_1}\right).\gamma; \tag{7.5-2}$$

Let us assume that the processes take place on the surface of the Earth, i.e. $R_1 = R_3$ and that

$$U_{G3} = A = const.; \tag{7.5-3}$$

Under these conditions, we also assume that

$$a)\ r_1 = R_1 = R_3 = 0; \ b)\ r_2 = R_2; \ c)\ r = r_2 - r_1 = r_2; \tag{7.5-4}$$

I.e. the potential U_{G3}, respectively R_3, is assumed as the beginning of the coordinate system, i.e.

$$r_1 = 0 \ \text{and} \ r_2 \neq 0; \tag{7.5-5}$$

Under these conditions $U_{G3} = 0$, and the potential ΔU_{G21} from (7.5-2) is

$$\Delta U_{G21} = -m_3\frac{\gamma}{r_2}; \tag{7.5-6}$$

to which, for an object of matter m_0 in point M_2, corresponds potential gravitational energy $W_{G2} = W_G$ and force F_G

$$\text{a) } W_{G2} = \Delta U_{G21}.m_0 = -M_3 \frac{m_0.\gamma}{r_2} = W_G; \text{ b) } \vec{F}_G = \frac{dW_G}{dr}.\vec{r}_0; \tag{7.5-7}$$

If the object m_0 at velocity zero in point M_2 has zero magnetic energy $W_H = W_K = 0$ and it falls freely from point M_2 to the Earth, i.e. along pathway r_2, in point M_1 on the Earth it will obtain magnetic (kinetic) energy

$$W_H = W_K = \int_0^{r_2} \vec{F}_G.d\vec{r} = \frac{m_0.v^2}{2}; \tag{7.5-8}$$

where: v is the velocity of the object during its fall at point M_1 (on the surface of the Earth).

According to the law of energy conservation

$$\text{a) } W_G = W_K; \text{ b) } W_G - W_K = 0; \tag{7.5-9}$$

at point M_1 the object has potential energy $W_G \neq 0$ and $W_K = 0$, and at point $(r = 0)$ $W_G = 0$ and $W_K \neq 0$.

In this way a well-known fact is illustrated, that the potential gravitational energy converts into magnetic (kinetic) energy.

A reverse conversion is possible, if the object, which is at point M_1 at $r = 0$ on the surface of the Earth, is supplied with sufficient quantity of electromagnetic energy to reach point M_2. In this case the electromagnetic energy converts into gravitational potential energy at point M_2.

The explanation of the above processes is in the fact that the two kinds of fields are genetically homogenous, they are both generated by electromagnetic matter.

Example with a photon

Let a photon of energy W_{ν_0} and matter (mass) m_{ν_0}

$$a) W_{\nu_0} = h.\nu_0; \quad b) m_{\nu_0} = \frac{W_{\nu_0}}{c^2}; \tag{7.5-10}$$

(where: h is Planck's constant; and ν_0 – frequency) is at point M_2, then its potential gravitational energy is

$$U_{G\nu_1} = \frac{-M_3.m_{\nu_0}.\gamma}{r_2}; \tag{7.5-11}$$

During the motion of the photon from M_2 to M_1 it experiences the gravitational force of the Earth $\vec{F}_{G\nu}$ and so it increases its velocity above the wave velocity c, as a result of the force of attraction $F_{G\nu}$ by the gravitational field of the Earth, and its velocity will increase by ν_{21}, and thence its frequency will increase, too (according to Doppler effect), where the velocity ν_{21}, which the photon of mass m_{ν_0} gains is caused by the force of the gravitational field of the Earth, which is

$$a) \vec{F}_G = m_{\nu_0}.\vec{G}_3; \quad b) \vec{G}_3 = \vec{a}_3 = -\frac{m_3.\gamma.\vec{r}_0}{2}; \tag{7.5-12}$$

Due to the short distance $\Delta r_{21} = (r_2 - r_1)$ along which F_G acts, we can assume that $F_G = const$. Under this condition, the kinetic energy, which the gravitational force F_G releases to the photon of mass m_{ν_0} is

$$a) \Delta W_\nu = F_G.\Delta r_{21} = \frac{m_\nu.v_{21}^2}{2}; \rightarrow \quad b) v_{21} = \left(\frac{2.F_G.\Delta r_{21}}{m_{\nu_0}}\right)^{1/2} = \left(\frac{m_3.\nu.\gamma.\Delta r_{21}}{m_{\nu_0}}\right)^{1/2}; \tag{7.5-13}$$

As a result of this velocity v_{21}, according to Doppler effect, the frequency ν of the photon and its velocity v change to

$$a) \nu_{21} = \nu_0.\frac{c + v_{21}}{c} = \nu_0.\frac{u_c}{c}; \quad b) u_c = c + v_{21}; \tag{7.5-14}$$

As a result, the energy and matter of the photon at point M_1 will increase to

$$a) W_{\nu_1} = \int_0^{r_2} \vec{F}_{G\nu}.d\vec{r} = h.\nu_0\left[\frac{c + v_{21}}{c}\right]; \quad b) m_{\nu_1} = \frac{W_{\nu_1}}{c^2}; \tag{7.5-15}$$

As a result of the gravitational force, which acts upon the photon, its velocity will increase above the velocity of light to $u_c > c$ ***(7.5-14) – a fact which disproves the assertions in the Special Theory of Relativity but is accepted by Einstein in his General Theory of Relativity*** .

The gain of energy and matter of the photon from M_2 to M_1

$$a)\ \Delta W_{\nu_{21}} = W_{\nu_1} - W_{\nu_2} = h.\nu_0\left[\frac{c+v_{21}}{c} - 1\right] = h.\nu_0.\frac{v_{21}}{c};\ b)\ m_{\nu_{21}} = \frac{\Delta W_{\nu_{21}}}{c^2}; \tag{7.5-16}$$

These changes under certain conditions are measurable.

Let an example be calculated at 21.5 m distance between the points M_2 and M_1 and be compared with the measured values.

Here simplification is required, but the accuracy is sufficient for comparison with the measurement.

Since the gravitational fields G_2 and G_1 at points M_2 and M_1 are approximately equal, we can use the resultant average value of GF, which is

$$\vec{G}_{21} = \frac{\vec{G}_2 + \vec{G}_1}{2} \approx \vec{G}_3 = -M_3\frac{\gamma.\vec{r}_0}{R_3^2} = 9{,}8\left[m.s^{-2}\right]; \tag{7.5-17}$$

The velocity v_{21} at M_1 and the time t_{21} at M_2 and M_1 are

$$\text{a)}\ \Delta v_{21} = G_3.t_{21};\ \text{b)}\ t_{21} = \frac{\Delta r_{21}}{c};\ \text{c)}\ v_{21} = \frac{G_3.\Delta r_{21}}{c}; \tag{7.5-18}$$

The difference between the frequencies at M_2 and M_1 is

$$\Delta v_{21} = \nu_{21} - \nu_0 = \frac{G_3.r_2}{c} = \frac{9{,}81.21{,}5}{9.10^{16}} \approx 2{,}3.10^{-15}\ Hz; \tag{7.5-19}$$

With the above numerical data, frequency $\Delta v_{21} = 2{,}3.10^{-15}\ Hz$ was measured by R.V. Pound (R. V Pound. On the weight of photons in "Achievement of physics" vol. LXII issue 4. 1960, in Russian) by the method of Moessbauer, whereby this result was obtained with an error of $\pm 1\%$.

This experiment directly confirms Newton's gravitational theory as well as the conversion of the potential gravitational energy into electromagnetic (kinetic) energy because the formulae used in the experiment are from Newton's gravitation.

MOREOVER, POUND'S EXPERIMENT PROVES PRACTICALLY THAT THE VELOCITY OF LIGHT IS NOT CONSTANT. DEPENDING ON THE DIRECTION OF ITS VELOCITY IN RELATION TO THE GRAVITATIONAL FIELD G, IT CAN BE

$$u_c = c \pm v_{21} \neq c; \tag{7.5-20}$$

7.5.2. Deviation of a ray of light from a star by the gravitational field of the Sun

7.5.2.1. *Gravitational field of a photon (electromagnetic waves)*

For a better visualization, without violating the general character of the conclusions, flat electromagnetic waves are considered along with the gravitational field generated by them and inseparable from them.

It is assumed that waves are so oriented relative to the coordinate system so that

$$a)\ E_x = 0; E_y = E; E_z = 0;\ \ b)\ H_x = 0; H_y = 0; H_z = H; \tag{7.5-21}$$

The intensities of fields E and H are synchronized in phase and perpendicular to each other, their amplitudes are E_m and H_m, and the angular frequency is $\omega = 2.\pi.\nu$ (ν – frequency in Hz). The fields are sinusoidal.

$$a)\ E = E_m.\sin\omega.t;\ \ b)\ H = H_m.\sin\omega.t; \tag{7.5-22}$$

The density of their matter (mass) is

$$\text{a)}\ \rho_E = \frac{\varepsilon_0.E^2}{2c^2};\ \text{b)}\ \rho_H = \frac{\mu_0.H^2}{2c^2};\ \ \text{c)}\ \rho_m = \rho_{EH} = \rho_E + \rho_H = \frac{\varepsilon_0.E^2}{c^2} = \frac{\mu_0.H^2}{c^2}; \tag{7.5-23}$$

The sum of the moment values of the powers P of fields $\vec{E}$ and $\vec{H}$ is

$$P_0 = P_E + P_H = \left(\varepsilon_0.\mu_0\right)^{-1}.E_m.H_m.\sin^2\omega.t = P_{\underline{0}} + P_{\tilde{0}}; \tag{7.5-24}$$

where:

$$P_{\underline{0}} = \left(\varepsilon_0.\mu_0\right)^{-1}.\frac{E_m.H_m}{2}; \tag{7.5-25}$$

is a constant component of P_0 for the whole wave, and

$$P_{\tilde{0}} = \left(\varepsilon_0.\mu_0\right)^{-1}.\frac{E_m.H_m}{2}.\cos 2\omega.t; \tag{7.5-26}$$

is a variable component of P_0, where their sum for two half-periods, for two half-waves $\lambda/2$, is zero, due to which its resultant force in interaction with another gravitational field is zero.

Since power is energy per unit of time $P = W/t$, then power P_0 divided by the length of one half-wave $\lambda/2$ gives the average linear density of energy of electromagnetic waves per unit of length

$$\tau_{w_0} = \frac{2.P_0}{\lambda}; \tag{7.5-27}$$

And τ_{w_0} divided by c^2 gives the average linear density of matter (mass) of electromagnetic waves in the form of a filament

$$\tau_{m_0} = \frac{\tau_{w_0}}{c^2} = \frac{2.P_0}{\lambda.c^2}; \tag{7.5-28}$$

This linear density of electromagnetic matter of the photon with length $l_f = 3$ m *and diameter of its cross-section* $D \approx 10^{-7}$ m *is also a linear gravitational charge, which, analogously to the linear electric charge, generates gravitational field of cylindrical radial symmetry.*

$$\vec{G}_{\tau} = \frac{-2.\tau_{m_0}.\gamma.\vec{r}_0}{r} = -\vec{G}_{\tau_0} + \vec{G}_{\tau_0}.\cos 2\omega.t = \vec{G}_{\underline{0}} + \vec{G}_{\tilde{0}}; \tag{7.5-29}$$

where:

$$\vec{G}_{\underline{0}} = \frac{-E_m.H_m.\gamma.\vec{r}_0}{c^2.r}; \tag{7.5-30}$$

is a constant component of the cylindrical gravitational field of electromagnetic waves. And

$$\vec{G}_{\tilde{0}} = \frac{E_m.H_m.\gamma.\vec{r}_0}{c^2.r}.\cos 2\omega.t; \tag{7.5-31}$$

is the variable component of the gravitational field, which has double frequency $2.\nu$ *relative to the one of* ν_0 *of electromagnetic waves, whose sum along one wave* λ *(for one period* T*) is zero.*

Such a radially cylindrical gravitational field can be obtained with sufficient accuracy, if the cross-section $D_v = 2.r_v$ is much smaller than the length ℓ_v of the gravitational charge (mass of one wave). In fact, since electromagnetic waves have photons as their carriers, the above condition should be met in compliance with the sizes of the photons.

According to V. Golovanov*, the minimum surface, lighted by a laser ray is $S_m \approx 5.10^{-13}\ m^2$ or its diameter is $D_v \approx 10^{-6}\ m$, upon which fall, for instance, about 10^2 photons and the diameter (the cross-section) of the photon is $D_v < 10^{-7}\ m$. According to D. I. Penner**, the emission time of a photon is $\tau_v \approx 10^{-8}\ s$, hence it follows that the length of a photon from the frequency of the light range is $\ell_v = \tau_v.c = 10^{-8}3.10^8 = 3\ m$.

It is apparent that the ratio of the photon length ℓ_v to diameter D_v is

$$N = \frac{\ell_v}{D_v} \approx \frac{3}{10^{-7}} = 3.10^7 \text{ пъти}; \tag{7.5-32}$$

At frequency of the visible light of $\sim 10^{15}\ Hz$, the length of the wave is $\lambda = \frac{c}{\nu} = \frac{3.10^8}{10^{15}} = 3.10^{-7}\ m$, and one photon has

* Golovanov V. Sopernitsi reztsa (Russian). Publ. by Mashiz. M. 1977 (Ch. V).

$$n = \frac{\ell_v}{\lambda} \approx \frac{3}{10^{-7}} = 3.10^7 \text{ waves;} \tag{7.5-33}$$

With these data it is obvious that it holds true for the photon that:

First: *The gravitational field of the photon is really only radially cylindrical (7.5-29).*

Second. *In no case can the photon be abstracted to a dimensionless point – a fact, which was also confirmed by Einstein*[*]*, who wrote*: ***"The idea of the photon as a point-like structure does not permit explanation of interference phenomena, which arise with two rays." Nonetheless, he calculated the deviation of light by approximating the photon into a point.***

THEREFORE, THE CALCULATIONS, MADE BY SOLDERMAN IN 1801 AND BY EINSTEIN IN 1911, FOR THE DEVIATION OF THE RAY OF LIGHT FROM A DISTANT STAR BY THE GRAVITATIONAL FIELD OF THE SUN, ***WHERE THE PHOTON IS ABSTRACTED TO A POINT, AND ITS GRAVITATIONAL FIELD IS PROPORTIONAL TO*** r^{-2} ***YIELD UNRELIABLE RESULTS.***

Third. The gravitational field generated by the light (electromagnetic) waves is radially cylindrical, pulsating and unidirectional, so that this condition is always fulfilled.

$$\vec{G}_v = \vec{G}_\tau \le 0; \tag{7.5-34}$$

7.5.3. Value of the light ray deviation

According to (7.5-28) the linear density of matter of the electromagnetic waves in the light range of $\nu = 10^{14}$ Hz is

$$\tau_m = \frac{h.\nu}{\ell_v.c^2} = \frac{6,6.10^{-34}.10^{14}}{3.9.10^{16}} = 2,4.10^{-34} \text{ kg/m;} \tag{7.5-35}$$

The gravitational field of the photon is radially cylindrical

$$\vec{G}_\tau = -\frac{2.\tau_m.\gamma}{r}.\vec{r}_0; \tag{7.5-36}$$

not spherical.

The gravitational force F_v between the gravitational field of photon $\vec{G}_\tau$ and the gravitational field of the mass M_c of the Sun is

$$F_v = M_c.G_\tau = -\frac{M_c.2.\tau_m.\gamma}{r}; \tag{7.5-37}$$

The calculation of the angle of deviation of angle $\Delta\varphi$ of the rays of the star is made as per Ch. Kittel[**] relative to a normally oriented reference system in the center of the Sun, so that axis x coincides with the radius toward the nearest point M to the ray of the Sun. The component of the force of the photon F_v upon axis x is

$$F_{vx} = F_v.\cos\alpha; \tag{7.5-38}$$

where: α is the angle between the radius r_c of the Sun and the radius r in the point under consideration M.

$$a)\ \cos\alpha = \frac{r_c}{r};\quad b)\ r^2 = r_c^2 + y^2; \tag{7.5-39}$$

where: y is the coordinate point M of the ray, for which point force F_{vx} is calculated.

The component of the momentum of the linear density of the photon matter upon axis x is

$$P_{vx} = \tau_m.v_x = 2\int_0^\infty F_{vx}.dt = \int_0^\infty F_{vx}.\frac{dy}{v_y} \approx \frac{2}{c}\int_0^\infty F_{vx}.dy; \tag{7.5-40}$$

where: v_x is the component of the photon velocity upon axis x, where

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[*] A. Einstein. Physics, Philosophy and Scientific Progress (in Russian). Collected Scientific Works, vol. IV, p. 316, translated from Physics, Philosophy and Scientific Progress. 1950.

[**] Berkley Physics Course (in Russian), vol. I. Mechanics. Ch. Kittel, W. Knight, M. Ruderman. Science. M. 1983. (p. 417, p § 14. 2) (translated from Ch. Kittel. Berkeley Physics Course. v. I McGraw. Hill Book Company).

$$a)\ dy = v_y.dt \approx c.dt;\quad b)\ v_y \approx c; \tag{7.5-41}$$

After replacing F_{vx} with the relationship (7.5-38) and (7.5-39) a and cancelling τ_m we have

$$v_x = \frac{2.\gamma.M_c}{c}.2\int_0^{\infty}\frac{dy}{r_c^2+y^2} = \frac{4.\gamma.M_c}{c.r_c}arctg\,\frac{y}{r_c}\bigg|_0^{\infty} = -\frac{2.\gamma.\pi.M_c}{c.r_c}; \tag{7.5-42}$$

The tangent of the angle of its deviation is

$$tg\Delta\varphi = \frac{|v_x|}{c} = \Delta\varphi = \frac{2.\gamma.\pi.M_c}{c.r}rad = 2,73"; \tag{7.5-44}$$

Therefore, when the ray of light passes by the Sun at distance equal to the radius r_c of the Sun and the linear density τ_m of its matter is considered, the obtained gravitational force is greater, and thence the angle of deviation $\Delta\varphi = 2,73"$ is also greater than if the photon is approximated into a point.

In [2] (p. 353) it is written that according to Dikke, from the processing of the measured experimental results in solar eclipse, the angular deviation is $\Delta\varphi = 1,43"$ to $2,73"$. If the measurement is free of systematic errors, but it may have error up to 20%, i.e. with an error of 20% – $\Delta\varphi$ = 1.71" to 3.24":

Therefore $2,73"$ is within the range of probable deviation with errors from the measurement.

The above calculations once again confirms the homogeneity of electromagnetic and gravitational fields.

7.5.4. Graviphoton: a quantized gravitational field

The interaction between electron e_0^- and positron e_0^+ at rest generates photons □ with energies W_f and mass m_f, as follows

$$a)\ e_0^- + e_0^+ \rightarrow 2\gamma;\ b)\ 2.m_{e0}.c^2 = 2.h.\nu = 2.W_f;\ c)\ m_f = m_{e0} = \frac{h.\nu}{c^2}; \tag{7.5-45}$$

I.e. the mass m_f of the generated photons is equal to the mass at rest of electrons

$$m_f = m_{e0} = q_e^2.k_m; \tag{7.5-46}$$

Here it should be pointed out that as it was noted in paragraph 7.5.2.1., the photon's length is

$$\ell_f = \tau.c = 10^{-8}.3.10^8 = 3\ \text{m} \tag{7.5-47}$$

where: τ is time of emission of the photon at velocity $c = 3.10^8$ m/s .
The energy W_f and the mass m_f of the photon at frequency 10^{14} Hz are

$$a)\ W_f = h.\nu = 6,62.10^{-34}.10^{14} = 6,62.10^{-20}\ \text{J};\ b)\ m_f = \frac{W_f}{c^2} = \frac{6,62.10^{-18}}{9.10^{16}} = 0,733.10^{-34}\ \text{kg}; \tag{7.5-48}$$

Under these conditions the gravitational field of the photon is cylindrical

$$a)\ \vec{G}_f = -\frac{m_f.\gamma}{r}.\vec{r}_0;\ b)\ \tau_{me} = \frac{W_f}{c^2.\ell_f} \tag{7.5-49}$$

where: l_f is length of the photon.

The gravitational energy of the photon W_{Gf} in the reaction (7.5-45)a is equal to the gravitational energy of the electron W_{eG} (7.5-45)c, and therefore

$$a)\ W_{Gf} = W_{eG} = \frac{m_{e0}.\gamma}{r_{e0}} = \frac{q_e^4.k_m.\gamma}{r_{e0}};\ b)\ m_{fG} = \frac{W_{fG}}{c^2}; \tag{7.5-50}$$

The ratio between the electromagnetic and the gravitational energies and respectively between the masses, according to equation (7.2-9) is

$$K_{eG} = \frac{W_{e0}}{W_{eG}} = \frac{m_{e0}}{m_{eG}} = \frac{W_f}{W_{fG}} = \frac{m_f}{m_{fG}} = 4,17.10^{42} = \text{const.}; \tag{7.5-51}$$

Taking into consideration the law of conservation of energy and mass, we can make the inference that this ratio K_{eG} (7.5-51) is constant and holds true for all bodies (objects).

From the formula of the electromagnetic energy of the photon

$$W_f = h.\nu; \tag{7.5-52}$$

to which, according to K_{eG} (7.5-51), corresponds gravitational energy

$$W_{fG} = h_G.\nu = \frac{h.\nu}{2.K_{eG}}; \tag{7.5-53}$$

here, as the frequency ν_G of the gravitational field of the photon is twice as high as the frequency ν of its electromagnetic field [see after equation (7.5-31)], in equation (7.5-53) in the nominator, there is a digit two, and the frequency ν is that of electromagnetic field. Under these conditions h_G is

$$h_G = \frac{h}{2.4,17.10^{42}} = \frac{6,65.10^{-34}}{8.34.10^{42}} = 7,9.10^{-77}\,[\mathrm{J.s}]; \tag{7.5-54}$$

Hence it follows that the formula of the gravitational energy of the photon, or the energy of the graviphoton (the gravitational energy of the photon) is

$$W_{fG} = h_G.\nu; \tag{7.5-55}$$

In this way the gravitational energy of the photon is quantized.

The gravitational mass of the photon or the mass of the graviphoton is

$$m_{fG} = \frac{m_f}{K_{eG}} = m_f.2,3.10^{-43}\ \mathrm{kg}; \tag{7.5-56}$$

The momentum of the graviphoton is

$$\vec{P}_{fG} = m_{fG}.\vec{c} = \frac{W_{fG}}{c}.\vec{c}_0; \tag{7.5-57}$$

In the above sense, it follows that in force gravitational interaction by gravitational force $\vec{F}_G$ between two bodies A and B with masses m_A and m_B

$$\vec{F}_G = -\frac{m_A.m_B.\gamma}{r^2}.\vec{r}_0; \tag{7.5-58}$$

Apart from electromagnetic energy, which is transferred from one *(A)* body to the other *(B)*, which for distance $\mathrm{d}\vec{r}$ is

$$\mathrm{d}W = \vec{F}_G.\mathrm{d}\vec{r};[\mathrm{J}]; \tag{7.5-59}$$

there is a transfer of gravitational energy as well

$$\mathrm{d}W_G = \frac{\mathrm{d}W}{K_{eG}} = \mathrm{d}W.2,3.10^{-43}\,[\mathrm{J}]; \tag{7.5-60}$$

I.e. here, too, the mechanism of interaction is the same, as in electromagnetic interaction.

7.5.5. General inferences

1. ***The essence of gravitational field is electromagnetic, but it is a secondary electromagnetic field.***

2. ***The gravitational potentials of bodies (planets) in Universe are always different from Coulomb's potential*** $\left(-\frac{\alpha}{r^2}\right)$**.**

3. ***APART FROM FORCES OF ATTRACTION ACTING BETWEEN BODIES, GRAVITATIONAL FIELDS ALSO GENERATE FORCES OF PRESSURE (STRESS) UPON BODIES FROM THEIR SURFACE TOWARD THEIR AXIS, WHICH RUN THROUGH THE CENTERS OF THE INTERACTING BODIES. THIS FORCE INFLUENCES THE TIDES (HIGH AND LOW WATERS) AND TECTONIC PROCESSES.***

4. ***The motion of planets is only along open orbits (rosettes).***

5. ***Strictly speaking, Kepler's laws about planets are approximate with certain errors. A fact, which explains the open orbit of the planet Mercury.***

7.5.6. Conclusion

The essence of gravitational field as a secondary electromagnetic field has these subsequences:

- it brings unity into the picture of the world as an electromagnetic continuum;
- deepens the knowledge of unitary electromagnetic matter of the world.

Literature

1. Ch. Kittel, V. Nayt, M. Ruderman. Barkleevsky kurs fiziki. Vol. I. Mekhanika. Nauka. Moscow, 1983. (Translated from: Ch. Kittel, V. Knight, M. Ruderman. Barkeley Physics Course, Vol. 1, Mechanics. McGraw-Hill Book Co., 1965).

2. Ch. Misner, K. Torn. Gravitatsiya, vol. 3, Publ. Mir, Moscow, 1977. Translated from Ch. Misner, Gravitation vol. 3, San Francisco. 1973.

7.6. FLAWS IN KEPLER'S SECOND LAW AND THE ANGULAR MOMENTUM OF PLANETS

7.6.1. Introduction

The first two Kepler's laws according to D. Giancoli [1] (Paragraph 5, 7) are:

First. The trajectory of motion (the orbit) of each planet around the Sun is an ellipse, in one center of which is the Sun.

Second. Each planet moves so that its distance to the Sun describes equal surfaces for equal intervals of time (the sector velocity is constant – P. P.'s note).

In respect to the quantities connected with the above laws, the parameters of the ellipses of the Earth in relation to the Sun are:

1. the semi-axes r_a and r_b of the ellipse of the Earth orbit are:

a) $r_a = 1,49.10^{11} m$; b) $r_b = 2,253.10^{11} m$;

2. the velocities of the Earth at the perihelion v_p and at the aphelion v_a are:

a) $v_p = v_{\max} = 33,3\ km/s$; b) $v_A = v_{\min} = 29,3\ km/s$;

3. The equation of the orbit (the ellipse) of the earth around the Sun is:

$$\frac{x^2}{r_a^2} + \frac{y^2}{r_b^2} = 1\,; \tag{7.6-1}$$

7.6.2. The distance from the Earth to the Sun at the perihelion changes for time of half a year

$$\Delta t = \frac{\text{time of one year}}{2} = \frac{3,155.10^7}{2} = 1,57.10^7 \text{ s}\,; \tag{7.6-2}$$

$$\Delta r_{ab} = r_b - r_a = (2,257 - 1,49).10^{11} = 0,767.10^{11} m; \tag{7.6-3}$$

or at a mean velocity of

$$v_0 = \frac{\Delta r_{ab}}{\Delta t} = \frac{0,767.10^{11}}{1,57.10^7} = 0,488.10^3 m/s; \tag{7.6-4}$$

i.e. the distance from the Earth to the Sun at perihelion r_a increases toward aphelion by $\Delta r_{ab} = v_0.\Delta t = 0,767.10^{11} m$ for time Δt and becomes $r_b = 2,257.10^{11} m$ at aphelion , i.e.

$$r_b = r_a + v_0.\Delta t = 1,49.10^{11} + 4,88.10^3.1,57.10^7 = 1,49.10^{11} + 0,767.10^{11} = \\ = 2,259.10^{11} m; \tag{7.6-5}$$

and vice versa, the distance at aphelion r_b decreases for time Δt (i.e. mean velocity v_0 of the distance r_a at perihelion) to distance r_a at perihelion, i.e.

$$r_a = r_b - v_0.t = 2,257.10^{11} - 4,88.10^3.1,57.10^7 = 2,257.10^{11} - 0,767.10^{11} = 1,49.10^{11} m; \tag{7.6-6}$$

These facts imply that the distance r from the Earth to the Sun along perihelion r_a increases for time t toward aphelion and vice versa r_b decreases r_a , i.e.

a) $r = r_a + v_0.t \neq const.$; b) $r = r_b - v_0.t \neq const.$; c) $r = r(t) = const.$; (7.6-7)

4.2. The velocity of the Earth relative to the Sun decreases from v_p at perihelion for time Δt to v_A at aphelion and vice versa – during its motion from aphelion v_A increases to v_p at perihelion.

The difference between the velocity v_0 at perihelion and v_A at aphelion is:

$$\Delta v_{PA} = v_P - v_A = 33,3 - 29,3 = 4km/s = 4.10^3 m/s; \quad (7.6\text{-}8)$$

for time $\Delta t = 1,57.10^7 s$

Or the mean acceleration along the distance between perihelion and aphelion, and vice versa

$$a = \frac{\Delta v_P}{\Delta t} = \frac{4.10^3}{1,57.10^7} = 2,54.10^{-4} m/s^2; \quad (7.6\text{-}9)$$

i.e. the change of the velocity v_P at perihelion toward the velocity decreases v_A for time

$$\Delta t = 1,57.10^7 s$$

$$\Delta v_{PA} = a.\Delta t = 2,54.10^{-4}.1,57.10^7 = 4.10^3 m/s; \quad (7.6\text{-}10)$$

or

$$\begin{aligned} &\text{a) } v_A = v_P - \Delta v_{PA} = 33,3.10^3 - 4.10^3 = 29,3.10^3 m/s \\ &\text{b) } v_P = v_A + \Delta v_{PA} = 2,93.10^3 + 4.10^3 = 33,3.10^3 m/s; \end{aligned} \quad (7.6\text{-}11)$$

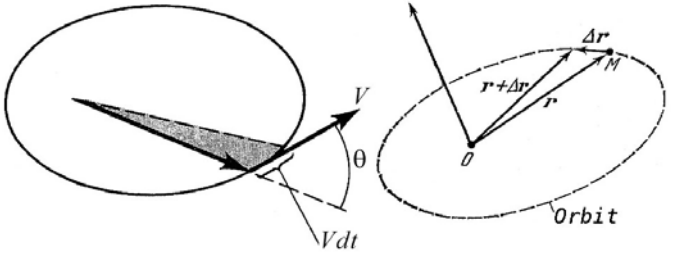
Therefore, the velocity of the change of the distance from the Earth to the Sun is function of the time, i.e.

a) $v_P = v_A + a.t \neq const.$; b) $v_A = v_P - a.t \neq const.$; c) $v = v(t) \neq const.$; (7.6-12)

7.6.3. Value of the sector velocity τ

Surface dS of the sector of the ellipse (Fig. 7.6.3.1), which is dimmed, which is between the distance from the Earth to the Sun $\vec{r}$ at the moment of time t and after time dt, at distance $d\vec{l} = \vec{v}(t).dt$ along the orbit, at angle Θ between $\vec{r}$ and $d\vec{l}$, which is also function of time t, since $\vec{r} = \vec{r}(t)$ and $\vec{v} = \vec{v}(t)$, i.e. $\Theta = \Theta(t)$ according to [1] (paragraph 10,) is:

a) $dS = \frac{1}{2}.r(t).v(t)\sin\Theta(t).dt = \frac{1}{2}\psi(t).dt = H(t).dt$; b) $H(t) = \frac{1}{2}r(t).v(t).\sin\Theta(t)$; (7.6-13)



a) **b)**

Fig. 7.6.3.1.

Whence it follows that the sector velocity τ is:

a) $\tau = \frac{dS}{dt} = H(t) = \frac{1}{2}.r(t).v(t).\sin\Theta(t) \neq const.$;b) $\tau = \tau(t) \neq const.$; (7.6-14)

i.e. since the distance from the Earth to the Sun depends on time t, the velocity of the Earth along its orbit depends on time v(t) and the angle between $\vec{r}(t)$ and $v(t)$. Θ depends on time $\Theta = \Theta(t)$, i.e. the sector velocity τ is a product of three terms, each of which is function of the time, and this fact unconditionally entails that τ is also function of time $\tau = \tau(t)$.

Example

If the sector velocity τ is described for a moment of time t, when the Earth moves from perihelion to aphelion at the described above values of the distance $r(t)$, the velocity $v(t)$ and $\sin\Theta = f(t)$, i.e. at

$$\text{a) } r(t) = r_A + v_0.t \text{ ; b) } v(t) = v_P - a.t \text{ ; c) } \sin\Theta = f(t) \tag{7.6-15}$$

for τ we have

$$\tau = \frac{1}{2}(r_a + v_0.t).(v_P - a.t).f(t).\left(A + B.t + c.t^2\right) = \tau(t) \tag{7.6-16}$$

where

$$\text{a) } A = r_a.v_p = const. \text{ ; b) } B = \left(r_a.a - v_0.v_p\right) = const. \text{ ; c) } C = v_0.a = const.; \tag{7.6-17}$$

I.e. τ is function of the time of first and second power, and is not a constant quantity.

But if assumed as in [1] (paragraph 5, 7), which states: "here m is the mass of the planet, r its average distance from the Sun, v_1 – ***its average velocity along its orbit***, T_1 – the time for which the planet accomplishes a full circle around the Sun (i.e. covers the length of the circumference $2.\pi.r_1$), the velocity is

$$v_1 = \frac{2\pi r_1}{T_1} \text{";}; \tag{7.6-18}$$

Or this citation shows that in [1] (paragraph 5, 7) it is assumed that a) $v_1 = const.$ ***and b)*** $r_1 = const.$***, since there is a text "(i.e. covers the length of the circumference*** $2\pi r_1$***)", but in spite of these constant values, which hold true only for a circumference, Kepler applied this formula for an ellipse, which was incorrect to do (was a flaw).***

7.6.4. Another proof that sector velocity is not constant – inaccuracy of Kepler's second law

The sector velocity τ is equal to the alteration of the area, which the radius-vector of a moving point-like object *M* describes for time dt, relative to a reference system with its beginning 0 (fig. 7.6.4.1). The material point *M* moves from point *A* with radius-vector $\vec{r}$ for time dt (angle $d\theta$) to point *C* with radius-vector $\vec{r}` = \vec{r} + d\vec{r}$.

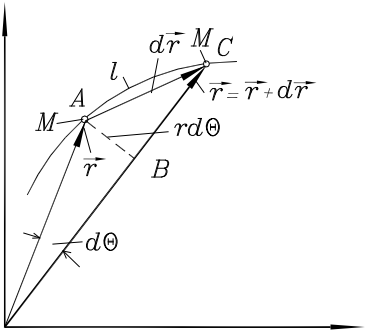


Fig. 7.6.4.1.

The area, which the radius-vector describes for time dt is

$$dS = dS` + dS`` = 0AB + ABC; \tag{7.6-19}$$

or

$$dS = \frac{1}{2}.r.rd\theta + \frac{1}{2}.r.d\theta.dr; \tag{7.6-20}$$

Only the area between trajectory l and gain dr of the radiusvector remains not included.

Taking into consideration that:

$$\text{a) } \frac{dr}{dt} = f`(r.t) \text{ ; b) } dr = f`(r.t)dt \text{ ;} \tag{7.6-21}$$

it follows that the sector velocity is

$$\tau = \frac{dS}{dt} = \frac{1}{2}.r^2.d\theta + \frac{1}{2}.f`(r.t).d\theta = \frac{1}{2}.r.d\theta\left[r + f`(r.t)dt\right]; \tag{7.6-22}$$

Only with a trajectory in the shape of a circle

$$\frac{dr}{dt} = f`(r.t) = 0; \tag{7.6-23}$$

therefore, only with a circle, the sector velocity is

$$\tau = \frac{dS}{dt} = \frac{1}{2}.r^2.d\theta = const.; \tag{7.6-24}$$

In all other cases of orbits, the sector velocity τ is variable (7.6-22); therefore, (7.6-24) can only be used as a first approximation.

THIS INCORRECT FACT IS ONE OF THE REASONS WHY THE ORBITS OF PLANETS ARE INTERPRETED AS CLOSED CURVES WHILE THEY ARE IN FACT OPEN ROSETTES.

THIS IS ACTUALLY ALL THE NECESSARY CORRECTION TO KEPLER'S SECOND LAW.

7.6.5. Value of the angular momentum of planets with elliptic orbits

7.6.5.1. General formulations

In [1] paragraph 10, 8 (example 10.4) it is written: "The value of the angular momentum L of the planets relative to the Sun is

$$\left|\vec{L}\right| = \left|\vec{r} \times m.\vec{v}\right| = m.r.v.\sin\Theta\,; \tag{7.6-25}$$

Substituting this in the previous expression (the expression for $\tau = \frac{dS}{dt}$, P.P.'s note), we have

$$\tau = \frac{dS}{dt} = \frac{1}{2m}.L = \frac{1}{2}.r.v.\sin\Theta\,; \tag{7.6-26}$$

Further on, it is written, "since L=const. it follows that $\tau = \frac{dS}{dt} = const.$," which had to be proved.

But here an incorrect assertion is made, through (7.6-25) that $v_1 = const.$ ***although the motion of the Earth (the planet) around the Sun is along an ellipse, despite the real situation (7.6-26), i.e. that*** $r = r(t)$, $v = v(t)$ ***and*** $\sin\Theta = f(t)$, ***and at the end of paragraph 10,8 from [1] it is written:***

"But the value of the angular momentum remains the same: L=const., since the gravitation force $\vec{F}$ has a direction toward the Sun (the attraction by the other planets is ignored), therefore $\tau = \vec{r} \times \vec{F} = 0$ ($\tau = \frac{dL}{dt}$ – this is given in [1] (paragraph 10,8 – P. P.'s note). Therefore, $\frac{dS}{dt} = const$, which had to be proved."

But taking into consideration that Kepler wrote about the angular momentum7.6-25) $L = \left|\vec{r} \times m.\vec{v}\right| = m.r.v.\sin\Theta$ *, and that the actual values of* r , v *and* $\sin\Theta$ *are variable quantities, during the motion of the planets along elliptic trajectories, where* r , v *and* $\sin\Theta$ *have variable values according to (7.6-26), it follows that the accurate expression for the absolute value of the angular momentum during the motion of the planet from perihelion to aphelion, with taking into consideration (7.6-25), is*

$$L = m.(r_a + v_0.t)(v_p - a.t)\,f(t) = m\left(A + B.t + C.t^2\right) \neq const.; \tag{7.6-17}$$

i.e. the angular momentum of the planets which move along elliptic orbit is not constant, but variable in value.

7.6.5.2. Emphasis

This incorrectness can be found in many scientific works, and most often in [1]. For example in [2] (paragraph 6,2 (Fig. 6.1) is given Fig. 7.6.3.1. From this figure, although it is apparent that it is for time dt or distance along the orbit $\Delta r = v.dt$, the radiuses are $\vec{r}_1 = \vec{r}$ and $\vec{r}_2 = (\vec{r} + \Delta\vec{r})$, i.e. that $r_1 \neq r_2$, then, when calculating dS, they are moment ones $r_1 = r_2 = r$ and it is written [2] in paragraph 9,9 (p. 84)

$$\text{a) } d\vec{S} = \frac{1}{2}(\vec{r} \times d\vec{r})\,;\ \text{b) } \frac{dS}{dt} = \frac{1}{2}.r.v = const.;$$

7.6.6. Conclusion

The angular momentums of the elliptic orbits of the planets relative to the Sun are not constants, but are functions of the time.

7.6.7. Literature

1.D. C. Giancoli General Physics. Prentice – Hall. Inc.1284. Translation into Russian: D. C. Giancoli. Physics. Vol. I. "Mir". Moscow. 1989.

2. Ch. Kittel. Mechanik. Berkeley Physics. Course.vol.1.Mc Graw-Hill Book Co 1965.

7.7. INTERPRETATION OF ALLAIS'S EFFECT

On 30 June 1954, during a solar eclipse, the French scientist Maurice Allais* discovered that the period of oscillation of a pendulum increased. This fact was later confirmed by other teams on other places on the Earth and was called Allais's effect.

There has not been given a satisfactory explanation to this effect until present day. Here is suggested an explanation of Allais's effect, by proceeding from Newton's gravitation, as follows:

1. Every body of mass m_i generates gravitational field, which in a given point i is the vector

$$\vec{G}_j = -\frac{m_i.\gamma.\vec{r}_0}{r_i^2}; \tag{7.7-1}$$

2. In a given point A between several bodies, the resultant gravitational field is

$$\vec{G}_{AR} = \sum \vec{G}_{iA}; \tag{7.7-2}$$

3. In a given point A on the surface of the Earth, significant for the resultant gravitational field $\vec{G}_{AR}$ in this point are the gravitational fields of:

a) the Earth: $\vec{G}_{A3} = \text{const.}$ in direction and in value for a determined potential surface of radius R_3;

b) the Sun: $\vec{G}_{AS} = \vec{G}_{AS}(t)$ – variable in direction and in value;

c) the Moon: $\vec{G}_{AL} = \vec{G}_{AL}(t)$ – variable in direction and in value.

Then the resultant gravitational field in point A is

$$\vec{G}_{AR} = \vec{G}_{A3} + \vec{G}_{AS}(t) + \vec{G}_{AL}(t) = \vec{G}_{AR}(t) \neq \text{const.}; \tag{7.7-3}$$

During solar eclipse the gravitational fields of the Sun $\vec{G}_{AS}$ and of the Moon $\vec{G}_{AL}$ are opposite relative to that of the Earth $\vec{G}_{A3}$, due to which the resultant field in point A of the Earth is minimal

$$\left|\vec{G}_{AR}\right| = \left|\vec{G}_{A3}\right| - \left|\vec{G}_{AS}\right| - \left|\vec{G}_{AL}\right| = \left|\vec{G}_{AR\min}\right| < \left|\vec{G}_{A3}\right|; \tag{7.7-4}$$

In this case, the period of the pendulum increases

$$T = T_{\max} = \sqrt{\frac{\ell}{\mathrm{G}_{\mathrm{ARmin}}}}; \tag{7.7-5}$$

where: ℓ is length of the pendulum.

In this sense, the oscillations of the pendulum depend on the time and on the gravitational fields of the masses, which are proportional to $\vec{G}_{AR}$.

Here, the interesting moment is when the Earth, the Sun and the Moon lie on a straight line, i.e. during solar or lunar eclipse. Such is the case in Allais's effect.

In solar eclipse, the Sun and the Moon are at the side of the studied point, the resultant gravitational field in the point is minimal, and at the point in the diametrical position on the other side of the Earth is maximal. During lunar eclipse, since the Sun and the Moon are on both sides of the Earth, their fields are opposite and only their difference acts upon the field of the Earth.

These alterations of the resultant gravitational field of the Earth can be ascertained experimentally through a system of laser rays, falling upon flat surface at sufficient distance between the lasers and the surfaces. It should be expected that for a period of 24 hours a laser ray would describe an almost closed curve, and analogously, the same would hold true for one year. In order to better establish this effect, three mutually perpendicular systems would be needed.

* Maurice Allaise is a Nobel prize laureate in economics.

Inferences

1. The gravitational forces which exert pressure (force) on various points of the Earth and on the bodies (objects) upon it are variable in time.

2. THE VARIABLE GRAVITATIONAL FORCES ACTIVATE TECTONIC PROCESSES IN THE EARTH LAYERS.

3. The variable gravitational forces can disturb the weak balances of mechanical systems.

7.8. ON ACCELERATION OF FALLING BODIES

First

Galileo's experiments at the Pizza Tower showed that regardless of their masses, bodies fall in equal times.

The explanation for this is as follows:

1. With regard to the gravitational field $\vec{G}$, mass *m* is a gravitational charge, since its gravitational field has a dimensionality of acceleration

$$\text{a) } \vec{G} = -\frac{m.\gamma}{r^2}.\vec{r}_0 = \vec{a}_G;\ \text{b) } \vec{G} = \vec{a}_G = \frac{\vec{F}_G}{m};\ \text{c) } \vec{a}_G \to \left[\text{m.s}^{-2}\right]; \tag{7.8-1}$$

is the acceleration, which depends on distance r^{-2}.

In the experiment with the Pizza Tower, the distance from the Earth is equal, and therefore, the gravitational fields of the Earth $\vec{G}_3 = \vec{G}_G$ are identical relative to all masses, which are on the tower, due to which the acceleration is also equal for all masses (gravitational charges). This fact entails that the forces, which act upon the various masses m_1, m_2,..., m_n are proportional to the masses

$$\text{a) } \vec{F}_{G1} = m_1.\vec{a}_G;\ \text{b) } \vec{F}_{G2} = m_2.\vec{a}_G; ...\vec{F}_n = m_n.\vec{a}_G; \tag{7.8-2}$$

due to which the pathways and times t_i, for which they travel along them, are also equal

$$\text{a) } r_n = \left(\frac{2.r_n}{a_G}\right)^{1/2};\ \text{b) } ...t_{ni} = \left(\frac{2.r_{ni}}{a_G}\right)^{1/2} = \left(\frac{2.r_j}{a_G}\right)^{1/2} = \text{const.}; \tag{7.8-3}$$

Second

The accelerations of the masses of the electric charges of electromagnetic forces do not depend on their masses, but they depend only on their distances to the charge, as is also the case with gravitational forces.

Let two values of electric charges are assigned

$$\text{a) } Q_1 = \left(\mp q_e\right);\ \text{b) } Q_2 = N.\left(\mp q_e\right); \tag{7.8-6}$$

to which correspond masses

$$\text{a) } m_1 = \frac{Q_1^2}{4.\pi.\varepsilon_0.r_{e0}.c^2} = \left(\mp q_e\right)^2.k_m;\ \text{b) } m_2 = N.m_1;\ \text{c) } k_m = \left(4.\pi.\varepsilon_0.r_{e0}.c^2\right)^{-1}; \tag{7.8-7}$$

where: $\mp q_e$ is the electric charge of the electron or positron; ε_0 – dielectric constant of vacuum; r_{e0} – computational radius of electrons (electron and positron); *c* – velocity of electromagnetic waves (light) in vacuum.

In an external electric field $\vec{E}_i$ forces $\vec{F}_1$, which act upon the electric charges Q_1 and Q_2 are

$$\text{a) } \vec{F}_1 = Q_1.\vec{E}_i = \left(\mp q_e\right).\vec{E}_i = m_1.\vec{a}_1;\ \text{b) } \vec{F}_2 = Q_2.\vec{E}_i = N\left(\mp q_e\right).\vec{E}_i = m_2.\vec{a}_2; \tag{7.8-8}$$

whence it follows that the accelerations $\vec{a}_1$ and $\vec{a}_2$ are obtained in this form

$$\text{a) } \vec{a}_1 = \frac{\vec{F}_1}{m_1} = \frac{\left(\mp q_e\right).\vec{E}_i}{\left(\mp q_e\right)^2.k_m} = \frac{\vec{E}_i}{\left(\mp q_e\right).k_m};\ \text{b) } \vec{a}_2 = \frac{\vec{F}_2}{m_2} = \frac{N.\left(\mp q_e\right).\vec{E}_i}{N.\left(\mp q_e\right)^2.k_m} = \frac{\vec{E}_i}{\left(\mp q_e\right)^2.k_m}; \tag{7.8-9}$$

I.e. the accelerations of the two masses m_1 and $m_2 = N.m$, are identical in values and directions

$$\vec{a}_1 = \vec{a}_2 = \frac{\vec{E}_i}{\left(\mp q_e\right).k_m}; \tag{7.8-10}$$

Or, similarly to the gravitational forces in the electric field, the accelerations of masses do not depend on their values.

7.9. TRANSVERSE GRAVITATIONAL FORCE AND THE SUN

The transverse gravitational force $\vec{F}_{\perp}$, which is perpendicular to the straight line passing through the centers of gravity of the two bodies, which attract each other by force $\vec{F}$, exists for all bodies, which have volumes $V > 0$.

This transverse force $F_{\perp}$ exerts transverse pressure directed perpendicularly to the Sun.

For instance, the seven planets and their moons (satellites) generate transverse pressures upon the Sun and these pressures move according to the motion of the planets along their orbits.

The transverse pressures p generate deformations on the Sun.

It is possible that in a certain moment of time the pressures of the planets overlap resulting in moments when there is synchronization of deformations, the resulting sum of which is maximal and causes eruptions on the Sun (magnetic storms on the Earth). This period of time may be eleven years, as it the period of maximal solar eruptions.

CHAPTER EIGHT
THERMODYNAMICS – THERMOELECTRODYNAMICS

8.1. INTRODUCTORY THOUGHTS*

The beginning of the studies of thermal manifestations, i.e. the manifestations of electromagnetic energy, was laid in times long before electromagnetic energy was discovered and used in practice.

This circumstance justifies the development of a science dedicated to thermal processes and named thermodynamics. More specifically, the term „thermodynamics" was introduced in 1854 by W. Thomson, who changed the original name of this section of physics, which had been called „mechanical theory of the heat". In general, the development of modern equilibrium thermodynamics is erroneously believed to have started in 1824 with the article "Reflections on the moving force of fire" by S. Carnot, where he proposed Carnot's cycle, instead of starting in 1822, when Fourier postulated his law of thermal energy.

On the development and the archaisms in thermodynamics, Prof. N. A. Kvasnikov** wrote in 2002:

"For historical reasons thermodynamics was created not by one generation of scientists, but by several generations, so there are a lot of viewpoints in it, various approaches, different formulations of the same questions, variety of designations, etc. This accounts for certain heterogeneity of material" and further (on p. 35) he wrote: **"Thermodynamics is not a unitary and universal theory. Its sphere of application and its capacities are limited." On p. 192 he also wrote: "The problems of thermodynamics can be solved without the notion of entropy… by using only immediately measurable quantities."** ***And further on, he also wrote:***

In § 1 (p. 17) he wrote: "As it was noted in the foreword, thermodynamics and statistical physics are not universal theory. Their sphere of application is strictly limited to the study of so-called thermodynamic systems. "

In § 3 (p. 36) he wrote: "Thermodynamics discusses only quasi-static processes. They are defined as infinitely slow processes, which consist of inexhaustible number of successive equilibrium states which hardly differ from one another; clearly, these processes ***are not real processes, but a special unreal boundary case****, the main advantage of which is that they are reversible, i.e. that there are no losses. "*

IN § 9 (P. 192) HE WROTE: "... WE HAVE SHOWN THAT THE PROBLEMS OF THERMODYNAMICS CAN BE SOLVED WITHOUT USING THE NOTION OF ENTROPY, OR CHEMICAL POTENTIAL AND SO ON, BUT BY OPERATING ONLY WITH IMMEDIATELY VARIABLE QUANTITIES. THE LATTER CIRCUMSTANCES MAKE THESE VERSIONS OF SOLUTIONS VERY ILLUSTRATIVE, AND THUS TO SOME EXTENT IS COMPENSATED THEIR ARTIFICIALITY, WHICH AT FIRST IS ASSOCIATED WITH THE NEED TO SEEK APPROPRIATE CARNOT'S CYCLE, ETC., AND ALSO WITH THE FEELING OF "ODDITY" IN THE SENSE OF STYLE OF PRESENTATION."

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* The author here uses popular terminology rather than scientific one.

** N. A. Kvasnikov. Thermodynamics and Statistical Physics. v. 1. Theory of Equilibrium Systems. Thermodynamics. (in Russian) Publ. Editorial URSS. Moscow. 2002.

This citation of Prof. Kvasnikov shows that:

- the solution of thermodynamic problems without entropy is much simpler and more illustrative;

- for Prof. Kvasnikov the simpler solution is without entropy, but since he (Kvasnikov) is accustomed to entropy, it seems to him that the treatment of thermal phenomena without entropy is artificial, instead of realizing just the opposite: that the solution with entropy is artificial, because it is in contradiction with the principle of scientific reliability and excellence and besides, entropy is questionable as to whether it is a physical quantity, for it is not measurable, and according to the principles of scientific reliability when something is not measurable, it lacks the property of scientific reliability. What is more, however, this unscientific value is treated as the second fundamental law of thermodynamics - a fact, which is a gross violation of the scientific character of thermodynamics, which cango without entropy or Carnot's cycle. In addition, with entropy, directly measurable quantities are also used. For example, Einstein wrote: "Of two theories, which explain a phenomenon equally well, the more perfect is the one that uses less initial formulations." Academician M. Markov[*] wrote: "Einstein summed up the issue of evolution of science with the words: "Evolution develops in the direction of ever increasing simplicity of its logical foundations." And Heisenberg in one of his works ("What does ' understanding' mean in theoretical physics") wrote: "It can still be deemed that the best criterion of the correctness of new ideas is the old Latin proverb "Simplex sigillum veri" (simplicity is a sign of truth), which was written in large letters in the lecture rooms at GöttingenUniversity.

- entropy is a gross violation of the scientific principles (scientific requirements) as presented above .

ON THIS ISSUE, THE LAST WORD BELONGS TO ISAAC NEWTON, WHO IN "PRINCIPLES ..." ON P. 96 WROTE: "WE ARE TO ADMIT NO MORE CAUSES OF NATURAL THINGS THAN SUCH AS ARE BOTH TRUE AND SUFFICIENT TO EXPLAIN THEIR APPEARANCES.". I.E. WE MUST USE THE PRINCIPLE OF SIMPLICITY - WITHOUT ENTROPY.

HERE WE MUST EMPHASIZE ONE OF THE REQUIREMENT ON SCIENTIFIC RELIABILITY, WHICH STATES: FOR A CERTAIN QUANTITY TO BE RECOGNIZED AS A SCIENTIFIC ONE, FIRST OF ALL IT MUST BE MEASURABLE, I.E. WITHOUT BEING ABLE TO MEASURE QUANTITATIVE VALUES OF A CONCEPT (NOTION), AS IS WITH THE NOTION OF ENTROPY, THERE IS NO SCIENTIFIC TRUTH IN IT. This requirement is necessary so that we can compare the quantitative values estimated for entropy with the ones measured in experiments (practice). Since this is the procedure for proving the reality of the laws of entropy. And as it is known, the quantitative values of entropy cannot be measured, nor is there a full algorithm for calculation of its quantitative values, according to Boltzmann's formula, respectively, the thermodynamic probability.

Another feature (essential weakness - flaw) of present-day thermodynamics is that it ignores the experimental fact, which has been known to humanity for centuries, that the electromagnetic waves - the photons[**] (light from the sun) are the expression of heat (thermal energy) i.e. that photons are heat energy, which is something material according to the modern idea that photons are a field form of electromagnetic matter (electromagnetic elementary particles), and which can be converted into a substantial form of electromagnetic matter.

It is a well-known experimental fact that atoms and molecules absorb and emit photons, but the photons absorbed by atoms (substantial form of electromagnetic matter) are absorbed by the electrons of the atoms, which move along orbits around the nuclei of the atoms. Subsequently, the electromagnetic energy of the photons $W_f = h.\nu$ (h - Planck's constant, ν - frequency of the photon) of the photon converts into magnetic (kinetic) energy $\Delta W_{He} = \Delta W_{Ke}$ of the electron, which is in the atom, i.e. the magnetic (kinetic) energy of the electron increases from W_{He}, before the absorption of the photon by $\Delta W_{He} = W_f = h.\nu$ after the absorption of the photon and becomes

$$W_{He} = W_{He0} + \Delta W_{He} > W_{He0}; \qquad (8.1\text{-}1)$$

[*] M. Markov. Unity and diverse forms of matter in the pysical picture of the world. (in Russian) Magazine "Nauka i zhizn", Publ. "Pravda" Moscow, issue 7, 1982.

[**] The notion of electron was introduced in 1926.

Since the sum of the magnetic (kinetic) W_{He} and the potential W_P energies, i.e. the full energy W of the electron is constant

$$W_0 = W_H + W_P = \text{const.}; \tag{8.1-2}$$

its potential W_P energy decreases, as follows

$$W_P = W_0 - W_{He} = W_0 - W_{He0} - \Delta W_{He}; \tag{8.1-3}$$

and the electron moves to a higher orbit.

During a photon emission by the atom, the electron that emitted a photon moves to a lower orbit.

The presented above shows that according presented present-day ideas, the mechanism of absorption of heat energy (photon energy, energy of the photon gas) by the atom, which is electromagnetic energy, the heat transforms into magnetic energy of the electron of the atom (molecule). And during emission of a photon by the atom, part of the magnetic (kinetic) energy of the atom (molecule) turns into a photon (a photon energy).

Here arises the question, what is the explanation of the availability of a photon gas.

The explanation is given by two experimental facts, with a meaning of experimental (empirical) laws, as follows:

First. Isaac Newton* in his book "Opticks..." of 1717 in a synthesized form presented the following experimental facts, which he observed:

"All bodies emit and absorb light."

" Bodies turn into light, and light into bodies."

"These are normal natural phenomena."

Here it should be pointed out that now it is known that light is a field form of electromagnetic matter in the form of electromagnetic waves (photons), while bodies are substantial form of electromagnetic matter - substance.

The above experimental laws proved by Newton in modern terminology would state:

First. "All substantial electromagnetic objects emit and absorb photons."

Second. "Substantial electromagnetic objects convert into photons (field electromagnetic matter), and the field objects from electromagnetic matter (electromagnetic waves – photons) convert into objects of substantial form of electromagnetic matter."

Third. "These are normal natural processes (phenomena)".

Indeed, there are such laws in present-day physics, but the most important conclusion from them has not been yet fully realized, namely, that all matter in nature (the unitary matter) is only electromagnetic. It is this idea that results in a most apparent and clear way from the above empirical laws, described by Isaac Newton in 1704.

Second. There is also a second experimental law analogous of the laws of Newton, this is the law of Gustav Kirchhoff from 1860, which states: ***"All bodies emit and absorb radiant (now electromagnetic – P.P.'s note) energy, whereby the ratio of the emitted W_i to the absorbed W_P energies is constant and does not depend on the kind of the bodies at equal temperature."***

Here follow the conclusions from Newton's experimental facts, only that they were not in such an obvious form.

Making allowances, however, for what Newton and Kirchhoff meant in their times, we can conclude that radiant energy is electromagnetic energy and that bodies emit and absorb electromagnetic energy, i.e. it follows that they should be homogenous in essence, because only objects of homogenous essence can interact. And here the homogenous essence is an expression of electromagnetic essence.

Newton's and Kirchhoff's experimental facts entail these laws:

First. ***Matter in nature is solely and only of electromagnetic essence, i.e. matter is only electromagnetic in field (photons) and substantial forms (states).***

Second. ***In the environment outside the bodies there are always (without interruption in space and the time) electromagnetic waves (photons), which according to modern terminology in physics form the notion of a photon gas, which is essentially in the form of the respective density of photons. And since the photons are the an expression of the carriers of thermal (electromagnetic) energy, it follows that in the environment there is a density of thermal energy, which essentially is electromagnetic energy of the electromagnetic waves (the photons).***

This essential fact about thermal energy is generally ignored in modern thermodynamics without any reason.

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* Newton I. Opticks or a treatise of the reflections, refractions, inflections and colours of light (in Russian). "Gostehizdat". M. 1954.

8.2. INCORRECT AND CORRECT APPROACHES IN THERMODYNAMICS OF THE GAS

With the application of statistical physics in thermodynamics, in the kinetic theory of gases it is assumed that only molecules are carriers of heat in the gas, i.e. thermal energy is synonymous only to the kinetic energy of molecules. At mass m_M *and mean statistical velocity* $\overline{v}$ *of molecules, the thermal energy of one degree of freedom is*

$$W'_{KM} = \frac{m_M.\overline{v}^2}{2} = \frac{1}{2}.k_B.T; \tag{8.2-4}$$

And for the three degrees of freedom it is

$$W_{KM} = 3.W'_{KM} = \frac{3}{2}.k_B.T = \frac{m_M.\overline{v}^2}{2}; \tag{8.2-5}$$

where: k_B is Boltzmann constant; T - temperature in degrees by Kelvin – K.

At a volume of the gas V_Γ with N molecules, to one molecule on average corresponds volume V_N of the gas, to which volume corresponds density n_0 of the molecules of the gas, i.e.

$$\text{a) } V_N = \frac{V_\Gamma}{N} = \frac{1}{N/V_\Gamma} = \frac{1}{n_0}; \text{ b) } n_0 = \frac{N}{V_\Gamma} = density\,(concentration)\,of\ molecules; \tag{8.2-6}$$

The mean statistical velocity of the molecules is

$$\overline{v}^2 = \frac{3.k_B.T}{m_M}; \tag{8.2-7}$$

And the velocity alters from zero to maximum, according to the probabilistic law of Maxwell.

$$\text{a) } k_B = 1{,}38\cdot 10^{-23}[J\cdot grad^{-1}]\cdot[J\cdot K^{-1}]; \text{ b) } \vec{v} = \left(\frac{3.k_B.T.\vec{r}_0}{m_M}\right)^{1/2}; \tag{8.2-8}$$

Here k_B has an experimentally established value.

But here it is not explained in what kind actually heat exists and in what way the molecule accumulates thermal energy W_{KM} (8.2-5). Since to obtain this mean statistical velocity, a molecule of mass m_M must experience an acting force $\vec{F}_T$, which should give it acceleration $\vec{a}$ and velocity $\vec{v}$.

$$\text{a) } \vec{a}_M = \frac{\vec{F}_T}{m_M} = \frac{d\vec{v}}{dt}; \text{ b) } d\vec{v} = \vec{a}.dt; \text{ c) } \vec{v} = \vec{a}_M.t = \left(\frac{3.k_B.T}{m_M}\right)^{1/2} = \frac{\vec{F}_T}{m_M}.t; \tag{8.2-9}$$

whence it follows that the force is

$$\vec{F}_T = \frac{\left(3.m_M.k_B.T.\vec{r}_0\right)^{1/2}}{t} = \frac{d\vec{P}}{dt}; \tag{8.2-10}$$

$$\text{a) } W = \int_0^t \vec{F}.d\vec{r} = \frac{\left(3.m_M.k_B.T.\vec{r}_0\right)^{1/2}}{t}.\vec{r} = \left(3.m_M.k_B.T\right)^{1/2}.\vec{v}; \text{ b) } \vec{r} = \vec{v}.t; \text{ c) } d\vec{r} = \vec{v}.dt; \tag{8.2-11}$$

Therefore, some notes should be made:

First. ***So far, thermodynamics has not given a specific answer as to how this velocity*** v ***is generated, so this fact is a good reason to reject this model where molecules are assumed to be the carrier of thermal energy because it is unknown how and why their motion becomes fluctuating.***

Second. ***It is known that thermal energy is transferred in a vacuum as well and that without any molecules (e.g. from the Sun to Earth), according to Stefan-Boltzmann's law***

$$\text{a) } W_T = \sigma.T^4 = w_f.c; \text{ b) } w_f = \frac{W_T}{c} = \frac{\sigma.T^4}{c} = \frac{W_T}{V_\Gamma}; \tag{8.2-12}$$

where: σ is Stefan-Boltzmann coefficient; w_f - density of energy of the photon gas, which is emitted from the surface of a body with surface temperature T, which is thermal (photon) energy in a unit of volume.

THIS REAL WAY OF TRANSFER (MOTION) OF THERMAL ENERGY DOES NOT NEED MOLECULES AS CARRIERS. AND THIS IMPLIES THAT MODERN THERMODYNAMICS IS NOT AN ACCOMPLISHED SCIENCE OF THERMAL PHENOMENA.

The density of thermal energy in a unit of volume of the gas expressed by the idea that the thermal energy in the molecule (the atom) is equal to the magnetic (kinetic) energy W_{TM} of N molecules in volume $V_{\Gamma M}$ of the gas, i.e.

$$W_{\Gamma} = N.W_{k_m} = N.\frac{m_M.\vec{v}^2}{2} = N.\frac{3}{2}.k_B.T = W_{TM} = W_{HT}; \tag{8.2-13}$$

It was shown in Chapter one, paragraph 4, that kinetic energy of bodies is magnetic energy as it was defined by Maxwell in "Treatise on electricity and magnetism" of 1873 in paragraph 638.

Obviously, the density of energy $w_{\Gamma M}$ is equal to the density of the photon energy

$$w_f = w_{\Gamma M} = \frac{W_{\Gamma M}}{V_{\Gamma M}} = n_0.\frac{m_M.\overline{v}^2}{2} = n_0.\frac{3}{2}.k_B.T; \tag{8.2-14}$$

This is not explicit in thermodynamics, although it is known that radiant thermal energy is electromagnetic (photon) energy of electromagnetic waves, but in the kinetic energy of molecules no such energy is discussed.

I.e. Stefan-Boltzmann's law does not comply with the idea of thermal energy as described in (8.2-13) and (8.2-14), or respectively, the availability of thermal energy from the Sun rejects the model in which only molecules are carriers of thermal energy.

Third. With regard to the transfer of thermal energy through a solid body, there is the 1822 Fourier's law

$$dQ = dW_T = -\lambda.\frac{dT}{dr}.dS.dt; \tag{8.2-15}$$

where: dQ is the quantity of thermal energy, which passes through surface dS of substance with coefficient of thermoconductivity λ for time dt.

Or we define as a thermal flow $\vec{j}$ per a unit of time through a unit of cross-section

$$\vec{j} = w_T.\vec{v}_T = \frac{-\lambda.(T_2 - T)}{dr} = -\lambda.\frac{\left[T(r+dr) - T(r)\right]}{dr}.T_{ro} = -\lambda.\frac{\partial T}{\partial .r}.\vec{r}_0;\ \vec{r}_0 = \frac{\vec{r}}{|\vec{r}|}; \tag{8.2-16}$$

where: w_T is density of thermal energy; $\vec{v}_T$ - the velocity of the density of thermal energy through substance of coefficient λ.

Here the density of the thermal energy in the substance is

$$w_T = \frac{j}{v_T} = -\frac{\lambda}{v_T}.\frac{\partial T}{\partial r} \rightarrow \frac{[\mathrm{J}]}{[\mathrm{m}^2]}; \tag{8.2-17}$$

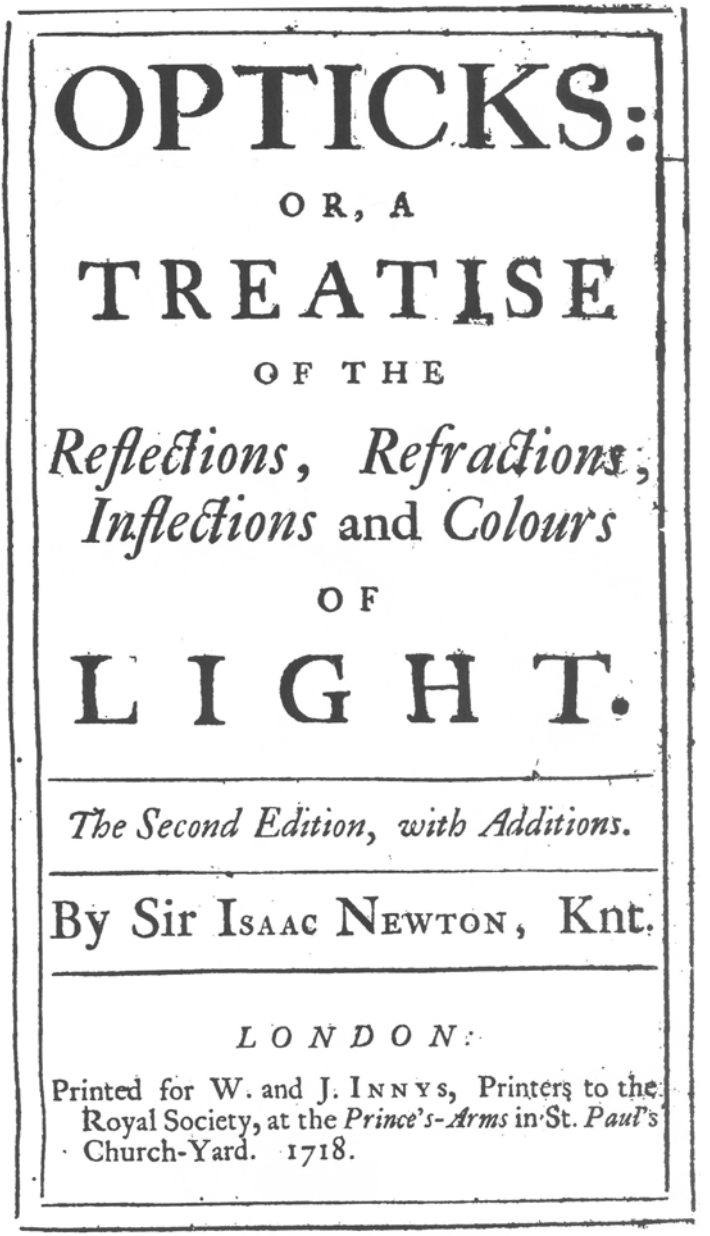
where: v_T is the velocity of motion of the density w_T of the thermal energy.

This law proves that:

Thermal energy moves from places of higher density of energy (temperature) to places of lower density of energy (temperature), i.e. essentially, here Maxwellian pressure holds true.

Thermal energy is electromagnetic energy – a fact, which follows from Stefan-Boltzmann's law, too.

Fourth. ***Newton, in the second edition of his book "Opticks…", whose faximile of its front cover is given in Fig. 8.2.1.***



OPTICKS:

OR, A

TREATISE

OF THE

Reflections, Refractions, Inflections and *Colours*

OF

LIGHT.

The Second Edition, with Additions.

By Sir Isaac Newton, Knt.

LONDON:

Printed for W. and J. Innys, Printers to the Royal Society, at the *Prince's-Arms* in St. *Paul's* Church-Yard. 1718.

D.

Fig. 8.2.1.

On p. 323 and 324 in this book it is written, and the text is given in Fig. 8.2.2 in the English of those times (1818)

Qu. 18. If in two large tall cylindrical Veſſels of Glaſs inverted, two little Thermometers be ſuſpended ſo as not to touch the Veſſels, and the Air be drawn out of one of theſe Veſſels, and theſe Veſſels thus prepared be carried out of a cold place into a warm one; the Thermometer *in vacuo* will grow warm as much, and almoſt as ſoon as the Thermometer which is not *in vacuo*. And when the Veſſels are carried back into the cold place, the Thermometer *in vacuo* will grow cold almoſt as ſoon as the other Thermometer. Is not the Heat of the warm Room convey'd through the *Vacuum* by the Vibrations of a much ſubtiler Medium than Air, which after the Air was drawn out remained in the *Vacuum*? And is not this Medium the ſame with that Medium by which Light is refracted and reflected, and by whoſe Vibrations Light communicates Heat to Bodies, and is put into Fits of eaſy Reflexion and eaſy Tranſmiſſion? And do not the Vibrations of this Medium in hot Bodies contribute to the intenſeneſs and duration of their Heat? And do not hot Bodies communicate their Heat to contiguous cold ones, by the Vibrations of this Medium propagated from them into the cold ones? And is not this Medium exceedingly more rare and ſubtile than the Air, and exceedingly more elaſtick and active? And doth it not readily pervade all Bodies? And is it not (by its elaſtick force) expanded through all the Heavens?

Fig. 8.2.2.

And in the next Fig. 8.2.3 is given the from Fig. 8.2.2, but in modern English

If in two large tall cylindrical Vessels of Glass inverted, two little Thermometers be suspended so as not to touch the Vessels, and the Air be drawn out of one of these Vessels, and these Vessels thus prepared be carried out of a cold place into a warm one; the Thermometer *in vacuo* will grow warm as much, and almost as soon as the Thermometer which is not *in vacuo (in vacuum)*. And when the Vessels are carried back into the cold place, the Thermometer *in vacuo* will grow cold almost as soon as the other Thermometer. Is not the Heat of the warm Room conveyed through the Vacuum by the Vibrations of a much subtler Medium than Air, which after the Air was drawn out remained in the Vacuum? And is not this Medium the fame with that Medium by which Light is refracted and reflected and by whose Vibrations Light communicates Heat to Bodies, and is put into Fits of easy Reflexion and easy Transmission? And do not the Vibrations of this Medium in hot Bodies contribute to the intenseness and duration of their Heat? And do not hot Bodies communicate their Heat to contiguous cold ones, by the Vibrations of this Medium propagated from them into the cold ones? And is not this Medium exceedingly more rare and subtle than the Air, and exceedingly more elastic and active? And doth it not readily pervade all Bodies? And is not (by its elastic force) expanded through all the Heavens?

Fig. 8.3.3

This experiment, conducted by Newton in 1818, entails the inference that not only gas molecules are carriers of thermal energy, according to equation (8.2-4), but carriers of thermal energy is also the photon gas, both in the solid substantial form of electromagnetic matter, as described by Fourier's law (8.2-15) of 1822, and in gases, and the photon has density of electromagnetic (photon) energy

$$w_f = \sum W_{fij} = h.\sum_{i=1;\ j\neq 0}^{i=n.j<10^{20}\ \mathrm{Hz}} \nu; \tag{8.2-18}$$

where: h is Planck's constant; ν_{ij} - frequency of the photons, whereby ν_i is number of photons in general, and ν_j - is number of the photons with different frequencies j.

The pressure P_f, which is exerted by w_f is

$$P_f = \frac{1}{3}.w_f; \tag{8.2-19}$$

And the thermal energy W_{fT} and the pressure $\vec{P}_{fT}$ of the photon gas in volume V_{fT} are

$$\text{a) } W_{fT} = w_f.V_{fT};\ \text{b) } \vec{P}_{fT} = \frac{w_{fT}}{c}.\vec{c}_0;\ \vec{c} = \frac{\vec{c}}{|\vec{c}|}; \tag{8.2-20}$$

The experimental facts presented above reject in a most categorical way the assumption that only molecules are carriers of thermal energy and reinforce by experimental facts the law that thermal energy is also transferred by the photon gas, which has a density of thermal energy w_f and generates pressure $\vec{P}_f$, which is generated when the energy of the photon $W_f = h.\nu$ is absorbed for time τ and momentum $\vec{p}_f = \frac{W_f}{c}.\vec{c}_0$ and force

$$\text{a) } \vec{F}_f = \frac{\vec{P}_f}{\tau};\ \text{b) } \vec{F}_{fT} = \frac{\vec{P}_{fT}}{\Delta t} = \frac{w_f}{\Delta r}.\vec{c}_0; \tag{8.2-21}$$

This force from the photon gas sets molecules of the gas in motion to velocity v, which is the same in the photon gas as the one in the probability of Maxwell for the gas molecules

$$v = \left(\frac{3.k_B.T}{m_M} \right)^{1/2}; \tag{8.2-22}$$

Here is should be specified that all atoms (molecules) continuously, but periodically emit and absorb photons with energy $W_f = h.\nu$, time τ whereby during the emission forces of recoil occur, and during the absorption of a photon a force of pressure occurs. These forces provide the motion of molecules. and they are proportional to the temperature (the density of the photon gas) between the molecules.

I.e. it is proved that not only molecules are carriers of thermal energy, since they are driven by the energy of the photon gas, whose photons move at velocity $\vec{c}$ and have a momentum

$$\vec{P}_f = \frac{W_f}{c}.\vec{c}_0 = \frac{h.\nu}{c}.\vec{c}_0; \tag{8.2-23}$$

The experiment of Newton, described in Bulgarian language in Fig. 8.3.4 poses the question, why both thermometers get heated almost simultaneously although a photon density of the energy acts in the vacuumed vessel as well as a density w_f of the energy of molecules, which have concentration n_0, see equation (8.2-14).

A probable explanation that in the vacuumed vessel the photon energy is distributed in the entire volume of mercury or alcohol, both in the reservoir and in the column that shows the degrees, while in the non-vacuumed vessel molecules act only on the reservoir of the expanding fluid (mercury or alcohol).

The characteristic features of the photon gas relative to the molecular gas are given in the following table

Table 8.2.1

Features of the molecules of an ideal gas and of a photon gas	
Molecules	Photons
1. $m_M = \text{const.};$	a) $c = \text{const.};$ b) $m_f = \frac{W_F}{c^2} \neq \text{const.};$
2. $W_{KM} = \varepsilon_M = \frac{p^2}{2m} = \frac{m\bar{v}^2}{2};$	a) $W_f = \varepsilon_f = h.\nu = p.c;$ b) $m_f.c^2;$
3. $N = \frac{N_0}{z}.\exp\left(-\frac{\varepsilon_f}{k_B.T}\right);$	$N_f = \frac{1}{\exp\left(\frac{\varepsilon_f}{k_B}\right) - 1};$
4. $N_0 = \text{const.};$	$N_f = \text{var.};\ \left(N_f \neq \text{const.}\right);$
5. $\vec{p} = m.\vec{v};$	$\vec{p} = m_f.\vec{c} = \frac{W_f}{c}.\vec{c}_0;$

The table shows the particularities of the photon gas relative to an ideal gas of *N* molecules. They are:

1) there is no distribution of the photons by momentum and velocity, since here their velocity is $v = c = const.$;

2) the number of the photons N_f is not constant, whereas the number of the gaseous particles (the molecules) N_0 *is* constant;

3) the mass of the photons is not constant $m_f = \frac{W_f}{c^2} \neq \text{const.};$

4) the energy of the individual photons is different $W_f \neq \text{const.}$, ***but the energy in the volume with ensemble of photons in a closed system is constant*** $W_{fT} = \sum W_{fi} = w_f.V_{fT} = \text{const.}$ The volume of the photon gas is V_{fT};

The energy of photons in a unit of volume - density of the energy of photons w_f is equal to part of the energy of the gas in volume V_{fT}, i.e. $w_f = \frac{W_{fT}}{V_{fT}}$. And the energy which belongs to one molecule W_{km} is equal to

$$W_{km} = \frac{m.\bar{v}^2}{2} = k_\Gamma \cdot \frac{W_{\Gamma N}}{N} = \frac{energy\ of\ gas\ molecules}{number\ of\ molecules}; \qquad (8.2\text{-}24)$$

where: $k_\Gamma < 1$.

In conclusion, the characteristic features of thermal energy are:

1. it is electromagnetic energy in the form of a photon gas – electromagnetic waves (of electric and magnetic fields);

2. it generates force when photons hit upon atoms and molecules;

3. it generates pressure when hitting upon atoms and the molecules;

4. it performs work via the force or pressure which it generates;

5. ***it moves from places of higher density of energy of photons (thermal energy) to places of lower density of the energy of photons or from places of higher pressure to places of lower pressure, or from places of higher temperature to places of lower temperature, since temperature is proportional to the density of photon energy, which is thermal energy.***

6. ***there is no place in nature, where there is no photon gas – electromagnetic matter and electromagnetic energy – thermal energy, as well as gravitational field. I.e. in each point of space between bodies as well as between molecules, as well as between planets, there is photon gas (thermal energy – electromagnetic energy) of respective density of the energy of the photon gas w_f, which is electromagnetic energy, like the energy which the Earth receives through the sun rays.***

Under these conditions analogous dependencies for the photon gas and the molecular gas are given in Table 8.2.2

Table 8.2.2.

Molecular gas	**Photon gas**
1. Energy of the molecular gas $W_{\Gamma M} = w_M.V_M$;	1. Energy of the photon gas $W_f = w_f.V_{If}$.
2. Volume of molecular gas $V_{\Gamma M} = \frac{W_{\Gamma M}}{V_M}$;	2. Volume of a photon gas V_{If}.
3. Density of the energy of the molecular gas $w_M = \frac{W_{\Gamma M}}{V_{\Gamma M}} = \bar{W}_{k_m}.n_0^{-1}$;	3. Density of the energy of the photon gas $w_f = \frac{W_f}{V_f} = \bar{W}_{k_m}.n_0^{-1}$.
4. Number of molecules N in $V_{\Gamma M}$, with masses m_M $N = n_0.V_{\Gamma M}$;	4. Number of the photons in V_{If} $N_f = \frac{1}{\exp\left(\frac{W_f}{k_B}\right)^{-1}} \neq \text{const.}; W_f = h.\nu;$
5. Concentration of molecules is $n_0 = \frac{N}{V_{\Gamma M}}$;	5. Concentration of photons $n_f = \frac{N_f}{V_{If}} \neq \text{const}.$
6. Mean statistical energy of one molecule $\bar{W}_{k_m} = \frac{m_M.\bar{v}^2}{2} = \frac{2.k_B.T}{2} = \frac{W_{\Gamma M}}{N} = w_M.n_0;$ where: k_B is Boltzmann constant.	6. Photon energy, which corresponds to volume V_N of the molecular gas on condition that: a) $W_{\Gamma M} = W_{If}$; b) $V_{\Gamma M} = V_{rf}$; is $W_{Nf} = V_N.w_M = \frac{w_M}{n_0}$
7. The volume, which belongs to one molecule $V_N = \frac{V_{\Gamma M}}{N} = \frac{1}{N/V_{\Gamma M}} = \frac{1}{n_0}$;	
8. Mean statistical velocity of one molecule $\bar{v}^2 = \frac{3.k_B.T}{2.m_M}.$	

Brief summary of paragraph 8.2

The considerations stem from two significant laws in thermodynamics.

First. Fourier's law of 1822

The thermal flow through the substance for a unit of area per second

$$j = -\lambda \frac{dT}{dr} = -w_B.v_j; \rightarrow \left[\mathrm{J.m^{-2}.s^{-1}}\right]; \tag{8.2-25}$$

where: λ is coefficient of thermoconductivity of substance (the substantial form) of electromagnetic matter; w_f – the substantial density of thermal (electromagnetic density) energy; v_j - the velocity of thermal energy in substance $\mathrm{grad}T = \frac{dT}{dr}.\vec{r}_0; \vec{r}_0 = \frac{\vec{r}}{|\vec{r}|}$.

Second. The law of Stefan-Boltzmann (1880 – 1884)

The emitted thermal flow of photon energy from a unit of area for a unit of time according to (8.2-18)

$$\vec{\Pi} = \sigma.T^4.\vec{c}_0 = \left[\vec{E}.\vec{H}\right] = h \sum_{i=1;\, j\neq 0}^{i=n;\, j<10^{20}\ \mathrm{Hz}} \nu_{ij} = w_f.\vec{c}; \rightarrow \left[\mathrm{J.m^{-2}.s^{-1}}\right]; \vec{c}_0 = \frac{\vec{c}}{|\vec{c}|}; \tag{8.2-26}$$

where: Π is Poynting vector; $\vec{E}$ and $\vec{H}$ are electric and magnetic fields; w_f - density of photon (electromagnetic) energy; c – velocity of electromagnetic waves (light) in vacuum.

It follows that $j = \Pi,$ because they are for a unit of area and a unit time, and it follows

$$\text{a) } j = \Pi = w_B.v_j = w_f.c;\ \text{b) } w_B = w_f.\frac{c}{v_j};\ \text{c) } w_f = \frac{w_B.v_j}{c} = \frac{\tau.T}{c};\ \text{d) } v_j = \frac{w_f.c}{w_B} = \frac{\sigma.T^4}{w_B}; \tag{8.2-27}$$

The presented above makes it evident and clear that:

1. Thermal energy is electromagnetic energy, i.e. electromagnetic laws of electrodynamics hold true for it under the specific conditions of thermal processes (photon gas) and the magnetic (kinetic) energy of molecules.

2. The ascertainment in the above item 1 entails that thermodynamics, as a specific electrodynamics, doe not need the three principles, because sufficient are the general physical laws of Newtonian electrodynamics:

a) unitary matter in the world is only electromagnetic matter in field and substantial forms;

b)there is a law of matter and energy conservation;

c) electromagnetic (photon) energy moves from places of higher density (higher temperature) to places of lower density, and

d) the lowest, threshold limit of the density of kinetic energy of physical objects tends to zero, i.e. the lowest temperature, to which thermal phenomena tend, is zero degrees Kelvin(0K).

3. The assumption that thermal energy is electromagnetic, on the hand, simplifies the principles of thermodynamics, on the other hand, makes it clearer and its regularities more general in terms of electromagnetic phenomena and, moreover, this is really important since it would alleviate its presentation with regard to the unity of science as is the evolutionary trend in the development of knowledge. The problems of thermodynamics of gases, liquid medium and substance could be reduced to a single, unitary science - thermoelectrodynamic theory of electromagnetic matter, i.e. thermoelectrodynamics.

8.3. WHAT IS THERMAL ENERGY

"A crucial prerequisite for the power of knowledge is not the belief in a reputedly infallible authority, but the irresistible power of experimental facts which irrefutably reveal the most reliable authority, Nature itself. The main criterion for this assertion is apparent – theory must not contradict to experimental facts – results."

8.3.1. Introductory thoughts

We should bear in mind that a scientific fact – logic in general, is a summary (interpretation) of experimental data, and therefore experiments are milestones on the road of logical constructions, in the sense of theoretical formulations in the form of laws and principles.

In this aspect, through interpretation of a wide range of natural manifestations (phenomena, processes, objects, etc.) the thesis of natural occurrences homogenous in their essence has arisen. I.e. that nature is one homogenous whole and that it is synonymous with unitary (homogenous) matter, called a material continuum as well. I.e. there is a material unity of natural phenomena – natural occurrences.

This fact of material unity is the objective basis predetermining the availability of unitary science of nature, as a whole called Newtonian electrodynamics (as presented in Chapter One herein) as one whole. This science studies the nature of manifestations as expressions of unitary electromagnetic matter which is synonymous to the notion of nature and which manifestations together make up one whole. In this way, the manifestations of its parts (fragments), the parts of matter, which have a relative independence, are also parts of one whole - nature In this sense, the science of thermodynamics is a specific case of the science of thermal manifestations of electromagnetic matter.

In this sense, the unity of the knowledge about nature, which also includes thermodynamics, as a whole, is predetermined by the facts that:

a) matter of nature is homogenous in essence and is called electromagnetic matter, i.e. it is formed of unknown homogenous initial resource (substance);

b) knowledge of matter is generated by reflections of manifestations (properties) of homogenous matter in the human mind.

c) the system of knowledge about all natural facts, incl. thermal phenomena, which are knowledge of the manifestations of electromagnetic matter, forms a unitary science of nature, whose basis (root) is Newtonian electrodynamics. The motivation of this assertion is the circumstance that there is no natural phenomenon in the root of which there is no movement of electromagnetic matter in a field or substantial form at micro or macro levels.

The facts set forth here entail the apparent natural law, which states:

ALL NATURAL OCCURRENCES ARE MATERIAL SINCE THEY ARE FORMED ONLY OUT OF ONE SOLE HOMOGENOUS INITIAL RESOURCE OF UNKNOWN ESSENCE, OCCURRING IN DIVERSE STRUCTURES, IN THE FORM OF A SUBSTANTIAL OR FIELD FORM AND IN DIFFERENT STATES OF REST AND DEVELOPMENT.

IN THIS SENSE IS ALSO THE WELL-GROUNDED INFERENCE (ASSERTION) THAT THE ESSENCE OF THE NOTION OF THERMAL ENERGY IS ALSO AN EXPRESSION OF SOMETHING MATERIAL, I.E. IT S ENERGY FORMED OUT OF HOMOGENOUS MATTER – OUT OF ELECTROMAGNETIC MATTER.

8.3.2. Essence of the answer to "What is thermal energy?"

The laureate of Nobel Prize in physics, Richard Feynman in his book "Feynman's Lectures" writes, **"even today it is not known what energy represents."**

However, proceeding from the thesis that a scientific fact (law, principle) is in essence an interpretation of summarized experimental results and therefore serves as a milestone of logical constructions, i.e. of theoretical formulations: definitions, laws and principles.

Then, with regard to this definition, interpretations and logical conclusions can be made in view of defining the meaning of the notion of energy and pointing out some essential circumstances, which bear relevance to the notion of thermal energy ,and energy in general, as follows:

1. ***There is a law of conservation of energy and mass which are inseparable tandem*** T_{w-m}**.**
2. ***There is a law of the relationship between energy W and mass (quantity of matter) m, i.e.:***

$$W = m.c^2 \tag{8.3-1}$$

where: c is the velocity of electromagnetic waves (light) in vacuum

3. ***There is a thesis (law) that matter (mass) is of homogenous essence, which is of electromagnetic essence – electromagnetic matter.***
4. ***Matter is in permanent motion.***

The above facts entail the following conclusions:

First

ENERGY IN GENERAL, INCLUDING THERMAL ENERGY, IS INSEPARABLE FROM MATTER AND IN ESSENCE IS MATTER IN A STATE OF MOTION, BECAUSE WERE IT NOT IN THE FORM OF MATTER THERE WOULD NOT BE POSSIBLE TO STATE THAT IT COULD BE CONSERVED SINCE ONLY OF SOMETHING MATERIAL CAN WE STATE (ARGUE) THAT IT IS CONSERVED.

Second

Energy in general, including thermal (electromagnetic) energy, is essentially is a typical state of matter, which is in a real or potential (explicit or implicit) state of motion.

Third

Energies W, including thermal energy, are homogenous in essence, as well as matter is - a fact, which is a direct result from the law $W = m.c^2$**.**

AND SINCE ON THE ONE HAND MATTER, WHICH IS A CARRIER-GENERATOR OF THERMAL PHENOMENA, IS HOMOGENOUS, AND ON THE OTHER HAND THERE IS ONLY ELECTROMAGNETIC MATTER, THEN IT FOLLOWS THAT THERE IS NO OTHER KIND OF MATTER, WHICH IS A CARRIER AND GENERATOR OF THERMAL PHENOMENA, BUT ELECTROMAGNETIC, HENCE THEREFORE, THERMAL PHENOMENA ARE ELECTROMAGNETIC PHENOMENA.

The reason for this assertion is the circumstance that if there were another kind of matter beside electromagnetic, then matter in nature would not be homogenous, i.e. nature would not be one homogenous in essence whole. ***THE CONDITION THAT MATTER IS HOMOGENOUS AND THE LAW*** $W = m.c^2$ ***REFERS TO IT, ENTAILS THE UNCONDITIONAL INFERENCE THAT ENERGY AS WELL, INCLUDING THERMAL ENERGY, IS ALSO SOLELY HOMOGENOUS IN ESSENCE, BUT IT CAN APPEAR IN DIFFERENT STRUCTURAL STATES OF ELECTROMAGNETIC MATTER***. For instance, these correspond to different structural states of electromagnetic matter a) independent electric charges (electrons and positrons); b) electric field; c) magnetic field and d) gravitational field; e) electromagnetic waves of various frequency which are generated by electrons and positrons in explicit or implicit form as electrons and positrons. To these fields correspond respective kinds (structural states) of energy. I.e. to the different structural states of electromagnetic matter correspond respective energies. **OR** ***ENERGY IS AN EXPRESSION OF THE RESPECTIVE STATE OF MATTER, I.E. THERE IS NOT ANY INDEPENDENT ENERGY WITHOUT A RESPECTIVE QUANTITY AND STATE OF ELECTROMAGNETIC MATTER, JUST AS THERE IS NOT ANY MATTER WITHOUT A RESPECTIVE QUANTITY OF ENERGY.***

By the beginning of 20th c. it had become clear that thermal energy is electromagnetic wave (radiation) energy in the form of an ensemble of electromagnetic radiation, which were later called photons, and their ensemble is called photon gas. This fact is evident in the publications of G. Kirchhoff in 1860, L. Boltzmann in 1884, Max Planck in 1900, J. C. Maxwell in 1873 and in the experimental results of P. Lebedev in 1900, who proved Maxwell's thesis that to the energy of photons W_f which are carried by light rays corresponds (generates) momentum $\vec{p}_f$, respectively pressure $p = \frac{1}{3}w$ (where w is the density of wave electromagnetic energy) and that is why photons can perform work, i. e. for the electromagnetic energy, Maxwell's pressures hold true.

THERE IS A THESIS IN PHYSICS THAT THE DYNAMIC FORM OF THERMAL ENERGY W_T ***OR THE THERMAL MASS*** $m_T = W_T / c^2$ ***ARE EXPRESSION OF THE ENERGY (MASS) OF THE PHOTON GAS, AT LOWER FREQUENCIES (ABOUND AND BELOW 1012 Hz). BUT ESSENTIALLY THE PHOTON ENERGY (ELECTROMAGNETIC ENERGY) FOR ALL FREQUENCIES OF THE PHOTONS, UNDER RESPECTIVE CONDITIONS MAY OCCUR AT RESPECTIVE CONDITIONS AS THERMAL ENERGY. IN THIS SENSE, THERMAL ENERGY IS A FIELD FORM OF ELECTROMAGNETIC MATTER, IN***

THE FORM OF PORTIONS (PHOTONS) OF ELECTROMAGNETIC WAVES .AND IT IS EXACTLY THE ENERGY OF THESE WAVES, WHICH IS ELECTROMAGNETIC ENERGY AT A RESPECTIVE FREQUENCY, IS ALSO THERMAL ENERGY. IN THIS ASPECT, IN THE PHYSICAL SENSE, I.E. IN ESSENCE, THERMAL ENERGY IS EQUAL TO ELECTROMAGNETIC ENERGY OF ELECTROMAGNETIC WAVES, AND THE MAGNETIC ENERGY OF ATOMS (MOLECULES)IS A POTENTIAL FORM OF THERMAL ENERGY.

However, electromagnetic energy of electromagnetic waves, depending on frequency ν of the waves, has various characteristic features (properties), which result mainly from the energy and the mass of one quantum of electromagnetic waves. Here, a quantum is assumed to be a sum of a series of n waves, bound in one impulse of duration τ seconds with a dominant frequency ν, which are emitted by an electron or the nucleus of an atom.

It should be pointed out here that there is also emission of a quantum of energy by atom nuclei, but they are very rare and at very high frequency, far above the thermal one (10^{12} Hz) and only their secondary manifestations may have a direct thermal effect, although as a whole they can manifest under respective condition as thermal energy as well.

The energy of a quantum of electromagnetic waves, called a photon, is determined by this formula

$$W_f = h.\nu; \tag{8.3-2}$$

where: h is Planck's constant; ν – frequency of waves.

Depending on the frequency ν of the rays, electromagnetic waves are classified in groups, for instance

a) $\nu \geq 10^{21}$ Hz – gamma rays;

b) $\nu \approx 10^{19}$ Hz – X-rays;

c) $\nu \approx 10^{15}$ and $\nu \approx 10^{14}$ Hz – ultraviolet rays;

d) $\nu \approx 10^{15}$ Hz – visible rays;

e) $\nu \approx 10^{14}$ Hz – infrared rays;

f) $\nu < 10^{12}$ Hz – thermal rays.

In general, every quantum of electromagnetic energy can turn into thermal energy; therefore, all electromagnetic waves are carriers of thermal energy, but due to the properties of the structures of material objects, which react with photons in a variety of ways depending on the frequency of the absorbed electromagnetic energy, which has influence upon them, or they react in a variety of ways to the thermal components of electromagnetic energies of photons.

Moreover, there are electromagnetic energies of such frequency that none of the structures of objects can absorb and these energies pass freely through them - for instance, just as light through glass objects.

These circumstances explain the rule that when an object experiences electromagnetic energies (waves), it reacts to them in a different way depending on its structure and the frequencies of the waves that influence it.

Therefore, the same electromagnetic waves (photons) can manifest in some structures of electromagnetic matter as explicitly thermal, and in others – as explicitly light (in transparent structures).

In general however, the mechanism of emission (generation) and absorption of photons by particles of substance is one and the same. Subsequently, the mechanism of absorption and emission of thermal energy (heat) is also one and the same, i.e. the mechanisms of interaction of electromagnetic energies are governed by the same principles.

Emphasis

An irresistible proof that the essence and carrier of thermal energy $Q = W_T$ are electromagnetic waves, described in the form of a photon gas, is the following experimental fact:

It is known that thermal energy Q for heating of premises (rooms) is hot water (in liquid and evaporated state), which passes through the heating radiators. However, the thermal energy, which heats the premises is not in the form of water, but in the form of electromagnetic waves (photon gas), which, as a result of Maxwell's pressure, accelerate the molecules of air – they heat the air in the room.

The mechanism of transfer of thermal energy Q from the hot water in the radiator is not via transfer of water molecules from inside the radiator to outside the room, but via:

First. ***Transfer of radiant electromagnetic energy, emitted by the molecules of water to the walls of the radiator, and they attain temperature T_P, but they do not absorb water molecules, i.e. the molecules do not leave the water.***

Second. ***Thermal energy Q, obtained within the radiator by the water in the form of a photon gas and, according to Fourier's law (8.2-15), it is transferred to the external surface of the radiator at temperature T_P, as a result of its temperature T_P, according to Stefan-Boltzmann law, and is emitted in the room at temperature $T_0 < T_P$, without transferring a single water molecule, but only of photons in the form of a photon gas.***

This thermal energy Q_P emitted in the room by a unit of area on the radiator at temperature T_P, according to Stefan-Boltzmann law is

$$Q_P = k_\sigma.\sigma.\left(T_P^4 - T_0^4\right); \tag{8.3-3}$$

Therefore, it is the photon gas that manifests in the room , at density of photon energy w_f, which is in direct contact with the objects in the room and with the molecules, which get accelerated to a higher velocity and at the same time absorb photon energy converting it into magnetic (kinetic) energy of molecules. Under these conditions, the objects constantly emit photons and absorb photons, according to the laws of Newton (1704) and Kirchhoff (1860), until temperature T_f, which corresponds to the photon gas becomes equal to temperature T_0 (the temperature of the objects in the room) . ***The experimental fact thus described makes it evident that thermal energy Q is not carried by the molecules of the substance, but the molecules only emit photons, i.e. portions of thermal energy are emitted in the form of photons or photons are the essence and the carriers of thermal energy.***

In this sense thermodynamics, as a science studying thermal energy, should study the manifestations of photons and of the photon gas, i.e. thermodynamics is electrodynamics of photons – the photon gas.

In this sense all sections of physics study the manifestations of electromagnetic matter, i.e. they are sections of the science of electrodynamics under various conditions (situations).

The experiments of Seebeck and Peltier show direct interconvertibility of thermal energy in electromagnetic energy and vice versa.

The presented above proves the fact that thermal processes are electromagnetic phenomena, and this fact leads to the inferences that

- ***IN GENERAL, THERMODYNAMICS IS ELECTRODYNAMICS UNDER RESPECTIVE SPECIFIC CONDITIONS;***
- ***THERMODYNAMIC PROCESSES DESCRIBE THE CONVERSION OF ELECTROMAGNETIC ENERGY FROM ONE FORM INTO ANOTHER (ELECTROMAGNETIC WAVES INTO MAGNETIC ENERGY AND VICE VERSA);***
- **SO THAT PHYSICS IS UNIFIED, IT IS REQUIRED THAT THERMODYNAMICS SHOULD BE RATIONALIZED, IN ASPECT THAT IT IS A SPECIFIC PART OF ELECTRODYNAMICS, WHICH CIRCUMSTANCE WOULD PERFECT IT IN THE SENSE OF THE PRINCIPLE OF SIMPLICITY, SINCE:**

FIRST, PHYSICS WOULD USE THE ALREADY KNOWN LAWS OF ELECTRODYNAMICS, AND

SECOND, PHYSIC WOULD USE A FEWER NUMBER OF SPECIFIC THERMAL QUANTITIES AND LAWS, I.E. IT WOULD BE SIMPLIFIED, AND THUS MORE PERFECT.

General formulations on thermal energy

It has been known since Antiquity that the Sun emits a flow of heat upon the Earth via light rays without atoms or molecules, i.e. neither atoms, nor molecules are carriers of thermal energy in a dynamic (real) state.

In modern terms, the flow of light rays is a flow of elementary field electromagnetic particles, which are called photons. They are carriers of electromagnetic energy W_f, electromagnetic mass (matter) m_f and electromagnetic momentum $\vec{P}_f$, i.e.

$$\text{a) } W_f = h.\nu \text{ ; b) } m_f = W_f / c^2 \text{ ; c) } \vec{P}_f = m_f.\vec{c} = \frac{W_f}{c}.\vec{c}_0; \vec{c}_0 = \frac{\vec{c}}{|\vec{c}|} \text{ ;} \tag{8.3-4}$$

This photon energy W_{fm} being a sum of photons, in a certain aspect is thermal energy W_{fm}, thermal mass m_{fT} and thermal momentum $\vec{P}_{fm}$, i.e.

$$\text{a) } W_{fm} = W_f \text{ ; b) } m_{fm} = m_f \text{ ; c) } \vec{P}_{fm} = \vec{P}_f \text{ ;} \tag{8.3-5}$$

The presented clearly shows that a given quantity of thermal energy from the Sun W_{fc} is a sum of photon energy

$$W_{fc} = \sum_{1}^{n} W_{fm} \; ; \tag{8.3-6}$$

while not containing a single atom or molecule, i.e. the transfer of thermal energy from one object, the Sun, to the other object, the Earth, is not achieved via atoms or molecules, but only via elementary particles, photons. I.e. the essence of thermal energy in the form of portions (quanta),apart from atoms (molecules) which are carriers of magnetic energy, which is a carrier of potential photons (potential thermal energy), are the photons, which are carriers of real (kinetic) thermal energy in the form of a flow of photons, a typical example of which is a laser ray, as well as in the form of a photon gas, which occupies all the world space – there is no space in the world without a photon gas.

Thermal energy in the form of a photon flow is described by Stefan-Boltzmann law

$$\Pi = k_{\sigma} \sigma . T^4 \; ; \tag{8.3-7}$$

where: Π is the flow of thermal energy for a unit of time – power of the energy of the photon, emitted from a unit of area of the substance; T – temperature of the emitting substance in degrees by Kelvin – K, k_{σ} and σ – physical constants.

The fact that all bodies (objects) emit and absorb light (light photons) was first experimentally discovered and described by Isaac Newton in his book "Opticks..." in 1704. Newton's discovery in a synthesized form states:

"All bodies emit and absorb light."

"Bodies turn into light, and light into bodies."

"This is a normal natural process."

"Light is a flow of small bodies, which move at velocity c (the velocity of light in vacuum)."

These facts, without quoting Newton, are described as Kirchhoff law in 1860 in the following sense:

All bodies emit and absorb radiant energy, whereby the ratio of the emitted to the absorbed energy depends on frequency ν and temperature T, but it does not depend on kind of the body, i.e.

$$K_W = \frac{\text{emitted energy}}{\text{absorbed energy}} = f(\nu . T) \; ; \tag{8.3-8}$$

This law, as well as the law of Newton, means that matter (mass) of all natural objects is homogenous and is only of electromagnetic essence – it is electromagnetic matter.

The motivation of this inference, which has the rank of a fundamental principle in the theoretical basis of physics is the genetic principle, which states "The cause is the genetic basis of the effect" or "The generator and the generated are genetically homogenous". This natural (intrinsic) principle is often ignored in physics, especially in the section of elementary particles.

IN THIS ASPECT, THE CARRIER AND THE ESSENCE OF THERMAL ENERGY, ACCORDING TO NEWTON AND KIRCHHOFF, ARE ELECTROMAGNETIC RAYS (WAVES), I.E. THERMAL ENERGY IS ELECTROMAGNETIC MATTER OR ELECTROMAGNETIC ENERGY IN A FIELD FORM.

Evidently, electromagnetic waves (rays) nowadays play the role of the "thermal fluid" of the earlier stages of development of the science about heat.

In reality, in nature, without photons no transfer of thermal energy may ever occur, and thermal energy is a field electromagnetic matter (mass) which is in peramnent motion.

Here some questions arise as to how substance (atoms and molecules) emits and absorbs photons.

The answer is given by the modern law: the law of conservation and conversion of energy from one state into another.

When a photon of energy W_f and momentum $\vec{P}_f$ hits upon an electron, which is in an atom orbital and has magnetic energy W_{H0} and velocity v_{e0}, it is absorbed by the electron (its velocity v increases) and so increases its magnetic (kinetic) energy from W_{H0} to

$$\text{a) } W_{HR} = W_{H0} + W_f > W_{H0} \; ; \; \text{b) } W_{H0} \equiv v^2 ; \tag{8.3-9}$$

and releases a respective momentum of motion to it.

In conformity with the conservation of the thermal balance of the atom relative to the photon gas in the environment (the surrounding temperature T), atoms emit photons (thermal energy).

The photon gas (or more precisely, the density of the photon energy) is what can be felt when approaching an object, and not the energy of the atom, which absorbed or emitted the photon.

Here it should be pointed out that photons, as wave processes, have momentum $\vec{P}_f$, which is absorbed by the electron of the atom for time τ, the result of which is a force, which acts upon their atom and has a value

$$\vec{F}_f = \vec{F}_\tau = \frac{\vec{P}'_f}{\tau} = \frac{W_f}{c}.\frac{1}{\tau} = \frac{W_f}{\Delta r};\ \Delta r = c.\tau; \tag{8.3-10}$$

This force sets the electron, respectively the atom into motion in direction of the momentum $\vec{P}_f$. The many photons, which hit upon the atom set it into oscillation around a middle point. An analogous, but opposite effect, called recoil effect is obtained during emission of photon.

Since atoms on the surface emit photons (generate forces, respectively, pressure, which is a force per a unit of area) toward the inside of the object, their oscillating movements are transmitted to the inside, as there exist photons between atoms as well.

The particles (molecules) of the gas are always in a gas of photons, i.e. the particles of the gas are always molecules and photons.

The energy density w_f of the photon gas, to which is proportional temperature T

$$T \equiv w_f; \tag{8.3-11}$$

In a gas of substantial particles (molecules), their velocity is proportional to the energy, which they obtain from the photons – Maxwell's pressure of photons, respectively from the density of photons.

In this sense, the atom itself is not a direct carrier of the photon, but it is a carrier of potential form of thermal energy and concurrently it emits photons, i.e. it is a source (generator) of photons, of explicit form of thermal energy, because it emits a photon as well as absorbs phonons from the outside, and – through the phonons which are thermal energy –the latter interacts with the substantial form of electromagnetic matter..

In this sense, a quantity of matter (mass) $m_T = W_T / c^2$, *which interacts with the substance, corresponds to thermal energy* W_T

The maximal dimension of the cross-section of the photon and the length l_f of the photon, according to some researchers, are about

$$\text{a) } D \approx 10^{-7}\ \text{m; b) } l_f = 3\ \text{m;}; \tag{8.3-12}$$

These data are for their effective values, which are used in the computations. In reality, the lengths are longer, but with heavily decreasing power at the end of the photon.

The action of the photons is illustrated by the following examples:

The power of electromagnetic waves – a flow of photons according to Stefan-Boltzmann law is

$$\Pi = k_\sigma \sigma . T^4 = w_T . c = \sum h\nu_i = c.\sum w_{fi};\ w_{fi} = h.\sum \nu_i; \tag{8.3-13}$$

where: k_σ – Stefan-Boltzmann constant; $k_\sigma < 1$ - accounting for the influence of the surface which, with a black body, emits $k_\sigma = 1$ T – temperature in K; $w_f = h\sum \nu_i$ – density of the energy of photons with various ferquencies; h – Planck's constant; ν_i – frequency

Photons are characterized by energy W_f, mass m_f, momentum $\vec{P}_f$ and force $\vec{F}_f$, as follows

$$\text{a) } W_f = h.\nu;\ \text{b) } m_f = W_f / c^2;\ \text{c) } \vec{P}_f = W_f / c\ .\vec{c}_0;\ \text{d) } \vec{F}_f \approx \frac{P_f}{\tau} = \frac{W_f}{c.\tau} : \vec{c}_0 = \frac{\vec{c}}{|\vec{c}|}; \tag{8.3-14}$$

upon a unit of surface, which, when reduced for surface S, are

$$\text{a) } \vec{P}_S = \vec{P}_n.S = S.\sum \vec{P}_f;\ \text{b) } \vec{F}_S = \vec{F}_n.S = \frac{d\vec{P}_S}{dt} = \frac{d}{dt}\left(\vec{P}_n.S\right); \tag{8.3-15}$$

That is why when the electromagnetic waves (photons) hit upon an object (body) with mass m_0 they impart to it acceleration $\vec{a}_i$, velocity $\vec{v}_i$ and kinetic energy.

Significant features of electromagnetic waves are:

a) ***They are carriers of energy, which, according to Maxwell, is absorbed and converted into kinetic (magnetic) energy of the object (body) that has absorbed it. As a result of this, the dynamic state and the structure of the object may be changed.***

b) ***They have momentum, which generates pressure and force upon the object that has absorbed them with the respective consequences: they impart to it acceleration and velocity during the time of their action Δt.***

It is known from Stefan-Boltzmann law that the carrier of thermal energy are photons of frequencies from $v = 1$ to $v \to \infty$, whereby thermal (electromagnetic) energy, emitted by a unit of surface in vacuum, which is in the density of photon energy, is:

$$w_T = Q = \int_0^{\infty} w_v . \mathrm{d}V = \sigma . T^4 = h . \sum_{i=1,\, j=0}^{i=n,\, j=\infty} v_{ij} = \frac{\Pi}{c} = \frac{\left[E . \vec{H} \right]}{c}; \tag{8.3-16}$$

where:

$$\Pi = k_\sigma \sigma . T^4 = \left[\vec{E} . \vec{H} \right] = w_T . c; \tag{8.3-17}$$

is Poynting vector. To the density of thermal energy corresponds the density of the mass of the quantity of electromagnetic (thermal) energy.

$$\rho_T = \frac{w_T}{c^2} = \frac{\Pi}{c^3} = \frac{\left[\vec{E} . \vec{H} \right]}{c^3} = \frac{k_\sigma . \sigma . T^4}{c^3}; \tag{8.3-18}$$

8.4. TEMPERATURE IS PROPORTIONAL TO THE DENSITY OF THERMAL ENERGY

1. Gaseous particles (molecules) moving at velocity $\vec{v}$ with mass m constantly emit and absorb photons and are in a medium of photon gas.

Let in a unit of volume of the gas there are n_0 molecules (the concentration of the molecules is n_0), and the densities of the energy and mass of the photon gas are w_f and ρ_f ($w_\mathrm{f} = \rho_\mathrm{f} . c^2$). As a result of the forces (momentums) pressure and of recoil, which atoms (molecules) receive from the momentums $\vec{P}_\mathrm{f} = W_\mathrm{f} \big/ \mathrm{c} \, . \vec{c}_0$ of the photons during emission and during absorption they are set into motion at velocity v_i and receive kinetic energies W_{kMi} at a mean statistical square of velocity $\overline{v}^2$. The mean statistical square of velocity $\overline{v}^2$ determines the mean kinetic energies of the molecule W_{kM} and of the density of the energy of the gas w_{kT}, as follows, at mass *m* of the molecules

$$\text{a) } W_\mathrm{kM} = \frac{m_M . \overline{v}^2}{2} = \frac{3}{2} k_B . T \text{ ; b) } w_\mathrm{kT} = n_0 . W_\mathrm{kM} = n_0 . \frac{3}{2} . k_\mathrm{B} . T = w_\mathrm{f} \text{ ;} \tag{8.4-1}$$

The pressure of the gas is

$$p_\mathrm{r} = \frac{1}{3} w_\mathrm{kT} = \frac{1}{3} n_0 . k_\mathrm{B} . T \text{ ;} \tag{8.4-2}$$

An elastic collision of the molecule generates pressure

$$p_\mathrm{r} = \frac{2}{3} w_\mathrm{KT} = \frac{2}{3} n_0 . k_\mathrm{Б} . T \text{ ;} \tag{8.4-3}$$

2. ***Because of the high velocity "c" of the photons, their distribution in a finite volume is always uniform, since their time of relaxation is practically about $\tau < 10^{-6} s$.***

3. The collisions between the molecules are believed to be about 10^9 per second and it is accepted that they are fully elastic.

4. From (8.4-1) we determine the temperature

$$\text{a) } T = \frac{2}{3} . \frac{W_\mathrm{KM}}{\mathrm{k_B}} \text{ ; b) } T = w_\mathrm{KT} . \frac{3}{n_0 . k_\mathrm{B}} \text{ ;} \tag{8.4-4}$$

From (8.4-4) it is evident that the temperature is proportional to the density of the thermal energy w_{KT}. And in electrodynamics, according to Maxwell's law on pressure, the thermal energy (which is electromagnetic energy) W_T and its mass m_T $\left(W_{\text{T}} = m_{\text{T}}.c^2\right)$ (the molecules) move from places of a higher density of energy w and of the mass $\rho = \frac{w}{c^2}$ to places of lower w and ρ. *From here, according to the laws of electrodynamics, the thermal energies W_T and mass m_T also move from places of higher temperatures to places of lower temperatures.* **THAT IS ESSENTIALLY THE SECOND PRINCIPLE OF THE THEORY OF THERMAL PHENOMENA, NOT ENTROPY. I.E. THE SECOND PRINCIPLE OF THERMODYNAMICS IS ALSO AN ELECTROMAGNETIC LAW.**

8.5. GENERATION OF THERMAL ENERGY

8.5.1. General formulations

In 1900, Max Planck proved by laws, described by formulae, the subsequences of Isaac Newton's experiments, described in paragraph one of Chapter One, that the atoms (molecules) constantly at short intervals of time, emit and absorb electromagnetic energy in the form of short-lasting impulses (for a time of the order of $\Delta t \approx \tau \equiv 10^{-8}\text{s}$) of electromagnetic energy in the form of packets of electromagnetic waves, called photons. Photons have energy W_{fi}, mass m_{fi}, momentum $\vec{P}_{\text{fi}}$ and force $\vec{F}_f$, i. e.

$$\text{a) } W_{\text{fi}} = h.\nu_{\text{i}}\text{ ; b) } m_{\text{fi}} = W_{\text{fi}}/\text{c}^2\text{ ; c) } \vec{P}_{\text{fi}} = m_{\text{fi}}.\vec{c} = W_{\text{fi}}/\text{c}.\vec{c}_0\text{ ; d) } \vec{F}_{\text{fi}} = \frac{d\vec{P}_{\text{fi}}}{\text{dt}} = \frac{dW_{\text{fi}}}{\text{dr}}.\vec{c}_0\text{ ; } \vec{c}_0 = \frac{\vec{c}}{|\vec{c}|}\text{ ;} \tag{8.5-1}$$

A surface of a substance (body) with an area $S = 1$ for a unit of time $t = 1$ according to Stefan-Boltzmann law (1879-1984) emits power N of electromagnetic energy of an ensemble (gas) of photons which generate pressure $\vec{p}_{\text{п}}$, density of energy W_{Π}, force $\vec{F}_{\Pi}$ and power N_{Π}, as follows

$$\begin{aligned}&\text{a) } \vec{N}_{\Pi} = \frac{\text{d}W_{\Pi}}{\text{d}t}.\vec{c}_0 = \vec{\Pi} = \sigma.T^4.\vec{c}_0 = w_{\text{п}}.\vec{c} = \left[\vec{E}.\vec{H}\right]\text{; b) } \vec{p}_{\text{п}} = \frac{\vec{\Pi}}{c}\text{ ;}\\ &\text{c) } \vec{F}_{\text{п}} = \frac{dW_{\text{п}}}{\text{dr}}.\vec{c}_0 = \frac{d\vec{\Pi}}{\text{c.dt}} = \frac{d\vec{\Pi}}{\text{dr}}\text{ ; d) } d\vec{r} = \vec{c}.dt\text{ ;}\end{aligned} \tag{8.5-2}$$

This relationship $\vec{\Pi} = \left[\vec{E}.\vec{H}\right]$ is called Poynting vector in electrodynamics, and $\vec{E}$ and $\vec{H}$ respectively, are the intensities of the electric and the magnetic fields.

If this force (or pressure $\vec{p}_{\Pi} = \frac{\vec{F}}{S}$) lands:

A. Upon a surface of a body of mass m and area $S \neq 1$, force $\vec{F}_{\text{S}} = \vec{F}_{\text{п}}.S$ acts upon the body generating its acceleration $\vec{a}_{\text{T}}$, and setting it into motion for time dt at velocity $\text{d}\vec{v}_{\text{T}} = \vec{a}_T.\text{d}t$ thus performing work $dA = \vec{F}_{\text{S}}.d\vec{r}$

$$\text{a) } \vec{a}_{\text{T}} = \vec{F}_{\text{S}}/\text{m}_{\text{T}}\text{ ; b) } dA = \vec{F}_{\text{S}}.d\vec{r} = \vec{F}_{\text{п}}.S.\vec{a}_{\text{T}}.t.dt\text{ ; c) } \text{d}\vec{r} = \vec{v}_{\text{T}}.\text{d}t = \vec{a}_T.t.dt\text{; d) } \vec{v}_T = \frac{\vec{F}_s}{m_T}.t\text{;} \tag{8.5-3}$$

B. Upon a piston of a cylinder of a steam engine with surface S, force $\vec{F}_{\text{S}} = \vec{F}_{\Pi}.S = \vec{p}_{\Pi}.S$ acts upon the piston for time dt setting it in motion along distance $\text{d}\vec{r} = v_{\text{T}}.\text{d}t$ thus performing work

$$\text{a) } dA = \vec{F}_{\text{S}}.d\vec{r} = \vec{p}.S.d\vec{r} = p.dV\text{ ; b) } dV = S.dr\text{ ;} \tag{8.5-4}$$

From the presented above, the following characteristic features of the electromagnetic (thermal) radiant energy can be outlined:

1. *It is described by deterministic (dynamic) laws;*

2. *It generates force (pressure) and can perform work.*

8.5.2. Photons are generated in the following processes

8.5.2.1. In interaction between a particle and an antiparticle and in particular in annihilation of an electron e^- and a positron e^+ are generated photons with energy $w_f = h.\nu$:

A) At velocities $v \approx 0$

$$\text{a) } e_0^- + e_0^+ \rightarrow 2.\gamma \text{ ; b) } 2.m_{e0}.c^2 = 2.h.\nu_0 \text{ ; c) } W_f = h.\nu_0 = m_{e0}.c^2 \text{ ;} \tag{8.5-5}$$

B) At velocities $v < c$

$$\text{a) } e^- + e^+ \rightarrow 2.\gamma + (p + \overline{p}) \text{ ; b) } 2.m_e.c^2 = 2.h.\nu_0 + 2.m_n.c^2 \text{ ;} \tag{8.5-6}$$

$$\text{a) } e^- + e^+ \rightarrow 2.\gamma + (n + \overline{n}) \text{ ; b) } 2.m_e.c^2 = 2.h.\nu_0 + 2.m_n.c^2 \text{ ;} \tag{8.5-7}$$

where: γ is photon; $p, \overline{p}\ u\ n, \overline{n}$ – proton and antiproton and neutron and antineutron.

8.5.2.2. In case an electron collides against a wall at velocity $v \neq 0$,since the velocity of the electron for time $\Delta t << 1$ drops from $v \neq 0$ to $v_1 = 0$, the result is a mean acceleration $\overline{a}_e = \overline{v}/\Delta t$ and according to classical electrodynamics, at $a_e \neq 0$, the electron emits power which is

$$N_e = \frac{dW}{dt} = \frac{q_e^2.a_e^2}{6.c^3} \text{ ;} \tag{8.5-8}$$

At velocity of the electron $\nu_e \approx 10^6\ m/s$ the emitted energy is $\Delta W = N.\Delta t = 9.98.10^{-18}$ J;

And at velocity $v_e = 10^2 \div 10^3\ m/s$ the emitted energy is

$$\text{a) } \Delta W = 9,98\left(10^{-26} \div 10^{-24}\right) - J; \rightarrow \text{b) } \nu = 1,5\left(10^8 \div 10^{10}\right) \text{Hz;} \tag{8.5-9}$$

8.2.5.3. When certain effort (pressure or extension) is exerted upon substance, the orbitals of the electrons change their normal state and they emit photons (inside or outside the substance). This is the reason why, in mechanical treatment (cutting or plastic treatment), the substance gets hot.

In principle, at the level of substantial manifestations of thermal energy, it always occurs in the form of a photon gas (ensemble of photons), which is generated or absorbed by the substance. However, depending on the structure [construction of the system of material objects in which photons are manifested (generated or absorbed)], as a result of the changes in the energy, relevant forces (of pressure or extension) of Maxwell's pressures appear and different effects are generated. For example:

a) when exerting pressure (in mechanical treatment of materials), since the pressure is stress

$$\text{a) } p = \frac{F}{S} = \frac{force}{surface} \rightarrow \frac{\left[J.m^{-1}\right]}{\left[m^2\right]} = \frac{[J]}{\left[m^3\right]}\text{; b) } p = w = \text{density of the energy;} \tag{8.5-10}$$

a flux of photon gas is generated with density of the energy $w \equiv p.$.

This energy interacts (presses on) with the molecules, which leads to weakening of the force bonds between the molecules, which are bound through the force of cohesion F_c (which is derivative of Lennard-Jones potential and is described here in Chapter Eight, paragraph 8.7) and when it weakens sufficiently, the bond between the molecules disintegrates. This is the electromagnetic (physical) essence of the mechanical treatment of materials. But in ancient times this essence was not clear and this electromagnetic process was called a mechanical process without clarifying the essence of the mechanism of cutting or the essence of the forces.

8.5.2.4. In friction between smooth surfaces of the bodies, since they are not perfectly smooth, the structural bonds of part of the molecules with the bodies tear apart, which are generated by the forces of cohesion - the derivative of Lennard-Jones potential. And in another part of the molecules deformations are generated in a relatively thin layer of the bodies.

These two processes result in generation of photons and heating of the surfaces of the bodies.

8.5.3. Why cosmic bodies are heated to high temperatures

In cosmology, there is a formulation that cosmic bodies were formed from cosmic dust, which consisted of molecules (mainly hydrogen molecules and atoms). Great gravitational forces occurred under the action of the gravitational field and they generated high pressures between molecules, which compacted them and thus formed a cosmic body, which was then heated to high temperatures. However, the mechanism of heating the bodies to high temperatures has never been discussed.

For this increase of temperatures, herein is given the following hypothesis. At increased pressure between molecules (atoms) the orbits of their electrons are deformed in the same way as when materials are processed mechanically, and the substance gets heated. So it is with cosmic bodies as a consequence of the pressure of the gravitational forces, the orbits of the electrons in the molecules of the space (air) dust are deformed and their electrons emit photons, i.e. thermal energy is released and the bodies are heated. When heated to high temperatures, the atoms (molecules) disintegrate and the process of heat (photons) release is intensified, since the temperature T is proportional to the density w_f of the photons. I.e. with the increase of the density of the thermal energy, w_f and T also increase as a result of which nuclear reactions occur in which hydrogen atoms emit heat and helium atoms are formed from them.

In this sense, nuclear reactions, which take place between the electromagnetic atoms of hydrogen, emit electromagnetic energy in the form of photons and helium atoms, which are also electromagnetic matter, i.e. nuclear reactions are electromagnetic reactions.

8.5.4. On Brownian motion

Since all atoms and molecules in liquid form, periodically emit and absorb photons, during which process forces are generated (of recoil and of pressure) upon them, therefore, they are always in fluctuating condition. This is the factor, which also generates Brownian motion.

8.6. MECHANISM OF TRANSFER OF THERMAL ENERGY FROM A GAS THROUGH A SOLID MEDIUM

8.6.1. General formulation

Let us consider a plane wall with surface $S = 1$, temperature T_0 and concentration of molecules n_S on the surface S_1 as well as in each cross-section of the wall on a plane parallel to S along the thickness Δ of the wall perpendicular to S.

In a balanced state of the wall relative to the environment, their temperatures are T_0.

According to statistical physics, it has been wrongly assumed that under the above conditions, each molecule contains the quantity of thermal energy W_{k_m}, the truth, however, is that according to M. Planck, this electromagnetic energy corresponds to the energy of the photon ensemble (gas) with energy W_v, as follows

$$W_{\text{KM}} = \frac{m\bar{v}^2}{2} = k_{\text{B}}.T_0 = W_v = h.\sum_{i=1;j\neq 0}^{i=n;j<10^{20}} \nu_{\text{ij}} \; ; \tag{8.6-1}$$

where: h is Planck's constant; ν_j is j the frequency of the photon (with number j), and i is the number of the photons with identical frequency ν_i; the frequency here is limited to that of the gamma photons.

Let upon the external layer of molecules n_S at $S = 1$ m^2 falls a thermal flux of photons according to Stefan-Boltzmann law

$$\text{a)}\ \frac{\text{d}W_{\Pi}}{\text{dt}} = \Pi = k_{\sigma}.\sigma.T_0^4 = \frac{w_{\Pi}}{4}.c \; ; \ \text{b)}\ w_{\Pi} = 4\Pi/c \; ; \tag{8.6-2}$$

where: $w_{\text{п}}$ is the density of the thermal energy carried by the photons, emitted from the surface of an object with temperature T_0; c - velocity of the photons (electromagnetic waves - the light).

To w_{Π} corresponds the density of the mass of thermal (electromagnetic) energy ρ_{Π} and density of the thermal momentum $\vec{P}_{\Pi}$

$$\text{a)}\ \rho_{\Pi} = w_{\Pi}/\text{c}^2 \; ; \ \text{b)}\ \vec{P}_{\Pi} = \rho_{\Pi}.\vec{c} = \frac{w_{\Pi}}{\text{c}}.\vec{c}_0 \; ; \ \vec{c}_0 = \frac{\vec{c}}{|\vec{c}|} \; ; \tag{8.6-3}$$

To the derivative of $\vec{P}_{\text{П}}$, relative to time, corresponds a thermal force $\vec{F}_{\Pi}$ upon a unit of surface ($S = 1$), which is also pressure $\vec{p}$

$$\text{a)}\ \vec{F}_{\Pi} = \frac{\mathrm{d}\vec{P}_{\text{П}}}{\mathrm{dt}} = \frac{\mathrm{d}\rho_{\text{П}}}{\mathrm{dt}}.\vec{c} = \frac{\mathrm{d}w_{\text{П}}.\vec{c}_0}{\mathrm{c.dt}} = \frac{\mathrm{d}w_{\Pi}}{\mathrm{d}r}.\vec{c}_0 = \vec{p}\ ;\ dr = c.dt\ ; \tag{8.6-4}$$

Under these conditions, when the molecules have on their surface energy $W_{\text{КМ}} = W_{\text{V}}$ and temperature T_0 and the energy of radiation $\vec{\Pi}$ (8.6-2) falls upon them, which is, for one molecule, $\Delta W_{\text{ПМ}} = \Pi / n_0$, where n_0 is the molecule concentration, it follows that the quantity of the thermal energy of the molecule at temperature T_0 increases to

$$\text{a)}\ W'_{\text{КМ}} = W_{\text{КМ}} + \Delta W_{\text{ПМ}} = k_{\text{B}}.T' > k_{\text{B}}.T_0\ ;\ \text{b)}\ T' = T_0 + \Delta T;\ \text{c)}\ \Delta T = T' - T_0 = \frac{\Delta W_{\text{ПМ}}}{\mathrm{k_B}}\ ; \tag{8.6-5}$$

and $W'_{\text{КМ}}$ continues (with the time) to increase, so T' becomes higher than the temperature T_0 of the molecules in the contiguous layer, which is within the thickness of the wall at distance $\Delta r \ll \Delta$, due to which according to Maxwell's pressure or the law (8.6-6) the first layer with surface $S = 1$ (on the surface) emits energy $\Delta W_{\text{П12}}$ toward the second layer at temperature $T' < T_0$

$$\Delta W_{\text{П12}} = k_{\sigma}.\sigma.\left(T'^4 - T_0^4\right) = \Delta W'_{\text{T}}\ ; \tag{8.6-6}$$

until the temperatures become equal or this state sets in: $T_0 = T'_0 = T'$.

Or the same relationship, obtained for the layer with surface $S = 1$ through Fourier's law, is

$$\text{a)}\ \Delta W_{\text{П12}} = -\lambda.\frac{\left(T' - T_0\right)}{\Delta \mathrm{r}}\ ;\rightarrow \text{b)}\ \Delta W_{\Pi 12} = -\lambda.\frac{\mathrm{d}T}{\mathrm{d}r}\ ; \tag{8.6-7}$$

Evidently, this deterministic process of motion of the density of photon energy in a solid medium continues in the wall until it passes through its whole thickness Δ and is emitted out on the other side, on condition that the temperature of the surface (at the end of Δ) is $T_{\Delta} > T_{\text{ср}}$ where $T_{ср}$ is the temperature of the environment at the end of Δ.

According to I. Newton's law for convection and radiation, thermal energy $W_{\text{ТЛ}}$ is released from the wall at $S = 1$, which is

$$W_{\text{ТЛ}} = \alpha\left(T_{\Delta} - T_{\text{ср}}\right) = \alpha.\tau\ ;\ \tau = T_{\Delta} - T_{\text{ср}}\ ; \tag{8.6-8}$$

where: α is a coefficient of thermal release in radiation and convection.

Evidently, after the photon flux has generated force and pressure, it creates pressure $\vec{P}$ upon the molecules of the gas, which are located at the external side of the medium on surface S_M, and accelerates them to velocity $v > 0$, and then the density of this layer of molecules becomes smaller compared to the rest, which pushes it upward and that layer of molecules moves upward $\vec{F}_M = \overline{p}.S_M$, which releases energy to it and performs work which at $S \neq 0$ is

$$\text{a)}\ W = \int \vec{F}_{\Pi}.\mathrm{d}\vec{r} = \int \vec{p}.S_M.\mathrm{d}\vec{r} = \int p.\mathrm{d}V = W_{T\Pi}; \tag{8.6-9}$$

The density of the thermal energy, which is transmitted through the solid body, is determined according to the law of J. Fourier of 1822, and is:

$$dQ = -\lambda.\frac{dT}{dr}.dS.dt; \tag{8.6-10}$$

where: dQ is the thermal energy, which passed through surface dS for time dt at temperature gradient $\frac{dT}{dr}$ and λ coefficient of thermoconductivity of the body.

Or the thermal flow through a unit of area for a unit of time

$$j = \frac{dQ}{dS.dt} = -\lambda.\frac{dT}{dr}; \rightarrow \frac{[\mathrm{J}]}{[\mathrm{m}^2]}.\frac{1}{[\mathrm{s}]}; \tag{8.6-11}$$

is the density of the thermal flow (thermal flow through a unit of area for a unit of time).

By introducing the density of the thermal energy

$$w_T = w_Q = \frac{Q}{V} = \frac{Q}{l^3}; \rightarrow \frac{[\mathrm{J}]}{[\mathrm{m}^3]} = [\mathrm{J.m^{-3}}]; \tag{8.6-12}$$

The density of the thermal flow j is

$$\text{a)}\ j = w_Q.v_T = w_T.v_T;\ \text{b)}\ v_T = \frac{j}{w_T}; \tag{8.6-13}$$

where: v_T is the velocity of $w_Q = w_T$ when it passed through the body.

In a stationary mode, it follows

$$j = -\lambda.\frac{dT}{dr} = A = \text{const}.; \tag{8.6-14}$$

whence it follows that at $j = A = \text{const}.$

$$\text{a)}\ \frac{\partial T}{\partial r} = \frac{dT}{v_T.dt} = \frac{A}{\lambda} = \text{const}. = B;\ \text{b)}\ B = \frac{A}{\lambda} = \text{const}.; \tag{8.6-15}$$

$$\text{a)}\ \frac{dT}{dt} = v_T.B = \frac{v_T.A}{\lambda} = \text{const}. = H;\ \text{b)}\ v_T = \frac{H}{B} = \frac{H.\lambda}{A} = \text{const}.; \tag{8.6-16}$$

I.e. the velocity v_T of the density of the thermal energy is const. Under these conditions for the stationary process, the emitted thermal flow, according to the law of Stefan-Boltzmann, which is also Poynting vector (the density of the flow of electromagnetic energy)

$$\text{a)}\ \Pi = k_\sigma.\sigma.T^4 = [\vec{E}.\vec{H}] = w_f.c = \text{const}.;\ \text{b)}\ w_f = \frac{4.\Pi}{v_T} = \sum W_{fi} = \text{const}.; \tag{8.6-17}$$

which falls upon and is absorbed by the surface of the body, i.e.

$$\text{a)}\ \Pi = [\vec{E}.\vec{H}] = j;\ \text{b)}\ k_\sigma.\sigma.T^4 = w_f.c = w_j.v_T = \text{const}.;\ \text{c)}\ w_j = \frac{\sigma.T^4}{v_j} = \frac{[\vec{E}.\vec{H}]}{c} = \text{const}.; \tag{8.6-18}$$

I.e. the thermal energy, which passes through the body is electromagnetic energy, the same energy as the one that bodies emit and absorb according to the laws of Stefan-Boltzmann (1879 - 1884) and Kirchhoff (1860).

THIS IS THE ANSWER TO THE QUESTION, WHAT IS THE ESSENCE OF THERMAL ENERGY AS REAL DYNAMIC ENERGY, WHICH PROPAGATES THROUGH THE PHOTON GAS IN NATURE. IT IS ELECTROMAGNETIC ENERGY IN THE FORM OF PHOTONS, AND IS NOT CARRIED BY MOLECULES, AND SCIENCE OF IT IS A SPECIFIC CASE OF THE SCIENCE OF ELECTRODYNAMICS, SUCHA AS THE THEORY OF THE PHOTON GAS IN SOLID BODIES (SUBSTANCES AND LIQUIDS) AS WELL AS PARTIALLY IN GAS ENVIRONMENT.

And therefore, thermodynamics should be called thermoelectrodynamics, which does not need Carnot's cycle, or Clausius entropy, but only needs electrodynamics of Newton, Planck, Kirchhoff and others. Thus it is proved that thermodynamics (thermoelectrodynamicsta) is unified with the other parts of physics, which is a science of the manifestations of electromagnetic matter.

Emphasis

It is evident from the description of the mechanism of transfer of thermal energy released by a substance in a volume V_T **that not a single molecule of the substance is carried through the wall. This fact proves that molecules are not carriers of dynamic (explicit) thermal energy, since it is only in the form of a photon gas, but they solely emit and absorb photons, *although present-day thermodynamics leaves a wrong impressions that thermal energy in volume*** V_T ***of the gas is carried by***

the molecules. This wrongly alleged idea of thermal phenomena, which is deeply rooted in the minds of not a small number of researchers, has been established by the circumstance that statistical calculations do not make it sufficiently clear that the statistical method is a computing method but it is not quite proper as regards the expression of the physical essence of thermal process. **In fact, most researchers are fully aware of the apparent fact that molecules are not carried through the wall, but heat is carried by the photons of the photon gas.** ***It is only that the coefficient of thermal conductivity λ in the law of Fourier (8.6-10) that depends on the kind and concentration n_0 of the molecules of the medium whose λ is discussed.***

In this case, an old idea is brought forth again, the idea of a thermal fluid, which is the photon gas *and which determines pressure $P_\Gamma = \frac{W_f}{3}$ in volume V_Γ of the gas of the molecules, whereby here too* ***the statistical method of calculation has led to a misinterpretation that there is no photon gas or photon pressure, although in electrodynamics it is clearly indicated that to energy $W_f = h.\nu$ corresponds momentum $\vec{P} = \frac{W_f}{c}.\vec{c}_0;\ \vec{c}_0 = \frac{\vec{c}}{|\vec{c}|}$ and this fact proves the photon pressure.***

According to the law, proved by Lord Rayleigh in 1902, all wave processes, which move at wave velocity, exert pressure (force) upon the surface of objects which they encounter at a wave velocity.

The analysis of the mechanism of passing of thermal energy $W_T = h.\sum \nu_i$ through a solid body shows that the beginning of the thermal flow W_T has a temperature T_1 and the end of the surface of the body has $T_2 < T_1$.

If the temperature of the external medium, when the heat is leaving the body, is $T_0 < T_2$, then it releases upon the surface of the body $S_2 = 1$ surface temperature T_2 via thermal flow through area $S_2 = 1$, which is

$$Q_T = \alpha\left(T_2 - T_0\right); \tag{8.6-19}$$

This law was formulated by Is. Newton.

In this case, it is evident that the quantity of thermal energy Q is not carried by any molecules, nor by atoms . I.e. the quantity of heat is the heat, which the photon gas carries and it is

$$Q_T = W_{fT} = \sum W_{fi} = h.\sum \nu_i; \tag{8.6-20}$$

which is a sum of the energies of the photons, which have passed through the wall.

Therefore, the molecules (atoms) of a solid body, and of any substance in general (gas, liquid or solid) are only absorbents and emitters of photons of the photon gas. And only the photons themselves are carriers of real (dynamic) thermal energy which is in the form of electromagnetic waves, i.e. thermal energy is only carried by electromagnetic waves. But the electromagnetic waves themselves, photons, are emitted and absorbed by molecules (atoms). The mechanism of absorption of photons of the atom (molecule) consists in the following. When the photon hits the electron, which is in a respective orbit, it is absorbed by the electron, which is of respective magnetic (called kinetic) energy, at respective velocity *v*

$$W_{He} = \frac{m_{e0}.v^2}{2}; \tag{8.6-21}$$

where: m_{e0} is mass of the electron at rest, since $v \ll c$.

As a result of this absorption, the energy of the photon is transformed (restructured) and is localized upon the electron in the form of magnetic energy ΔW_{He}, as a result of which it is absorbed by the electron and its velocity increases to $v' > v$, by Δv, due to which its magnetic energy increases.

$$\text{a)}\ W'_{He} = \frac{m_{e0}.v'^2}{2};\ \text{b)}\ v' = v + \Delta v; \tag{8.6-22}$$

Due to this fact, the electron moves to a higher orbit. After a short interval of time, the electron in the atom emits a photon of energy W_f and momentum $\vec{P}_f = \frac{W_f}{c}.\vec{c}_0$ and returns to its original orbit.

In this sense, atoms and molecules are not carriers of photons, and hence it follows that they are not carriers of dynamic thermal energy as well, but are only carriers of **potential thermal energy, such as the magnetic energy of the electrons, which is called kinetic and part of which is transformed into a photon (thermal) energy.** *Moreover, the potential thermal energy of the nucleus of the atom is the oscillating energy of the nucleus and its parts (protons and neutrons), since the nucleus, too, under respective conditions, emits high-energy photons.*

In this sense, the molecules of the gas are also carriers only of potential thermal energy, which is inside the molecules in the form of magnetic (kinetic) energy of the electrons, which are in orbits around the nuclei of the atoms and molecules, which are enveloped by the electrons, connecting the atom molecules. And this potential thermal (magnetic) energy, in suitable conditions is transformed into radiant (photon) kinetic (thermal) energy.

If in a given volume V_Γ there is gas with a concentration n_0 of its molecules, the total number of the molecules is $N = V_\Gamma.n_0$. **Modern thermodynamics wrongly assumes that each molecule is a carrier of mean statistical thermal energy. In such case, the total thermal energy W_T in volume V_Γ of the gas is**

$$W_T = W_k = N.\frac{m.\vec{v}^2}{2} = N.\frac{3.k_B.T}{2}; \qquad (8.6\text{-}23\ a)$$

where: m is mass of one molecule; $\vec{v}^2$ - the square of the mean statistical velocity of the molecule.
It follows from (8.6-23a) that the mean statistical thermal energy of one molecule is

$$W_{TM} = \frac{m.\vec{v}^2}{2} = \frac{3.k_B.T}{2}; \qquad (8.6\text{-}23\ b)$$

Expressions (8.6-23a) and (8.6-23b) are a result of formal assumptions, without an actual physical sense, since molecules are carriers only of potential thermal energy, and in appropriate conditions, for instance, a collision into a hard medium or between molecules or decreased density of the surrounding photon gas, they emit photons and decrease their magnetic energy to a density equal to the density of the photon gas. The motivation of this contention is the fact that in (8.6-23a) and (8.6-23b) no photons or photon gas have ever been taken into consideration, and it is exactly they that are the real carriers of thermal energy.

For if each molecule in general is a carrier of such thermal energy, when thermal energy passes through a solid body, some molecules should pass as well, but no such molecules are available.

In this case, the molecules of the molecular gas are only emitters and absorbents of photons. As a result of the forces of pressure and recoil, generated by the photons upon the molecules, they move and hit one another and have the respective oscillating movements, to which corresponds a respective magnetic energy, which depend on the density of photon energy w_f of the photon gas, which corresponds to temperature T in volume V_Γ of the gas and is between its molecules.

$$\text{a)}\ w_f = n_0.k_B.T.\frac{3}{2};\ \text{b)}\ T = \frac{2}{3}.\frac{w_f}{k_B.n_0}; \qquad (8.6\text{-}24)$$

It is known from Pound's experiment (1960) that masses m_f of the photons are attracted by gravitational field G_3 of the Earth by force

$$\text{a)}\ \vec{F}_f = -m_f.\frac{m_3.\gamma}{r^2}.\vec{r} = -m_f.\vec{G}_3;\ \text{b)}\ m_f = \frac{w_f}{c^2} = \frac{h.\nu}{c^2};\ \text{c)}\ \vec{G}_3 = -\frac{m_3.\gamma}{c^2}.r_0; \qquad (8.6\text{-}25)$$

where: m_3 is mass of the Earth; γ – gravitational constant.

The relationship between density of mass ρ_f and density of energy w_f of the photon gas is

$$\rho_f = \frac{w_f}{c^2}; \qquad (8.6\text{-}26)$$

And the pressure exerted by the gravitational filed upon the density of the mass of the photon gas ρ_f at altitude $\mathrm{d}h$ is

$$\mathrm{d}P = \rho_1.G.\mathrm{d}h = \frac{1}{3}.\frac{w_f}{c^2}.G.\mathrm{d}h = P.\frac{G}{c^2}.\mathrm{d}h; \qquad (8.6\text{-}27)$$

Since

$$\rho_f = \frac{w_f}{c^2} = \frac{\Pi}{3.c^3} = \frac{\left[\vec{E}.\vec{H}\right]}{3.c^3} = \frac{\sigma.T^4}{3.c^3}; \tag{8.6-28}$$

$$\text{a)}\ \frac{\mathrm{d}P}{P} = \frac{G}{c^2}.\mathrm{d}h;\ \text{b)}\ \frac{\frac{1}{2}.k_B.\mathrm{d}T}{\frac{1}{2}k_B.T} = \frac{G}{c^2}.\mathrm{d}h = \frac{\mathrm{d}T}{T};\ \text{c)}\ T = T_0.\exp\left(-\frac{G.h}{c^2}\right); \tag{8.6-29}$$

i.e. the temperature decreases with the increase of the altitude *h* above ground.

The relationship is analogous for the molecule of the gas.

8.7. HOW A SOLID BODY TURNS INTO GAS

First, it should be pointed out that atoms and molecules emit and absorb photons permanently, in gases as well as in solid bodies, which fact motivates the law of Stefan-Boltzmann

$$W_{из} = k_\sigma.\sigma.T^4 = w_f.c; \tag{8.7-1}$$

where: *T* is the temperature on the surface of the solid body, respectively the temperature of the molecules on the surface of the body.

And Fourier's law for the density of the thermal flow (through a unit of area for a unit of time)

$$\vec{j} = -\lambda.\frac{dT}{dr}.\vec{r}_0 = w_T.\vec{v}_T = w_f.\vec{v}_T; \tag{8.7-2}$$

where: $w_T = w_f$ is the density of the thermal energy through the volume of the solid body; *v* - the velocity of w_T through the solid body.

Namely, $\vec{j}$ ***is explained as a consequence of the emission of photons by the atoms (molecules) of the solid body and forming of the density of the photon energy*** w_f ***in the volumes between the molecules (atoms) of the solid body, where also act electromagnetic forces of cohesion*** F_c **.**

This force is equal to the derivative of Lennard-Jones potential and is

$$F_c = 4.\varepsilon.\left(\frac{\alpha}{r^{13}} - \frac{\beta}{r^7}\right) = F_c^{'} - F_c^{''}; \tag{8.7-3}$$

where: ε, α and β are respective constants for the corresponding structure of substance (substantial form) of electromagnetic matter.

As a result of the law of Stefan-Boltzmann, force and pressure are exerted upon the molecules by w_f, which is

$$\text{a)}\ \vec{F}_p = \frac{dW_{из}}{dr}.\vec{c}_0 = \frac{dW_{из}}{c.dt}.\vec{c}_0;\ \text{b)}\ \vec{P} = \frac{W_{из}}{c}.\vec{c}_0 = w_f.\vec{c}_0; \tag{8.7-4}$$

when

$$\vec{F}_p + \vec{F}_c \le 0; \tag{8.7-5}$$

free state of molecules occurs, i.e. the body turns into a gas.

8.8. WHY ARE THE SOLUTIONS IN PRESENT-DAY THERMODYNAMICS RELIABLE DESPITE THE INCORRECT FORMULATION THAT MOLECULES ARE CARRIERS OF THERMAL ENERGY

Let's have a gas of temperature *T*, concentration of molecules *n*, in volume of the gas V_Γ, number of molecules *N* and thermal energy of the gas W_Γ.

Under these conditions, the volume of the gas, where as a mean statistical quantity there is one molecule is

$$V_N = \frac{V_\Gamma}{N} = \frac{1}{n}; \tag{8.8-1}$$

The gas has densities of the energy w_Γ and of mass ρ_Γ, as follows

$$\text{a) } w_\Gamma = \frac{W_\Gamma}{V_\Gamma};\ \text{b) } \rho_\Gamma = \frac{w_\Gamma}{c^2}; \tag{8.8-2}$$

and the mean statistical magnetic (kinetic) energy of one molecule is

$$w_{HM} = W_{km} = \frac{m_M \overline{v}^2}{2} = \frac{3}{2}.k_B.T;\ T = \frac{w_\Gamma}{n}; \tag{8.8-3}$$

where: m_M is the mass of one molecule; $\overline{v}^2$ – the square of the mean statistical velocity of the molecule; k_B – Boltzmann constant.

Under these conditions the thermal density of the energy of the gas is

$$w_\Gamma = W_{HM}.N = \frac{3}{2}.k_B.T.n; \tag{8.8-4}$$

And the density of the mass ρ_Γ is

$$\rho_\Gamma = \frac{w_\Gamma}{c^2}; \tag{8.8-5}$$

However, when taking into account that there is also a photon gas of density of thermal energy w_f, then

$$\text{a) } w_\Gamma = \frac{3}{2}.n.k_B.T = \frac{3}{2}.n.k_B^{'}.T - w_f;\rightarrow \text{ b) } k_B^{'} < k_B; \tag{8.8-6}$$

i.e. since part of the thermal energy – w_f is carried by the density of the photon gas.

Since the temperature T is proportional to w_f

$$T = k_f.w_f; \tag{8.8-7}$$

In the volume, in which there is one molecule V_N (8.8-1), there is also a photon gas of density of energy w_f, in this volume there is also thermal energy of the photon gas, which is

$$W_{fN} = V_N.w_f = \frac{w_f}{n}; \tag{8.8-8}$$

by this W_{fN} energy should be decreased the energy, which is assumed to be $\overline{W}_{HM} = \overline{W}_{km}$ as a mean statistical energy of one molecule on condition that the density of the energy w_f of the photon gas is not accounted for. Since the availability of w_f under this condition should bring a decrease of k_B into $k_B^{'}$.

We should note the fact that so far, when measuring k_B, it has been proceeded from (5), while when determining $k_B^{'}$ it should be proceeded from (8.8-6). For $k_B^{'}$, from (8.8-6) it follows that it is

$$\frac{3}{2}n.k_B^{'}.T = w_\Gamma - w_f = \frac{3}{2}.k_B.T.n - w_f; \tag{8.8-6}$$

it follows that

$$k_B^{'} = \frac{3}{2}\frac{w_\Gamma - w_f}{n.T} = \frac{k_B.T.n - w_f}{n.T} = k_B.\frac{T.n}{T.n} - \frac{2}{3}\frac{w_f}{n.T} = k_B - \frac{2}{3}\frac{w_f}{n.T}; \tag{8.8-9}$$

Here a question arises, what the value of w_f is.

We proceed, as reference point, from the written by Dettlaff and Yavorski in their book (student book) “Course of Physics”, “Vysshaya shkola”, M., 1989 on p. 93, in paragraph 8.4.

"3. In normal conditions, i.e. at pressure $p_0 = 101325$ Pa and temperature $T_0 = 273{,}15$ K, many gasses (such as: hydrogen, helium, neon, nitrogen, oxygen, air and other) can be considered, with a good approximation, as ideal gasses. Essentially, under these conditions, the concentration of molecules of the gas in the order of their values is $n \sim 10^{25}$ m^{-3}, and the average distance between the molecules is $r \sim 10^{-8}$ m, sufficiently long for their forces of attraction to be ignored. The total volume of all the n molecules $n \sim 10^{25}$, which are contained in 1 m^3 is $S_M = \pi.n.\frac{1^3}{6} \sim 10^{-5}$ m$^{-3} \ll 1$. Therefore, the volume of molecules relative to the volume of 1 m^3 of the gas can be ignored. The total surface area of all $n \approx 10^{25}$ molecules in 1 m^3 is about $V_M = n.\pi.d^2 \approx 10^5 - 10^6$ m$^2 \gg 1$ m^2, i.e. much greater than the surface of the walls of the vessel, where is 1 m^3 of the gas. This means that the collisions between the molecules of the gas are much greater than the collisions in the walls of the vessel, where the gas is."

According to other publications, the frequency of collisions between the molecules is 10^{35}, and upon the walls is 10^{29}, at free motion of molecules long $\ell = 6{,}2.10^{-8}$ m.

If we assume that $T_1 = 500$ K is the maximum working temperature of the gas, which after performing work drops to $T_2 = 300$ K, the respective densities of the photon gas during emission from the surfaces of the walls of a vessel with volume $V_c = 1\text{ m}^3 = S_c = 6\text{ m}^2$ and surfaces of molecules 10^{25} is by number $S_M = 10^5 \div 10^6$ m^2, according to Stefan-Boltzmann law, the emitted density of energy per second at temperature 500 K, with coefficient for the surface which emits $k_T = 0{,}5$, is

$$w_f = \frac{S \cdot k_\sigma \cdot \sigma \cdot T^4}{c} = \frac{10^6 \cdot 0{,}5 \cdot 5{,}6 \cdot 10^{-8}}{3 \cdot 10^8} \cdot 6{,}25 \cdot 10^{10} = 5{,}8\, J\, in\, 1\, m^{-3}; \tag{8.8-10}$$

This density of energy is of the photon gas w_f.

The present-day assumption is that the thermal energy W_Γ of the gas is carried only by the molecules of the gas (with concentration *n* molecules in a unit of volume), whose mean statistical value is

$$\overline{W}_{KM} = \frac{m.\overline{v}^2}{2} = k_B.T = \frac{w_\Gamma}{n}; \tag{8.8-11}$$

Here a certain error is made, because the molecules, in addition to their forward motion at mean statistical velocity $\overline{v}$ can also have a rotating motion, i.e. their kinetic energy is greater than W_{KM} (8.8-3).

However, with the availability of the density of the photon energy w_f (8.8-8), the thermal energy of the gas is

$$w_\Gamma = n.W_{KM} + w_f; \tag{8.8-12}$$

i.e. the energy carried by the molecules is

$$W_{\Gamma M} = n.W_{KM} = w_\Gamma - w_f \tag{8.8-13}$$

i.e.

$$W'_{KM} = \frac{w_\Gamma - w_f}{n} < W_{KM}; \tag{8.8-14}$$

or analogously to (8.8-11), it follows

$$\text{a) } W'_{KM} = \frac{w_\Gamma - w_f}{n_0} = k_B.T - \frac{w_f}{n} = k'_B.T; \text{ b) } k'_B = k_B - \frac{w_f}{n_0.T} < k_B; \tag{8.8-15}$$

Here since $w_f \equiv T^4$, it follows

$$\frac{w_f}{n.T} \equiv T^3; \tag{8.8-16}$$

I.e. $k_B^{'}$ is obtained as a variable, which decreases when the temperature increases.

At temperature of the gas $T = 500$ K the density of the energy of the photon gas w_f, which is emitted from the surface of the walls of the vessel and the surface of molecules with a total area $S \approx 10^6$ m^2; is

$$w_f = \frac{S \cdot k_c \cdot \sigma \cdot T^4}{c} = \frac{10^6 \cdot 0{,}5 \cdot 5{,}66 \cdot 10^{-8} \cdot 5 \cdot 10^{10}}{3 \cdot 10^8} = 4{,}71 J\ in volume of 1 m^{-3}; \quad (8.8\text{-}17)$$

Under these conditions, from the full density of energy w_Γ of the gas in 1 m^{-3} with concentration n at normal pressure $p = 1{,}05.10^5$ Pa, the mean statistical energy, which is due to one molecule is

$$W_{KM} = \frac{w_\Gamma}{n} = k_B.T = 1{,}38.10^{-23}.500 = 6{,}9.10^{-21} \text{ J/n}; \quad (8.8\text{-}18)$$

And by accounting for the availability of density of the photon energy at $T = 500$ K

$$W_{KM}^{'} = \frac{w_\Gamma - w_f}{n} = 6{,}9.10^{-21} - 4{,}71.10^{-25} = 6{,}89953.10^{-25} \text{ J/n}^{-1}; \quad (8.8\text{-}19)$$

i.e.

$$\begin{aligned} &\text{a) } W_{KM}^{'} = 6{,}89953.10^{-21}; \\ &\text{b) } \Delta W_{KM} = W_{KM} - W_{KM}^{'} = 6{,}9.10^{-21} - 6{,}89953.10^{-21} = 4{,}71.10^{-25} \text{ Jn}^{-1}; \end{aligned} \quad (8.8\text{-}20)$$

And at $T = 300$ K

$$w_f = 10^6 \cdot \frac{0{,}5 \cdot 5{,}66}{3 \cdot 10^8} \cdot 3 \cdot 10^{10} = 2{,}83 J\ in\ volume\ of\ 1 m^{-3}; \quad (8.8\text{-}21)$$

$$W_{KM}^{''} = \frac{w_\Gamma - w_f^{'}}{n} = 1{,}38.10^{23}.300 - \frac{2{,}83}{n} = 4{,}14.10^{-21} - 2{,}83.10^{-25} = 4{,}1396.3.10^{-21} \text{ J.n}^{-1}; \quad (8.8\text{-}22)$$

$$k_B = \frac{W_{KM}}{T} = \frac{6{,}9.10^{-21}}{500} = 1{,}38.10^{-23}; \quad (8.8\text{-}23)$$

$$k_B^{'} = \frac{W_{KM}^{'}}{T} = \frac{6{,}9.10^{-21}}{500} = 1{,}3799.10^{-23}; \quad (8.8\text{-}24)$$

$$k_B^{''} = \frac{W_{KM}^{''}}{T} = \frac{4{,}1396.10^{-21}}{300} = 1{,}3798.10^{-23}; \quad (8.8\text{-}25)$$

I.e. when taking into account the energy of the photon gas, k_B changes depending on the temperature

$$k_B = \frac{W_{KM}}{T} - f\left(T^3\right); \quad (8.8\text{-}26)$$

For practical calculations, since the error is of the order of 0.01%, it is neglectfully small. But from a physical point of view, it is necessary to take into account that there is a photon gas, respectively a free photon energy with density $w_f > 0$**.**

However, in vacuum, and with the temperature staying constant, say, at $T = 300$ K and the density of the thermal energy $w_\Gamma = m_0.k_B.T = \text{const.}$, since the density of the molecules decreases, as follows:

At normal pressure $P_{01} = 4{,}01.10^5$ Pa $\rightarrow n_{01} = 10^{25}$ molecules in 1 m^3.

At low vacuum – pressure $P_{02} = 1{,}33.10^2$ Pa $\rightarrow n_{02} = 3{,}3.10^{22}$ molecules in 1 m^3.

At average vacuum – pressure $P_{03} = 1{,}33.10^{-1}$ Pa $\rightarrow n_{03} = 3{,}3.10^{19}$ molecules in 1 m^3.

At deep vacuum – pressure $P_{04} = 1,33.10^{-5}$ Pa $\rightarrow n_{04} = 3,3.10^{15}$ molecules in 1 m^3.

Without the photon energy, only wit the energy of the molecules, the density of the energy of gas $w_{\Gamma M}$ with its volume V_Γ and concentration of molecules n at $T = 300$ K, the energy of the gas at $P_{01} = 1,01 \cdot 10^5$ Pa and $n = 10^2$ is

$$W'_{\Gamma M} = n.\frac{3}{2}.k_B.T = 10^{25}.\frac{3}{2}.1,38.10^{23}.300 = 6,21.10^4 \text{ J}; \tag{8.8-27}$$

hence

$$k_B = \frac{6,21.10^4}{1,5.300.n} = \frac{1,38.10^2}{n} = \frac{138}{n}; \tag{8.8-28}$$

This makes it clear that Boltzmann coefficient k_B depends on the pressure of the gas, respectively on the concentration n of the molecules of the gas.

Since the average diameter of the molecule above was assumed by Dettlaff and Yavorski $d = 1,78.10^{-10}$ m, it follows that the surface area of the molecule is $n.d^2 = 10^{-19}$. Then at concentration n of the molecules in the gas the area of n molecules is $S_n = n = 10^{-19}$ m^2.

With accounting for the density of the photon energy w_f, whose value depends on the temperature, it follows

$$w_f = S_M.\frac{k_\sigma.\sigma.T^4}{c} = n.10^{-19}.\frac{0,5.5,6.10^{-8}}{3.10^8}.3^4.10^8 = 0,756 \text{ J.m}^{-3}; \tag{8.8-29}$$

For a vessel with transparent walls (glass), the density of the photon energy $w_f = \text{const.}$, because from the outside of the glass photon energy penetrates and inside it has value w_D, the same as it is outside at outside temperature T_0. But if the walls are not transparent and there is vacuum, at concentration n of the molecules, which have area $S_M = n.10^{-19}$ m^2.

For a glass vessel and vacuum

$$w_f = w_B = 7,5.10^{-1} \text{ J}; \tag{8.8-30}$$

1. Under these conditions Boltzmann coefficient in the glass vessel at $T = 300$ is

$$k_{Bf} = k_B - \frac{w_f}{n.T} = \frac{1,38.10^2}{n} - \frac{7,5.10^{-1}}{n.T} = \frac{138 - 0,005}{n} = \frac{137,995}{n} \approx \frac{138}{n}; \tag{8.8-31}$$

2. At normal pressure $P_{01} = 1,01.10^5$ Pa $\rightarrow n_{01} = 10^{25}$ molecules in 1 m^3

$$k_{B1} = 138.10^{-25} = 1,38.10^{-23}; \tag{8.8-32}$$

3. At low vacuum $P_{02} = 1,33.10^2$ Pa $\rightarrow n_{02} = 3,3.10^{22}$ molecules in 1 m^3

$$k_{B2} = \frac{138.10^{-22}}{3,3} = 4,18.10^{-21}; \tag{8.8-33}$$

4. At average vacuum $P_{03} = 1,33.10^{-1}$ Pa $\rightarrow n_{03} = 3,3.10^{19}$

$$k_{B3} = \frac{138.10^{19}}{3,3} = 4,18.10^{-18}; \tag{8.8-34}$$

5. At deep vacuum $P_{04} = 1,33.10^{-5}$ Pa $\rightarrow n_{04} = 3,3.10^{15}$

$$k_{B4} = \frac{138.10^{-15}}{3,3} = 4,18.10^{-14}; \tag{8.8-35}$$

But for a glass vessel, in which vacuum is created, the concentration (number) of the molecules n and their energy inside decrease

$$W_{\Gamma M} = n.k_B.T.\frac{3}{2}; \tag{8.8-36}$$

From the outside, however, enters photon gas, whose density of energy and temperature are the same as the density of energy of the gas and the temperature of the glass vessel, i.e.

$$w_f = n_0.k_B.T_0 = 10^{25}.1{,}38.10^{-23}.300 = 4{,}14.10^4 \text{ J.m}^{-3}; \tag{8.8-37}$$

Because the densities of energies become equal.

Under normal conditions it is evident that the impact of the photon energy upon k_B is neglectfully small and therefore, although from a physical point of view, k_B should be smaller, the error is neglectful, so the solutions are reliable.

8.9. PHOTON PRESSURE AND COSMIC OBJECTS

According to the written by Newton that all bodies emit and absorb photons, it follows that in the space between the substantial forms of electromagnetic matter (bodies, cosmic objects) there is a photon gas, which has density of electromagnetic energy w_f and mass ρ_f.

To this w_f corresponds pressure

$$P_f = \frac{1}{3} w_f; \tag{8.9-1}$$

This pressure generates two effects.

First

For area S_K of the cosmic objects (as a whole) with radius R_K, the area upon which acts pressure P, there occurs force of resistance relative to the velocity of motion of cosmic bodies

$$F_K = P_f.S_K = \frac{1}{3}.w_f.\pi.R_K^2; \tag{8.9-2}$$

and it decelerates their velocity. As a result of the deceleration of the velocity of cosmic bodies, they move away from the central body, around which they move. For example, the Moon moves away from the Earth, and the Earth – from the Sun.

Second

The photon gas expands in all directions and, by means of the pressure which it exerts upon the cosmic objects, it drags and shifts them apart from one another. In this sense, stars with their planets are separate objects, galaxies are separate objects, clusters of galaxies are separate objects. And all these objects shift apart from one another owing only to the pressures of the photon gas and the impact of the gravitational forces. And owing to the non-uniform density of the density of the energy of the photon gas and the values of the gravitational fields, the velocities of cosmic objects are variables, both in values and in directions.

8.10. CONCLUSIVE INFERENCES

First. **Thermal energy is electromagnetic energy and the laws of the electromagnetic theories of Maxwell and Planck hold true for it, with accounting for their specific features that their primary dynamic manifestation is in the form of a photon gas, and in a localized potential state, thermal energy is carried by the electrons in the atoms in the form of magnetic energy of electrons, since they move at velocity** $v_e \equiv 10^6$ m.s^{-1}**.**

Second. Thermal energy, as well as all other structural states of energy, which is only electromagnetic, can convert (get restructured) from one into another state, while retaining its quantities. *During this conversion, the initial state is called energy, and the converted (restructured) state is called work.* This is the reason why Newton defined that energy *dW* is measured by the performed work *dA* as a product of force $\vec{F}$ and distance *dr,* i.e.

$$\text{a) } dW = dA = \vec{F}.d\vec{r} \text{ ; b) } \vec{F} = \frac{dA.\vec{r}_0}{\text{dr}} = \frac{dW}{dr}.\vec{r}_0 = \frac{d\vec{P}}{dt}; \tag{8.10-1}$$

i. e. the work is the new state of the respective quantity of restructured energy.

Third. **Inside the substance, the dynamic state of thermal energy, which moves according to Fourier's law, is in the form of energy of photons – a denser photon gas, between the small distances between atoms and molecules, which according to Maxwell is electromagnetic (kinetic) energy, which should be called internal wave electromagnetic energy, which manifests and is described by the force or momentum or pressure. And what is more, molecules have oscillating movements, due to which they accumulate photons in the form of magnetic energy, which, through the emission of photons, they render to their neighboring molecules, which are of smaller thermal energy.** That is why gasses (vapors) perform work – they transform part of their internal wave energy into external by setting an object into motion.

Fourth. **The description of the thermal processes is in a determinist form, in the form of dynamic laws or through statistical physics by means of statistical laws.**

1. In general, due to the practically unlimited number of thermally interacting objects at micro level, their analysis as deterministic processes is impossible. ***The main reason for this is that there is no solution in physics to the issue of the description of energy interactions between more than two objects, and at micro level they are practically unlimited in number.***

2. Therefore, we use the facts (laws) that:

2.1. For a limited interval of time the probabilistic processes at micro level have determinist value.

2.2. The effective result of the sum of micro processes of a given macro object for a finite interval of time has a determinist value. Therefore, thermal processes are determinist macro manifestations with very slight fluctuations, of the order of $\Delta T \approx 10^{-9} K$ ***of the temperature in degrees by K.***

I.e. generally speaking, thermal processes change and are described as continuous in time, although they are known to be quantized.

For example. The description of velocities of gas particles is probabilistic in the sense that there is constant mean statistical value $\overline{v}^2 = \text{const.}$ ***, but the effective work, which the gas performs is described by deterministic laws.***

Fifth. Thermal processes can be illustrated as follows:

1. Gas molecules have mass m_M and concentration n at temperature T_0.

2. Photons, which are emitted and absorbed by the molecules, have energy W_f, momentum $\vec{P}_f$, mass m_f and move at velocity c.

$$\text{a) } W_f = h.\nu;\ \text{b) } \vec{P}_f = \frac{W_f}{c}.\vec{c}_0;\ \text{c) } m_f = \frac{W_f}{c^2};\ \text{d) } \vec{c}_0 = \frac{\vec{c}}{|\vec{c}|}; \tag{8.10-2}$$

The emission of a photon by the electron (atom, molecule) is for time of about $\tau = 10^{-8}$ s. Whence at velocity $c = 3.10^8$ m/s, the length of the photon in vacuum is

$$l_f = \tau.c = 10^{-8}.3.10^8 \approx 3 \text{ m}; \tag{8.10-3}$$

The average force of recoil F_0 during emission or of pressure F_0 during absorption of the photon is

$$\text{a) } \vec{F}_0 = \vec{F}_p \approx \frac{W_f}{c.\tau} = \frac{W_f}{l_f};\ \text{b) } l_f = c.\tau; \tag{8.10-4}$$

This force generates acceleration $\vec{a}$ of the molecule with mass m_M and imparts energy to it.

Apparently, since the mass of the molecule $m_M \gg m_f$, the kinetic energy, which the molecule receives from one photon is much less than the sum of the energy of the photons which act upon the molecule for a unit of time. In addition, since the next force, which will act upon the molecule, as a result of the absorption or emission of the photon, will be at angle $\alpha > 0^\circ$ relative to the preceding one, the sum of the two forces and the approximately 10^{10} collisions (force) that follow for a unit of time (second) is *much greater than zero.*

Modern physics (thermodynamics) has accepted Boltzmann idea, without any experimental confirmation, that the oscillating energy of the molecule, at concentration of the gas particles n, has only discrete values, which form arithmetic progression $0, \varepsilon, 2\varepsilon, 3\varepsilon...$, by minimal energy ε. I.e. Boltzmann, although he stated in other articles that photons are something independent relative to molecules and that they obey the law that their energy is in discrete portions $0, \varepsilon, 2\varepsilon, 3\varepsilon...$ For instance, the article, in which

Boltzmann proved Stefan's law was titled "Deduction of Stefan's law, on the grounds of electromagnetic theory of light, concerning the relationship between thermal emission and temperature" dated 1884 I.e. although Boltzmann himself proved, in this article on Stefan-Boltzmann law on radiation, that ***thermal energy has independent existence and is carried by photons, and that in the molecules there are no photons (there is no thermal energy in the form of photons, but it is in the form of magnetic energy of the electrons), but they can emit photons via transforming part of the kinetic energy of the electrons of atoms (the molecules) into short-lasting parts (momentums) of electromagnetic waves, despite this fact, he did not mention any photon energy.***

However, in this case, although the explicit and conspicuous experimental facts, which prove that thermal energy is in the form of a field electromagnetic matter, and there is no place in nature, as well as in space, without thermal energy in a field form of electromagnetic matter, **he himself, in the theory of thermal energy, postulated and asserted the unreliable claim that only molecules are carriers of thermal energy.**

Substance, taken as a separate part of substantial matter, is a carrier of thermal energy, which it releases only in the form of photons, which are emitted by its electrons, which are in the atoms of the substantial form of electromagnetic matter. But these emitted photons as a field form of electromagnetic matter are not any longer part of the atoms (molecules), but they have independent existence outside the substantial form of electromagnetic matter, which can then absorb and emit them once again.

Photons, which are in the space between atoms (molecules) of the respective medium (matter), since atoms constantly, at short intervals, emit and absorb photons, in this space between atoms (molecules) the photons form a layer of photons of a higher density of the photon gas (of thermal energy), through which they exert pressure upon atoms (molecules) inside substance. **I.e. in substance, there are photons (photon gas), which are not bound to the atoms and molecules, but are in the space between them and, moreover, with a high density of photons (photon gas).**

In the above sense, it is considered that matter (in substantial medium, including gas medium) is the carrier (it contains) photons, i.e. photons are in layers between atoms (molecules), and are not inside in the volume of the atoms (the molecules).

Due to this, coefficient of thermal content is defined for the respective medium (substance or gas), depending on the weight or volume quantity of the substance (gas). For the radiant thermal energy in vacuum, only the quantity of thermal energy is defined via the notion of density of thermal energy in a unit of volume.

Therefore, the mean statistical thermal energy of the molecules of the gas is equal to its magnetic (kinetic) energy, and the molecules of the gas are not a carriers of photon energy, ***but the processes of emission and absorption of photons in the intermolecular space are incessant in its periodicity for each molecule.*** In this sense, since the values of the energies of photons are discrete, the energies, which the molecules emit and absorb, are also discrete, whereby at $T = \text{const.}$ the sum of the emitted and absorbed photon energy per a unit of time is zero. And when this energy is absorbed by the molecules it is transformed into magnetic energy (called kinetic) of the electrons, altering their velocity and the radius of their orbits. During photon emission, parts of the magnetic energy of the electrons of the molecules are transformed into momentum of electromagnetic waves – called photons.

Here comes the question, if thermal energy, heat, is carried by photons, which are a field form of electromagnetic matter, different from the substantial form of electromagnetic matter, why the theory of thermal phenomena in present-day thermodynamics yields reliable results by using molecules (atoms).

Here first it should be pointed out that present-day thermodynamics by accepting Stefan-Boltzmann law shows that first, it does not reject directly (explicitly) the fact that heat is electromagnetic energy in the form of electromagnetic waves; and second, it makes a connection between thermal energy in the form of photons and molecules (atoms) by assuming that these electromagnetic waves, in the form of short impulses (parts) of electromagnetic waves, called photons, and the fact that molecules (atoms) emit and absorb photons. And that is why it assumes that thermal energy of molecules exists in the form of discrete portions (values) of energies $\varepsilon, 2\varepsilon, 3\varepsilon...$, such are the energies of photons.

By accepting this fact, molecules are seen as a discrete form of thermal energy, what photons actually are, with the only difference that the number of the molecules N in a closed volume is constant

$$N = \text{const.}; \tag{8.10-5}$$

while with photons, their number n in a closed volume

$$n \neq \text{const.}; \tag{8.10-6}$$

but in both cases the respective sums of their energies W are constants.

$$\text{a)}\ Q_T = W_T = \sum N.w_i = \text{const.};\ \text{b)}\ Q_T = W_{KM} = \sum w_i = \text{const.}; \tag{8.10-7}$$

However, when they refer to a wall of substance (substantial form of electromagnetic matter), molecules cannot pass through it, but only the thermal energy $Q_T = W_T$ ***carried by them passes in the form of photons.***

I.e. the molecules of the gas are carriers of potential thermal energy in the form of magnetic energy of atoms and molecules, and the molecules of the substance are also carriers of thermal energy, such as the potential thermal energy. Whereas in the notion that thermal energy is carried only by the photon, it is such in vacuum, gas and substance, but in various structural states. ***In vacuum, the photons emitted from one material area, as it is in Stefan-Boltzmann law, are only in one direction, while in the gas and the substance, they are outside he molecules – photons are in all directions.*** *Moreover, most often, in the gas, the density of photons* n_{0l} *is lower than the density* n_{0e} *of the photon between the molecules of the substance.*

In his book "History and Methodology of Thermodynamics and Statistical Physics" Publ. by "Visshaya shkola" Moscow, 1981, Y. Gelfer wrote: "By the beginning of the 80s, physicists had no doubt about the electromagnetic nature of thermal radiation. And that is why the main properties, which are inherent of light, should be observable in thermal radiation as well. In particular, this refers to the pressure, which generates electromagnetic waves of light. This fact, that the light wave presses upon the surface that is absorbing it by force equal to the volume density of electromagnetic energy, follows immediately from the theory of Maxwell, who wrote, "In a medium, where waves propagate, there exists pressure in direction, normal to the waves, numerically equal to the energy in a unit of volume" described the great physicist in his "Treatise on Electricity and Magnetism" of 1873. And the Italian physicist Bartoli wrote that were it not for that pressure, thermal energy would move from a colder place to a hotter."

Essentially, the first who proved most convincingly that heat moves from a hotter to a colder place was Fourier in his law of 1822, but this fact is ignored by researchers and is ascribed to Clausius, while Fourier's law is

$$\mathrm{d}Q = -\lambda.\frac{\mathrm{d}T}{\mathrm{d}r}.S.\mathrm{d}t; \tag{8.10-8}$$

where: the sign is minus, since thermal energy dQ moves from a hotter to a colder place, proportional to the coefficient of thermal conductivity λ and gradient $\frac{\mathrm{d}T}{\mathrm{d}l}$ of temperature on surface S for time dt.

In addition to this, Boltzmann wrote an article titled "Deduction of Stefan's law, on the grounds of electromagnetic theory of light, concerning the relationship between thermal emission and temperature." **This article makes it clear that Boltzmann was aware of the fact that thermal energy is electromagnetic energy of electromagnetic waves, photons**. And that this energy is emitted by atoms (molecules), but the atoms (the molecules) are not electromagnetic waves, photons. ***Nonetheless, in his capital works, Boltzmann discussed the theory of heat using probabilistic laws about the heat of molecules.*** **This not entirely correct theoretical idea was accepted by modern orthodox thermodynamics, which essentially rejects the previous theory, resulting from the work of Fourier, Maxwell and Planck, and in this way practically rejects the material essence of heat (thermal energy) via the introduction of the notion of entropy, despite the evident facts that:**

a) entropy is a limited notion, which does not have real sense in clarifying thermal phenomena if Fourier's law of 1822 is used;

b) entropy does not say almost anything about the essence of thermal energy;

c) thermal theory and practice can develop without entropy as well and, moreover, through a simpler mathematical apparatus;

d) Carnot's cycle is not necessary; it cannot be realized in piston machines whose operation it allegedly explains.

8.11. SOMETHING ON ENTROPY

Entropy dS was defined by Clausius with the formula

$$dS = \frac{\partial Q}{T}; \tag{8.10-1}$$

where the thermal energy ∂Q for a medium with mass m and thermal capacity k_T

$$k_T = \frac{\partial Q}{dT}; \tag{8.11-2}$$

is

$$\partial Q = m.k_T.dT; \tag{8.11-3}$$

And the entropy is

$$dS = \frac{\partial Q}{T} = m.k_T.\frac{dT}{T}; \tag{8.11-4}$$

after integrating from S_1 to S_2 we have

$$\Delta S = S_1 - S_2 = m.k_T.\int_{T_1}^{T_2}\frac{dT}{T} = m.k_T.\ell_n.\frac{T_1}{T_2}; \tag{8.11-5}$$

where: ΔS is a determinist value; l_n is a natural logarithm.

But for the entropy is used the formula of Boltzmann about entropy, as processed by Max Planck, which is

$$\text{a) } S_{12} = k_B\ell_n.P_T;\ \text{b) } P_T > 1; \tag{8.11-6}$$

where: P_T is a value, called thermodynamic probability, for whose calculation in various situations there is no algorithm. Therefore, entropy is only designated and discussed that it increases or decreases, without giving or measuring (there is no measuring device for it) any numerical value for it.

AND THIS FACT, THAT ENTROPY IS A NON-MEASURABLE AND PRACTICALLY NON-CALCULABLE BY NUMBERS VALUE, ACCORDING TO THE PRINCIPLE OF SCIENTIFIC RELIABILITY, WHICH STATES THAT ONLY WHEN ONE VALUE IS MEASURABLE, ONLY THEN IT IS A SCIENTIFICALLY RELIABLE VALUE, REJECTS ENTROPY AS A SCIENTIFICALLY RELIABLE VALUE, AND ALONG WITH THIS REJECTS IT ALSO AS A SECOND LAW OF THERMODYNAMICS, WHICH IN ESSENCE IS THERMOELECTRODYNAMICS.

Emphasis

There arises the question:

"What would modern thermodynamics win or lose if the theories of Carnot's cycle and entropy are dropped off it, i.e. if thermodynamics were discussed without Carnot's cycle and without entropy?"

Answers:

The answers are given by taking into account the written by Prof. Kvasnikov in paragraph 8.1. of this chapter, which states:

In § 1 (p. 17) he wrote: "As it was noted in the foreword, thermodynamics and statistical physics are not universal theory. Their sphere of application is strictly limited to the study of so-called thermodynamic systems. "

In § 3 (p. 36) he wrote: "Thermodynamics discusses only quasi-static processes. They are defined as infinitely slow processes, which consist of inexhaustible number of successive equilibrium states which hardly differ from one another; clearly, these processes ***are not real processes, but a special unreal boundary case****, the main advantage of which is that they are reversible, i.e. that there are no losses. "*

In § 9 (p. 192) he wrote: "... We have shown that the problems of thermodynamics can be solved without using the notion of entropy, or chemical potential and so on, but by operating only with immediately variable quantities. The latter circumstances make these versions of solutions very illustrative, and thus to some extent is compensated their artificiality, which at first is associated with the need to seek appropriate Carnot's cycle, etc., and also with the feeling of "oddity" in the sense of style of presentation."

First answer. About the need to seek appropriate Carnot's cycle

It is known that Carnot's cycle is not a real cycle, but is an idealization, which cannot be realized as a really acting cycle, whereby:

1. Even without Carnot's cycle, which uses the idea of thermal fluid, it is possible to describe and study theoretically these modes: a) adiabatic; b) isothermal; c) isochoric and d) isobaric.

2. As for the so-called Carnot's law

$$\text{a) } \frac{Q_1}{T_1} = \frac{Q_2}{T_2}...;\ \text{or b) } \frac{Q_1}{T_1} = \frac{Q_2}{T_2} = 0;$$

it can be derived by proceeding from the coefficient of thermal contents for determined limits of the temperature.

$$C_T = \frac{dQ}{dT};\rightarrow \text{ after integrating } \rightarrow \text{b) } C_T = \frac{Q}{T} = \frac{Q_1}{T_1} = \frac{Q_2}{T_2} = \text{const.};$$

and we have Carnot's law.

Or from Boltzmann's constant k_B

$$\text{d)}\ Q_{k_B} = \frac{m.\bar{v}_1^2}{2} = \frac{3}{2}.k_B.T_1; \rightarrow \text{b)}\ k_B = \frac{Q_1}{T_1} = \frac{Q_2}{T_2} = ... = \text{const.}$$

I.e. thermodynamics can develop even without Carnot's cycle.

Second answer. On entropy

First, entropy can also be described as a determinist value according to (8.11-5).

If entropy is dropped out, since it is not measurable by any devices, so it is not a physical quantity because it its value is non-measurable, thermodynamics does not lose anything, but only wins by handling only explicit quantities.

Third answer. Thermal phenomena (processes), according to Prof. Kvasnikov, should be described and studied only by immediately measurable thermal quantities. Such an approach (without entropy) would simplify and illustrate the descriptions of the real application of thermal phenomena, which circumstance, according to the requirement for scientific reliability and Newton's definition for application of the principle of simplicity (Occam's razor) would bring thermodynamics closer to scientific requirements.

Y. M. Gelfer, in his book "History and methodology of thermodynamics and statistical physics" in paragraph 22, p. 237 wrote: "The second principle of thermodynamics (entropy – P.P.'s note) is described mathematically as inequality, from which in a purely mathematical way are obtained other inequalities as well. But these inequalities are of little use for the calculation of specific processes, since: first**,** because they are inequalities and second, because they do not contain any instructions as the velocity of thermal processes, and third, there is no method for their measuring " "... entropy cannot help in studying processes in open systems, where there is exchange between mass and energy and the surrounding medium".

Conclusion

From a scientific point of view, modern thermodynamics must get rid of Carnot's cycle and entropy as soon as possible, so that it could meet the requirements for scientific reliability, i.e. to be in conformity with the principle of simplicity.

It is necessary that thermodynamics should interpret the photon thermal energy, such as thermal energy, which the Sun sends to the Earth, and without which life would be impossible on the Earth. However, despite the fact that this thermal energy is crucial for life, it is neglected in modern thermodynamics, while much attention is given to a needlessly complicated treatment of non-measurable and practically unusable notion, called entropy, although without it the theory of thermal phenomena, which are electromagnetic phenomena, could be developed much more successfully

CHAPTER NINE
CONCLUSION ABOUT PHYSICS

The presented in the previous eight chapters shows that:

Provided that matter in the world and its manifestations in the form of natural facts, such as relatively independent electromagnetic objects, phenomena, processes etc. represent the ancient and modern ideas of physical images and the unitary theory of the world (nature).

Experimental facts (empirical laws), given by Isaac Newton in his books of 1687 and 1704 are a sufficiently reliable grounds of the electromagnetic physical picture and theory of physics of nature, which has established some flawed assumptions in modern physics.

In the above sense, the physical ideas of Isaac Newton are not historical relics, but they are still relevant in present-day and future science of nature.

The flaws available in modern physics are basically due to incomplete reflection of the ideas in the writings of Newton and Maxwell and reposing too much trust in the writings (words) of some scientists.

In order to achieve a unitary and uniform physics, based on one single, unitary theoretical basis, it is necessary that it be rationalized according to Newton's legacy, most of which is presented in this book.

SUPPLEMENT

1. WHY PHYSICS FOUNDATIONS NEED TO BE RATIONALIZED

It is a fact that the science physics at the present time has major scientific and practical achievements. But in the theoretical aspect there remain some key issues unresolved, there are incorrect formulations and some significant errors, such as:

1. The point is that the nature of science since ancient times and today has been and is considered to be a comprehensive system of relatively independent components (parts) with a homogeneous nature. I.e., that it is genetically homogeneous whole, which is the only reason for its own existence and it has one initial deductive principle - theoretical foundations. Unfortunately, at this level of development of the theory of science of nature, its foundations do not yet have a single initial principle.

2. But if we proceed from the circumstance that all the physics (and all sciences in general) survey (study) manifestations (states) of something called matter, which is the carrier and the generator of these manifestations, we should conclude that the reason for the genetic homogeneity of the parts (elements) of the whole, the nature, must be in the homogeneity of matter, which is the generator of manifestations that science studies. This fact requires that a unitary science be created, i.e. essentially that its unitary theoretical basis be discovered in the form of a single initial principle – the Principal.

As to the question of the essence (of type) of matter, the situation is as follows:

a) on the one hand, in Newton's classical mechanics the dominant idea is that ***matter is homogeneous***, the manifestations of which are the laws of mechanics, as there is not a word about transition from one type of matter to another, nor about any particular type of matter in nature;

b) on the other hand, while it is accepted that there is matter of electromagnetic (electric) nature, which generate electric, magnetic and gravitational fields, energies and masses, etc., whereby, for that electromagnetic matter, the laws of mechanics hold true, plus other laws that are considered only electromagnetic, we should point out that: a) material objects, which are found to display (carry) only the mechanical laws, move at velocities v much lower than the speed of light (electromagnetic waves) c, i.e.

$$\text{a) } v \ll c;\ \text{b) } \frac{v}{c} \to 0; \tag{1-1}$$

and b) that the mechanical laws can be obtained through reduction of the laws of electromagnetic matter (relativistic laws, which are called here laws of Newton's electrodynamics) which hold true at velocities

$$\text{a) } v < c;\ \text{b) } \frac{v}{c} > 0; \tag{1-2}$$

I.e. the mechanical laws are a particular case of the electromagnetic laws. This is the reason to assume that the matter of the objects in mechanics is electromagnetic matter whose laws of their motion are specific cases of electromagnetic matter under condition (1-1). Or in other words, all matter in nature is only electromagnetic but the laws of motion of its objects are described at two extreme velocities: a) $v \ll c$ and b) $v < c$; i.e. their laws are identical, but different traits dominate because of their substantially different in values velocities described in formally different formulae since matter is only electromagnetic.

Such was the opinion of Isaac Newton too in his book "Principles ..." of 1704, where he described in a synthesized form the experimental facts (regularities), as follows:

„*All bodies emit and absorb light.*"

„*The changing of Bodies into Light, and Light into Bodies ...*"

"*... is very conformable to the Course of Nature ...*"

And in 1860 G. Kirchhoff proved the law: The ratio of emitted energy W_i to the absorbed radiation energy W_k is constant for all natural objects and depends on the frequency of the radiation and the temperature T of the bodies

$$\frac{W_i}{W_k} = f.(\nu.T) = \text{const;}" \tag{1-3}$$

I.e. via the experimental fact Kirchhoff supported the experimental facts which were Newton's position. **But these experimental facts were never taken into account when formulating the laws of physics, or rather, it was not taken into consideration in physics that the natural matter has electromagnetic essence – it is electromagnetic matter. Thence, that there exists a genetic unity (homogeneity) in all natural facts (phenomena).**

THIS CIRCUMSTANCE IMPLIES THAT UNITY IN NATURE IS DETERMINED BY THE FACT THAT ITS MATTER IS HOMOGENOUS AND IS OF ELECTROMAGNETIC ESSENCE. HENCE IT FOLLOWS THAT ALL TYPES OF FIELDS, ENERGIES AND MASSES AND NATURAL PHENOMENA ARE HOMOGENOUS AND ELECTROMAGNETIC.

The above fact (law) entails that the deductive principle in the science of nature consists of electromagnetic principles (laws), which principle, because of its highest comprehensiveness of regularities is termed Principal.

By assuming and proving that unitary matter of nature is electromagnetic matter in a field and substantial forms, the question of unity and homogeneity of nature (the world) and the unity and homogeneity of the sciences about it is solved without any alternative and unequivocally.

2. FLAWS IN INTERPRETATION OF MICHELSON-MORLEY'S EXPERIMENT (MME) AND SOME IMPLICATIONS FOR LORENTZ TRANSFPRMATIONS (LT) AND THE SPECIAL THEORY OF RELATIVITY

In the second half of the 20th c., Maxwell and Hertz established the concept (idea) that light is electromagnetic wave. O. Fresnel in 1818 proved that, with respect to its transmitter (source), the velocity of light is constant and equal to c, regardless of the state of motion or rest of its source. And in 1842, Doppler theoretically grounded the relationship between the velocity of sound and light waves and the velocity of the observer, whereby for light this relationship was confirmed experimentally in 1867 and was called Doppler effect –DE.

In those times, it was believed that the carrier of light is a medium called ether. In 1881 Michelson conducted his first experiment in Helmholtz's laboratory, but he did not obtain a satisfactory result. Afterwards, together with the chemist Morley they make experiments in Potsdam, Germany, until 1887, which experiment of Michelson-Morley is here designated as MME, and MMEs were conducted under altered conditions in the 20th c. by other researchers with results similar to the ones of 1887.

These MMEs are conducted with Michelson's interferometer. Its arrangement is a source of light, which emits a ray towards a semitransparent prism, which divides the ray into two rays to mutually perpendicular arms $\overline{OA}$ and $\overline{OB}$, which are fitted with mirrors at one end *O* and in the other ends *A* and *B*, whereby mirrors reflect the rays from *O* to *A* and respectively from *O* to *B*. And mirrors *A* and *B* reflect the rays to the respectively end *O*. The distances between the mirrors on the two arms are equal to ℓ_0.

The rays along both arms (since they result from the division of the initial ray, coming from the source fixed relative the arms) are homogenous and are sent simultaneously to the arms and therefore, they arrive back at the initial point at the same time. One ray moves, say, along $\overline{OA}$ in direction of the velocity of Earth $\vec{v}_3$, and the other, $\overline{OB}$, perpendicularly to it $\overline{OB} \perp \vec{v}_3$. According to H. Lorentz's idea, ether is immovable in space, so Earth moves relative to the ether at velocity $v = \vec{v}_3$. Therefore the times t_A and t_B, for which light rays will travel the distances $\overline{OA}$ and $\overline{OB}$ and back should be

$$\text{a) } t_A = \frac{\ell_0}{c-v} + \frac{\ell_v}{c+v} = \frac{2.\ell_v}{c\left(1-\frac{v^2}{c^2}\right)};\ \text{b) } t_B = \frac{\ell_0}{\left(c^2-v^2\right)^{1/2}} + \frac{\ell_v}{c.\left(c^2-v^2\right)} = \frac{2.\ell_v}{c\left(c^2-v^2\right)^{1/2}}; \tag{2-1}$$

After we add the velocities, as per Galileo's transformations, GT, i.e. on condition that the times do not depend on the velocities of motion of the observers, the ratio of t_A and t_B is

$$\text{a) } \frac{t_A}{t_B} = \frac{1}{\left(1-\frac{v^2}{c^2}\right)^{1/2}} = \left(1-\beta^2\right)^{-1/2};\ \text{b) } t_B = \frac{\ell_0}{\left(c^2-v^2\right)^{1/2}} + \frac{\ell_0}{c\left(c^2-v^2\right)} = \frac{2\ell_0}{c\left(c^2-v^2\right)^{1/2}}; \tag{2-2}$$

This is the reason why there should be interference between the rays in MME. But MME shows that there is no interference, i.e.

$$t_A = t_B; \tag{2-3}$$

This result (2-3) embarrasses physicists, since this result is in complete contradiction to the ideas of that time.

However, the above arrangement and interpretation of MME up to and including 1887 does not take into consideration Fresnel's law of 1818, which states: the velocity of light relative to its source is always $c = \lambda_g.\nu_g$, where: λ_g is wave length, and ν_g - wave frequency of the emitted light and does not depend on the velocity of its source. ***And MME uses Michelson's interferometer where the source of light and the interferometer are one whole, or the interferometer and the source of light are fixed to each other, i.e. the interferometer is one whole with the source. Under this condition, for the rays along*** $\overline{OA}$ ***and*** $\overline{OB}$ ***Fresnel's law holds true, i.e. the times*** t_A ***and*** t_B ***are equal***

$$t_A = \frac{2.\ell_0}{c} = t_B = \frac{2.\ell_v}{c}; \tag{2-4}$$

and therefore, there is no interference between the two rays along $\overline{OA}$ and $\overline{OB}$. But ***physicists have not realized this significant error in MME.*** *And H. Lorentz, who was convinced in the existence of motionless ether, introduced the principle of constancy of the velocity of light relative to the source and the observer so that he could explain the MME result.* This principle, in its part about the source, is consistent with Fresnel's law of 1818 , while in its part about the observer, it goes contrary to the Doppler effect and to Einstein, who in [1] in paragraph 7 deduced the Doppler effect with regard to frequency through the expression $\nu = \nu_G.\frac{c \mp v}{c.\left(1-\frac{v^2}{c^2}\right)^{1/2}}$ by using Lorentz transformations, LT, and in [1] paragraph 4, by LT is determined the wave length $\lambda = \lambda_g.\left(1-\frac{v^2}{c^2}\right)^{1/2}$, which entails that the ***velocity of light according to Einstein himself in [1] is***

$$\text{a) } u_c = \nu.\lambda = \nu_G.\lambda_G.\frac{(c \mp v)}{c} = c \mp v \neq c; \text{ b) } \nu_G.\lambda_G = c; \tag{2-5}$$

different from constant.

H. Lorentz presented the LT formation in 1904 , which are in the form

$$\text{a) } x_2 = \frac{x_1 = v.t_1}{\left(1-\beta^2\right)^{-1/2}}; \text{ b) } y_2 = y_1; \text{ c) } z_2 = z_1; \ t_2 = \frac{t_1 - \frac{v^2}{c^2}.x^1}{\left(1-\beta^2\right)^{-1/2}} = \gamma\left(t_1 - \frac{\beta}{c}.x_0\right); \beta = \frac{v}{c}; \tag{2-6}$$

The deduction of LT (2-6) by Lorentz, according to [2] paragraph 4.2, and in [1] were used by Einstein, who deduced them in 1920 in [3], Supplement I, through the following approach:

It is assumed that there exist two inertial systems, K_1 and K_2, which move towards each other at velocity $v = \text{const.}$ and that according to the results from MME (2-3), the velocities of light in both systems K_1 and K_2 are equal

$$c_1 = c_2 = c = \text{const.}; \tag{2-7}$$

which implies that since at moment

$$t_1 = t_2 = 0; \tag{2-8}$$

they are synchronized, i.e. at distance between them

$$r_1 = r_2 = 0; \tag{2-9}$$

after an interval of time t_1 and t_2, the distances of K_1 and K_2 to an object in point M, which the observer ascertains, are

$$\text{a) } r_1 = c.t_1; \text{ b) } r_2 = c.t_2; \tag{2-10}$$

although this is in contradiction to classical ideas and to GT, i.e. it contradicts the experiment, i.e. according to (2-10), r_1 and r_2 are notated in a form, where the times t_1 and t_2 are determined through LT, as follows

$$\text{a) } x_1^2 + y_1^2 + z_1^2 = c^2.t_1^2; \text{ b) } x_2^2 + y_2^2 + z_2^2 = c^2.t_2^2; \tag{2-11}$$

By taking into account the symmetry $y_1 = y_2; z_1 = z_2$ (2-11), then it follows that

$$\text{a) } x_2^2 - c^2.t_2^2 = x_1^2 - c_2^2.t_2^2; \text{ or b) } r_1 - c.t_1 = r_2 - c.t_2; \tag{2-12}$$

Lorentz assumes that the formulae for the transition from one inertial system to another, i.e. the formulae of LT transformation from one inertial system to another, are linear, because of the uniformity and isotropy of space and uniformity of time and they have this form

$$\text{a) } x_2 = \gamma.(x_1 - v.t_1); \text{ b) } y_2 = y_1; \text{ c) } z_2 = z_1; \text{ d) } t_2 = a.(t - b.x_1); \tag{2-13}$$

where: γ, *a* and *b* are constants, which can be determined as follows from (2-13) and (2-12), by assuming the limitation that at $\beta = \frac{v}{c} \to 0$, the formulae of the transformations (2-13) should turn into Galileo's transformations – GT, i.e. when $t_1 = 0$ and $x_1 = 0$ it follows that $t_2 = 0$ and $x_2 = 0$ and after placing the formulae from (2-13) into (2-11), we have

$$x_1^2\left(\gamma^2 - a^2.b^2.c^2 - 1\right) + x_1.t_1\left(-2.\gamma^2.v + 2.a^2.b.c^2\right) + t_1^2\left(\gamma^2.v^2 - a^2.c^2 + c^2\right) = 0; \tag{2-14}$$

Since

$$\text{a) } \gamma^2 - a^2.b^2.c^2 - 1 = 0; \text{ b) } \left(-2.\gamma^2.v.2.a^2.b.c^2\right) = 0; \text{ c) } \gamma^2.v^2 - a^2.c^2 + c^2 = 0; \tag{2-15}$$

After these equations are solved with regard to γ , *a* and *b,* we have

$$\text{a) } \gamma = a = \left(1 - \beta^2\right)^{-1/2}; \text{ b) } b = \frac{\beta}{c}; \text{ c) } \beta = \frac{v}{c}; \tag{2-16}$$

And after we apply 2-16) in (2-13), we have LT, described through (2-6). But the deduction of LT in (2-6), through the formulae (2-10) and (2-11) is done not by applying the principle of constancy of the velocity of light –PCVL, and with respect to the observer, whose mathematical notation for an observer at velocity v, according to Einstein in [1] paragraph 5, should be

$$u_c = c \pm v = c; \tag{2-17}$$

and indeed, when using (2-17) about the actual notation of r_2 and r_1 relative to the two reference systems K_1 and K_2 from (2-10) with taking into account the Doppler effect, this result is obtained

$$\text{a) } r_2 = (c \pm v_2).t_2 = c.t_2 = c.t_2; \text{ b) } r_1 = (c \pm v_1).t_1 = c.t_1; \tag{2-18}$$

which is a notation with taking into account the PCVL, by which Doppler effect is incorrectly (without a good reason) rejected.

Einstein in [3] in Supplement I wrote about the deduction of LT that he proceeded from PCVL in the form of the following notation

$$\text{a) } r_1 = c.t_1; \text{ b) } r_1 - c.t_1 = 0; \text{ and c) } r_2 = c; \text{ d) } r_2 - c.t_2 = 0; \tag{2-19}$$

Out of this notation of PCVL, Einstein in [3] in Supplement I, deduced LT, described by (2-6).

However, for the ratio of x_2 over t_2 , from LT (2-6), we obtain

$$\text{a) } \frac{x_2}{t_2} = \frac{\gamma.(x_1 - v.t_1)}{\gamma.\left(t_1 - \frac{\beta}{c}.x_1\right)} = \frac{c.(x_1 - v.t_1)}{x_1 - v.t_1} = c; \text{ b) } x_2 = c.t_2; \text{ c) } t_2 = \frac{x_2}{c}; \tag{2-20}$$

Or by applying the notation of PCVL in (2-17) for time t_2 we have

$$t_2 = \frac{x_2}{c} = \frac{x_1 - v.t_1}{c.\left(1 - \frac{v^2}{c^2}\right)^{1/2}} = \frac{c.t_1 - v.t_2}{c.\left[\frac{(c-v)(c+v)}{c^2}\right]^{1/2}} = \frac{t_1.(c-v)}{c} = t_1.\frac{c}{c} = t_1; \tag{2-21}$$

or LT are reduced to

$$\text{a) } x_2 = c.t_1; \text{ b) } y_2 = y_1; \text{ c) } z_2 = z_1; \text{ d) } t_2 = t_1; \tag{2-22}$$

Einstein in [4] wrote „that even in infinitely small spatial-temporal areas Lorentz transformations cannot be justified, if the strict principle of constancy of the velocity of light c is rejected".

In [1] paragraph 5, Einstein deduced through LT the formula for addition of the velocities v_1 and v_2 in the form

$$v_{12} = \frac{v_1 + v_2}{1 + \frac{v_1.v_2}{c^2}}; \tag{2-23}$$

he assigned $v_1 = c$ in (2-23) and obtained

$$\text{a) } v_{12} = \frac{c + v}{1 + \frac{c.v_2}{c}} = \frac{c.(c + v_2)}{(1 + v_2)} = c; \text{ or b) } v_{12} = c + v = c; \tag{2-24}$$

which deduction is according to (2-17), and then he wrote: „therefore, the velocity of light c cannot be altered when it is added to a velocity $v < c$."

But here he made a mistake, because when using LT, he did not have the right to assign $v = c$, ***because at*** $v = c$ ***LT get annulled, for example:***

$$x_2 = \frac{x_1 - v \cdot t_1}{\left(1 - \beta^2\right)^{1/2}} = \frac{c \cdot t_1 - c \cdot t_1}{\left(1 - 1\right)^{1/2}} = \frac{0}{0} = \text{indeterminacy}; \tag{2-25}$$

Therefore (2-24) is also a flawed proof of PCVL.

Emphasis

Einstein, proceeding from [1], where it was written on page one: „Examples of this kind, such as the unsuccessful experiment (MME – P.P.'s note), attempting to determine the motion of Earth relative to "luminiferous ether" lead us to the assumption that the laws of mechanics hold true for all coordinate systems – the laws of electrodynamics and the laws of optics. This assumption (which herein we shall refer to as „Principle of relativity"), we intend to turn it into a prerequisite and to make an additional assumption, which at first sight is seemingly in contradiction, namely, that in vacuum light always propagates at a certain velocity ***c***, which does not depend on the state of motion of the emitting body. These two prerequisites are sufficient, so that, by laying them into the basis of Maxwell's theory of bodies at rest, we can build a simple electrodynamics of moving bodies, free of contradictions."

This citation entails the conclusions that:

- Einstein intended to use Fresnel's law of 1818, of which he did not know it existed. For, if he knew, then he should have corrected the error in MME.

- in the process of work on this article, H. Lorentz's idea arouse, that the velocity of light relative to a moving observer is constant (does not depend on his velocity), which Einstein developed in [1] in paragraph 5, but for which idea he did not adduce any experimental facts, on the contrary, in paragraph 7, named „Theory of aberration and Doppler effect" he disproved his own claim that the velocity of light relative to a moving is constant and equal to c, because he himself deduced the Doppler effect.

- Since he did not know of Fresnel's law, Einstein incorrectly interpreted in [1] paragraph 2, the relativity of the length and the intervals of time, because the rod emitted light, in the thought experiments, which he analyzed in paragraph 2.

Literature

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3. FLAWS IN THE DEFINITION OF SIMULTANEOUSNESS

In the cited above item 2, Einstein's article [1] of 1905 in "First Kinematic Part", paragraph 2 "On relativity of the length and time interval", he wrote:

"Let us imagine that at both ends *A* and in of a rod are fastened clocks which are synchronized with the clocks in the system at rest, i.e. their indications correspond to "the times in the system at rest" in those locations, where they are placed: therefore these clocks are synchronized with the system at rest.

Further, let us imagine that next to each clock there is an observer who moves along with it and that these observers apply to both clocks the criteria of simultaneousness of the motion of both the clocks as established in paragraph 1. Let a light beam is emitted from *A* at the moment of t_A, and is reflected from in at the moment of t_B and returns back to *A* at the moment of $t_A^{'}$. Bearing in mind the principle of constancy of velocity of light, this principle at the beginning of paragraph 2, subitem 2 of the above cited article, states: "2. Every light beam moves in a system of coordinates at rest at certain velocity *c*, regardless of whether this beam is emitted by a body at rest or in motion.", we have

$$\text{a) } t_B = t_A = \frac{r_{AB}}{c-v};\ \text{b) } t_A^{'} - t_B = \frac{r_{AB}}{c+v}; \tag{3-1}$$

where: r_{AB} is length of the rod moving at velocity *v*, measured in the system at rest.

The observers, who move together with the rod at velocities *v*, find out that the clocks at points *A* and in do no run in a synchronous way, and at the same time the observers who are in the system at rest would claim that these clocks run in a synchronous way.

Therefore, we can see that we shouldn't impart **absolute** meaning to the concept of simultaneousness. Two events which are simultaneous when observed from one system of coordinates are no longer perceived as simultaneous when observed from another system, moving relative to the given one".

Here, when recording the regularities (3-1), Einstein did not respect Fresnel's law of 1818, which states: ***The velocity of light towards the emitter is always constant and is equal to its wave velocity, regardless of the state of motion or rest of the source (the body that emits it).***

According to this law of Fresnel's, however, since the source of light, the clocks and the points A and in are fastened to the rod, which moves at velocity v, the velocity of light relative to the rod is always (regardless of whether it moves at velocity v or is at rest) c, then because of Fresnel's law, equations (3-1) should be written in this form

$$\text{a) } t_A - t_B = \frac{r_{AB}}{c};\ \text{b) } t_A^{'} - t_B = \frac{r_{AB}}{c}; \tag{3-2}$$

I.e. the condition of synchrony is fulfilled

$$t_A - t_B = t_A^{'} - t_B; \tag{3-3}$$

as cited by Einstein in paragraph 1 in the same article.

Therefore, the clocks are synchronized both for the observers next to the clocks and in a system at rest.

Therefore, the concept of simultaneousness (3-1), which is offered in the special theory of relativity (STR) drops off as a reliable physical idea and the idea that follows from Galileo's transformations (GT) and Fresnel's law remains.

4. NATURE OF GRAVITATIONAL FIELD

It is known that electromagnetic matter in field and substantial forms, as electromagnetic waves (light photons) and electrons (electron e^- and positron e^+), are carriers and generators of gravitational fields, energies and masses which essentially are homogenous to the generated gravitational fields, energies and masses of external electromagnetically neutral material objects (bodies).

Moreover, for mass *m* of objects of electromagnetic matter or of external (seemingly) electromagnetically neutral matter, gravitational field is generated, described by the formula

$$\vec{G} = -\frac{m.\gamma}{c^2}.\vec{r}_0; \vec{r}_0 = \frac{\vec{r}}{|\vec{r}|}; \tag{4-1}$$

where: γ is gravitational constant; *r* – distance from the body.

Since the mass of electron (electron e^- and positron e^+) at rest is

$$\text{a) } m_{e0} = \left(\mp q_e\right)^2 .k_m; \text{ b) } k_m = \left(4.\pi.\varepsilon_0.r_{e0}.c^2\right)^{-1}; \text{ c) } \left(\mp q_e\right)^2 > 0; \tag{4-2}$$

where: $\mp q_e$ is electric charge of electrons; ε_0 – dielectric constant of vacuum; r_{e0} – computational (classical) radius of electron; c – velocity of light $k_m = \text{const}$.

In motion at velocity $v < c$, the electron generates a magnetic field around itself

$$\vec{H} = \varepsilon_0.\left[\vec{v}.\vec{E}_e\right] = \frac{q_e.v.\left[\vec{v}_0.\vec{r}_0\right]}{4.\pi.c^2}; \vec{v}_0 = \frac{\vec{v}}{|\vec{v}|}; \vec{r}_0 = \frac{\vec{r}}{|\vec{r}|}; \tag{4-3}$$

The electric *E* and magnetic *H* fields have densities of their masses

$$\text{a) } \rho_E = \frac{\varepsilon_0.E^2}{2.c^2}; \text{ b) } \rho_H = \frac{\mu_0.H^2}{2.c^2}; \tag{4-4}$$

which generate gravitational fields

$$\text{a) } \vec{G}_E = -\frac{\rho_E.\gamma}{r^2}.\vec{r}_0; \text{ b) } \vec{G}_H = -\frac{\rho_H.\gamma}{r^2}.\vec{r}_0; \tag{4-5}$$

where: μ_0 is magnetic constant of vacuum.

THESE GRAVITATIONAL FIELDS (4-5) ARE COMPONENTS OF THE GRAVITATIONAL FIELDS OF THE ELECTROMAGNETIC WAVES (PHOTONS) TO WHICH CORRESPOND GRAVITATIONAL ENERGIES AND MASSES. THESE ARE THE GRAVITATIONAL FIELDS, BECAUSE OF WHICH LIGHT BEAMS ARE ATTRACTED AND DISTORTED, WHICH FACT IS WRONGLY INTERPRETED AS DISTORTION OF SPACE.

It follows from (4-1) and (4-2) that

$$\vec{G} = -\frac{m_{e0}.\gamma}{r^2}.\vec{r}_0 = -\frac{\left(\mp q_e\right)^2.k_m.\gamma}{r^2}.\vec{r}_0; \tag{4-6}$$

This fact is unshakable evidence that the gravitational field is electromagnetic - secondary electromagnetic field, because it is generated by the electric E (4-5)a and magnetic H (4-5)b fields.

On the other hand, the fact that electromagnetic matter in field and substantial forms generates gravitational fields as well and generates gravitational forces, for example between electrons with masses m_{e1} and m_{e2}

$$\vec{F}_G = -\frac{m_{e1}.m_{e2}.\gamma}{c^2}.\vec{r}_0 = -\frac{\left(\mp q_{e1}\right)^2.\left(\mp q_{e2}\right)^2.\gamma.\vec{r}_0^2}{r^2}.k_m^2. \tag{4-7}$$

confirms the thesis that the unitary matter of Nature is electromagnetic matter.

Moreover, Newton's gravitation, described by equations in a form, analogous to Maxwell's equations for the electromagnetic matter, given by S. Poisson in 1813 are

$$\text{a) } rot\vec{G} = 0; \text{ b) } div\vec{G} = -\rho_m.4.\pi.\gamma; \tag{4-8}$$

where: ρ_m is density of electromagnetic matter (mass) of the object which generates gravitational field *G*; γ is gravitational constant.

Moreover, by treating the gravitational field as a secondary electromagnetic field, its unipolarity is motivated, for it is proportional to the square of the electric charge $\left(\mp q_e\right)^2$, which is always positive.

$$\vec{G} \equiv \left(\mp q_e\right)^2 > 0; \tag{4-9}$$

And up to this present day, a reliable proof for the gravitational field unipolarity is not yet known.

Moreover, Einstein wrote in his article "The meaning of relativity", Princeton Unic. Press. Princeton. N. Y. 1921: "Now we shall try to define the laws of gravitational field. For this purpose, we shall use for a model Poisson's equation in the theory of Newton $\text{div}G = -\rho.4.\pi.\gamma$" (P.P.'s note: her *G* is gravitational field; γ - gravitational constant).

"In the basis of this equation is the idea that the source of gravitational field is the density of substance ρ. So it is in the general theory of relativity, but the special theory of relativity shows that instead of scalar density of substance, we must operate with the tensor of energy related to a unit of volume. The latter,

however, does not include only the tensor of energy of substance, but also the electromagnetic field. In reality, substance consists of electrically charged particles and it must be considered as a part, as a major part, of electromagnetic field... from this viewpoint, we must introduce the tensor of second rank T_{ik}*..., which includes in itself the densities of energies of electromagnetic field and of substance.* Further, we shall refer to it as "tensor of energy and matter".

And in A. Einstein's article "Spielen die Gravitatins felder im Alfbau der materiellen Elementarteilchen eine wesentliche Rolle? Sitzungberpreuss. Akad. Wiss. 1919. T.I. (349 – 356), he wrote: "the equation of the field is

$$R_{ik} - \frac{1}{2} g_{ik}.R = -\chi.T_{ik} \,, \tag{4-10}$$

where: R_{ik} is Riemann's tensor of the curve, R – scalar of the curve; T_{ik} – tensor of the energy of matter".

Einstein in his article "Autobiograrisches (Autobiographical Notes)" in his book "Albert Einstein – Philosophers – Scientist" ed. by P.A. Schilpp. Evanston (Illinois) 1945, 1 – 95, after the notation (4-10) wrote: "The second term of the left part of the equation is added for formal considerations, namely: the left part is notated so, that its divergence, in the sense of absolute differential calculus is equal to zero. The right part includes everything that cannot be united in the unitary theory of field. ***Of course, I have never doubted even for a minute that this formulation (4-10) is only a temporary solution to the situation, which is made in order to […] of the general principle of relativity of such a closed-form expression. This formulation is essentially nothing else but a theory of gravitational field, which is artificially presented without the uniform field of a structure yet unknown" "..therefore we shall speak now only about the equations of pure gravitational field"*** (emphasis added by P.P.).

Further on he wrote: ***"In it (4-10) T_{ik} is a tensor of energy of electromagnetic field, which is generated by electrically charged particles, which form matter".***

In his article "Aeher und Rellativitätstheorie". Verlang von Julius Springer. Berlin. 1920, A. Einstein wrote, ***"According to our present-day view, in their nature, elementary particles of matter are nothing else but a thickened electromagnetic field".***

In his article "Grundgedanken und Probleme der Relativitätstheorie" in the book "Nobellstiftelsen, les Prix Nobelen 1921 – 1922" Imperemerie Royale. Stocholm. 1923, Einstein wrote: ***"IN ORDER TO COMPLETE THE FOUNDATIONS OF THE GENERAL THEORY OF RELATIVITY IT IS NECESSARY THAT WE INCLUDE IN IT ELECTROMAGNETIC FIELD, WHICH IS, ACCORDING TO OUR CONVICTION, THIS MATERIAL, OUT OF WHICH WE MUST BUILD THE ELEMENTARY FORMATIONS OF MATTER".***

WHENCE IT IS EVIDENT THAT EINSTEIN'S IDEA OF CREATION OF GRAVITATIONAL FIELD IS THAT ELECTROMAGNETIC MATTER GENERATES GRAVITATIONAL FIELD. AND ACCORDING TO THE GENETIC PRINCIPLE, THE GENERATING AND THE GENERATED ARE GENETICALLY HOMOGENOUS, I.E. GRAVITATIONAL FIELD IS A SECONDARY ELECTROMAGNETIC FIELD.

5. FLAWS IN THE PRINCIPLE OF CONSTANCY OF THE VELOCITY OF LIGHT – PCVL

The most accomplished definition of PCVL was given by Einstein in [1] (p. 677) where he stated: "***The other principle on which the special theory of relativity is based, is the principle of constancy of the velocity of light in vacuum (further herein, this principle will be referred to as PCVL – P. P.'s note). According to this principle, light always propagates at the same velocity in vacuum regardless of the state of motion of the observer and the source of light."***

In confirmation of the above definition, Einstein in [2] (p. 76), wrote: ***"When adding to the velocity of light another velocity smaller than c, we obtain again the velocity of light c"***.

And in [4] (p. 474), he wrote: ***"We remember that the velocity of light is the same towards all inertial frames of reference. This fact is incompatible with the classical transformations."*** Here, by classical transformations are meant Galileo's transformations - GT.

Or, this verbal definition of PCVL, described by a mathematical equation, on condition that the velocity smaller than c is designated by v_H (velocity of the observer) ($v_H < c$), the resultant velocity and according to PCVL, with the same directions of $\vec{c}$ and $\vec{v}_H$

$$\text{a) } u = c \pm v_H = c = \text{const.}; \rightarrow \text{ b) } v_H = 0; \tag{5-1}$$

Besides, in [3] (p. 13, paragraph 3) in the formula for addition of velocities, derived through Lorentz transformations (LT), it is assumed that one velocity, $v_1 = c$ and this it is obtained

$$\text{a) } u_c = \frac{v_1 + v_2}{1 + \frac{v_1.v_2}{c^2}};\ \text{b) } u_c = \frac{c+v}{1+\frac{c.v}{c^2}} = \frac{(c+v).c^2}{c^2+c.v} = \frac{(c+v).c^2}{(c+v).c} = c; \tag{5-2}$$

and after this formula it was written: "***Further on it follows that when we add the velocity of light to a velocity, which is smaller than the velocity of light*** $(v < c)$***, it cannot be measured"***. *I.e. the mathematical notation of PCVL by equation (5-1) holds true, but here the assumption of* $v_1 < c_1$ *in the formula obtained by LT is not correct because formula (5-2)a is deduced through LT which are not valid at v = c, since they get annulled, as it is seen from the following formulae of LT when* $v = c$ *is assigned*

$$\text{a) } x' = \frac{x - v.t}{\left(1 - \frac{v^2}{c^2}\right)^{1/2}} = \frac{x - c.t}{\left(1 - \frac{c^2}{c^2}\right)^{1/2}} = \frac{x - c.t}{(1-1)} \to \infty;$$

$$\text{or b) } t' = \frac{t - v.t}{\left(1 - \frac{v^2}{c^2}\right)^{1/2}} = \frac{c^2.t - c.t}{c^2.(1-1)} = \frac{c^2.t - c.t}{c^2.0} \to \infty; \tag{5-3}$$

Despite the above arguments for PCVL, Einstein himself in the same article [3] in paragraph 7 "Aberration and Doppler's effect theory" which are calculated through Lorentz transformations, at angle $\upsilon = 0$ between the straight, which connects the source of light and the velocity *v* of the observer, for the frequency ν' in Doppler's effect depending on the generator frequency ν_0 of light by this law

$$\nu' = \frac{\nu_0.(c \mp v)}{c.\left(1 - \frac{v^2}{c^2}\right)^{1/2}}; \tag{5-4}$$

Here the term $\left(1 - \frac{v^2}{c^2}\right)^{1/2}$ in the nominator is consequence of LT. And the value of the length λ' of the light wave was not given in paragraph 7. As it is known, however, according to LT, lengths are shortened, and from paragraph 4 of [3] it also follows that λ' is

$$\lambda' = \lambda.\left(1 - \frac{v^2}{c^2}\right)^{1/2}; \tag{5-5}$$

It follows from (5-4) and (5-5) that the velocity of light changes from the Doppler's effect

$$u_c = \nu'.\lambda' = c \mp v \neq c; \tag{5-6}$$

i.e. Einstein proved through the Doppler effect that the velocity of light relative to a moving observer is not equal to c, but can be higher or lower than c, i.e. PCVL does not exist, and the fact that PCVL does not exist, given in writing by Einstein himself, entails that all other claims which result from PCVL drop off.

IN OTHER WORDS, IT WAS EINSTEIN HIMSELF WHO PROVED, IN THE SAME ARTICLE [3], IN WHICH HE FIRST ARGUED THAT PCVL EXISTED (5-1) AND (5-2), THAT SUCH A PRINCIPLE DOES NOT EXIST.

Interestingly enough, for over a hundreds years now, it has been argued in physics that PCVL exists and no one has ever noticed that the article, in which the special theory of relativity was first published, turns out to disprove this same argument – there is no STR, because it is validated through PCVL, and PCVL is not a reality, it is a chimera.

Literature

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6. FLAWS IN LORENTZ TRANSFORMATIONS (LT)

6.1. Initial formulations

Lorentz transformations in motion of inertial reference system, IRS, in parallel to axis x are

$$\text{a) } x'=\frac{x-v.t}{\left(1-\frac{v^2}{c^2}\right)^{1/2}};\ \text{b) } y'=y;\ \text{c) } z'=z;\ \text{d) } t'=\frac{t-\frac{v^2}{c^2}}{\left(1-\frac{v^2}{c^2}\right)^{1/2}}; \tag{6-1}$$

In [1] (p. 201) Einstein wrote: "... It turns out that even in infinitely small space-time areas, Lorentz transformations do not hold true, if we reject the idea of the constancy of the velocity of light."

The previous item 5, equation (5-1) describes the principle of constancy of velocity of light, PCVL, relative to the observer

$$u_c = c \pm v_H = c = \text{const.}; \tag{5-1}$$

which, applied to LT (6-1) gives the following results:

a) only for the nominators of (6-1)a and (6-1)d, reduction is obtained into

$$\left(1-\frac{v^2}{c^2}\right)^{1/2}=\left(\frac{c^2-v^2}{c^2}\right)^{1/2}=\left(\frac{c^2}{c^2}\right)=1; \tag{6-2}$$

b) for this purpose (6-1)a and (6-1)d of LT are reduced into

$$\text{a) } x'=\frac{x-v.t'}{\left(1-\frac{v^2}{c^2}\right)^{1/2}}=\frac{c.t'-v.t'}{1}=\frac{(c-v).t'}{1}=c.t';\ \text{b) } c=\frac{x'}{t'};$$
$$\text{c) } t'=\frac{c^2.t-v.t}{c^2\left(1-\frac{v^2}{c^2}\right)^{1/2}}=\frac{c^2.t-v.c.t}{c^2.1}=\frac{c(c-v).t}{c^2}=\frac{c^2}{c^2}.t=t;\ \text{d) } t'=t; \tag{6-3}$$

Or, when PCVL is assumed, LT, out of which they are deduced, are essentially obtained in another form of notation of PCVL, in this form

$$\text{a) } x'=c.t';\ \text{b) } t'=t;\ \text{c) } y'=y;\ \text{d) } z'=z;\ \text{e) } t'=t; \tag{6-4}$$

Here it is characteristic of LT that they are only another kind of notation of PCVL

$$\text{a) } \frac{x}{t}=\frac{x'}{t'}=...=\frac{x^n}{t^n}=c;\ \text{b) } x=c.t;\ \text{c) } x'=c.t'; \tag{6-5}$$

I.e. the velocity, which was determined in [4] (paragraph 2) by the expression

$$\text{speed} = \frac{\text{distance}}{\text{time}} = \frac{x}{t} = \frac{x'}{t'} \ldots = c; \tag{6-6}$$

This was confirmed by Einstein in [2] (p. 548), where for (6-5) he wrote: "This equation describes the propagation of light, when it refers to system K'. In this way, the velocity of light is equal to c relative to the referential system K as well. **This is evident, as the equations of the Lorentz transformations are deduced exactly in supposition of this result**" (emphasis added by P.P.) *This was shown in supplement 2 by formulae (2-19) .*

But this situation for LT contradicts Doppler's effect – DE, as laid down in the previous item 5; what is more, DE was confirmed experimentally long before article [4] and based on that experiment, a number of measuring devices have been made, whereas there is no experiment to confirm the PCVL, as described by LT; on the contrary, DE rejects it.

It is apparent from the presented here that LT are not transformations for describing how a phenomenon occurring in system K would look in system K' moving at uniform velocity $v = const.$ ***relative to K, but are only another kind of notation of PCVL.***

6.2. Experiment which rejects LT

According to LT, moving bodies, watched by external observers, i.e. observers in an external IRS – *K'*, relative to IRS – *K* of these where the bodies are, which system moves at velocity $v = \text{const.}$ their lengths L_0 in IRS – *K* get shortened for the observers in IRS – *K'* to L_1, and the times of motion T_0 in IRS – *K* get lengthened to *T* for the observers in IRS – *K*', i.e.

$$\text{a) } L = L_0 \cdot \left(1 - \frac{v^2}{c^2}\right)^{1/2}; \quad \text{b) } T = T_0 \cdot \left(1 - \frac{v^2}{c^2}\right)^{-1/2}; \tag{6-7}$$

Whereby Einstein wrote:

a) In [3] (p. 177): "***The shortening does not exist for the observer, who moves along with the body, but it is real for the observer, who does not move with the body and can be proved by physical means for an observer, who does not move together with the body***".

b) In [1] (p. 201) he wrote: "*... It turns out that even in infinitely small space-time areas, Lorentz transformations do not hold true, if we reject the idea of the constancy of the velocity of light c*".

But to this present moment there are none of experimental facts which prove formulae (6-7), and yet they are available in all books of physics.

The scheme of the experiment for disproval of Lorentz transformations is given in fig. 6.1. It consists of:

a) Michelson's interferometer, fixed to a source *G* of light momentums p_i of durations T_{0i} and intervals between them T_{0j};

b) Transmitter H_k of the returned and reflected by the mirrors *A* and *B* momentums at the ends of the arms $\overline{OA}$ and $\overline{OB}$ of the interferometer with center *O* to the system *K'*;

c) Reference system *K'* with coordinates *X'* and *Y'*, which are parallel to the coordinates *x* and *y* of the system *K*, which coincides with the interferometer. The systems *K* and *K'* move towards each other at velocity $\pm v$. In the system *K'* there is receiver $H_k^{'}$ which is a fixator (observer) of the times of the arriving light momentums of H_k.

The procedure of the experiment is as follows. From the beginning *O* of the interferometer in the system are emitted light momentums of frequency ν_0 along the two arms $\overline{OA} = r_0$ and $\overline{OB} = r_0$ of the interferometer. ***The momentums*** p_{ai}, p_{bi} ***are reflected by the mirrors A and B and return to the beginning O, and regardless of whether K moves or not, the times of the momentums, needed for covering the distances*** $\overline{OA}O$ ***and*** $\overline{OB}O$ ***are equal to:***

$$\Delta t = \Delta t_A = \frac{2\overline{OA}}{c} = \frac{2r_0}{c} = \frac{2\overline{OB}}{c} = \frac{2r_0}{c} = \Delta t_B; \tag{6-8}$$

and this is known from Michelson-Morley's experiment – MME. *Moreover, according to Fresnel 1828, since the velocity of light, relative to a transmitter is always c = const. and does not depend on its state of motion, and here the whole system of the interferometer is a transmitter, including points O, A and B, fixed to one another. Therefore the velocity of light relative to these points is c = const. and therefore MME indicates that the velocity of light relative to OA and in is c = const.*

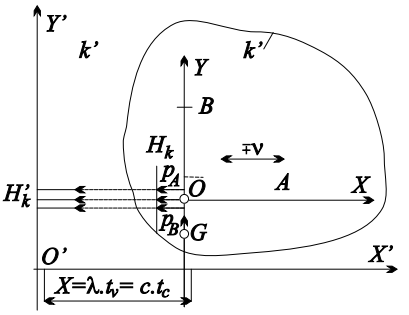

Fig. 6.1.

After that the momentums (beams) p_{ai}, p_{bi} hit the transmitter H_k and are transmitted by the system K to the system K' and hit the receiver H'_k after equal times:

$$\Delta t' = \Delta t_A = \frac{x}{c} = \frac{v.t_v}{c} = \Delta t_B; \tag{6-9}$$

Since the velocity of the transmitted waves does not depend on the velocity of motion of the transmitter, such as is the whole Michelson's interferometer, and the lengths of the pathways of the two beams are equal to r_0, depending on the relative velocity v between K and K' for a random time t_v.

It follows from (6-9) and (6-10) that although the systems K and K' are in relative motion, the beams p_{ai} *and* p_{bi}, transmitted from O along the two arms of the interferometer reach K' for equal times, frequencies, lengths of waves and velocities of light along both arms $\overline{OA}$ and $\overline{OB}$, i.e. these equations hold true:

$$\text{a) } L = L_0; \text{ b) } T = T_0; \tag{6-10}$$

I.e. the inference (6-8) of LT is rejected, and only Galileo's transformations, GT, remain in physics.

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7. FLAWS IN THE QUANTUM MECHANICS STATEMENT THAT IN CLASSICAL PHYSICS ENERGY PROPAGATES CONTINUOUSLY

In 1900, M. Planck introduced the formula of the energy of the photon

$$W_f = h.\nu; \tag{7-1}$$

where: h is Planck's constant; ν- frequency of the waves of the photon.

About this formula, H. Wichmann in his book "Quantum Physics. Berkeley Physics course", chapter 1, paragraph 46, wrote:

"It will further become clear that formula (46)a $\left(h = \frac{W}{\nu}\right)$ *expresses the fundamental principle of quantum physics, namely, the universal character of this relation between the energy and the frequency* $W = h.\nu$. ***This relationship is absolutely alien to classical physics. And the mysterious constant h is a manifestation of the secrets of nature yet to be revealed****." (*emphasis added by P.P.*)*

In 1914, P. Ehrenfest published an article[*] in which he proved that the structure of formula (7-1) for the energy of the photon, which is for a certain interval of time

$$\Delta t = n.T_0 , \tag{7-2}$$

(where: n = integer; T_0 – period of one wave $T = \nu^{-1}$) was not unique, but universal and holds true for all wave processes in macrophysics, too.

He studied the energy of the oscillating process of a pendulum for a given (finite) interval of time Δt and found that the value of the energy is

$$W_M = \text{const.}\nu; \rightarrow W_M = H.\nu; \tag{7-3}$$

where: const. = H is the constant, which depends on constructive parameters of the pendulum.

The calculations (see Chapter Six, paragraph 6) made by the author (P. Penchev) of the wave energies for a given (finite) interval of time $\Delta t = n.T_0$ on:

a) oscillating mechanical motion;
b) mechanical waves in elastic environment;
c) ordinary electromagnetic waves;
d) oscillating mesh of capacity c_0 and inductivity n_0.
showed that for the energies, formula (7-3) holds true, i.e.

$$W = H.\nu; \tag{7-4}$$

where: H is a constant that depends on the constructive parameters of the transmitter of waves (oscillations).

I.e. the statement in quantum mechanics that the structure of the formula (7-1), or respectively, that the emitted wave energy is in portions (quanta)[**] only in quantum mechanics [in emission of atoms (molecules)], is flawed.

Under these conditions, a question arises as to how we should interpret Heisenberg's inequality for macro processes, where an equation analogous to that (7-1) of M. Planck holds true, but it refers to physics in general.

The cited fact makes negative impression because for almost 90 years the specialists in the area of quantum mechanics have applied a selective approach toward experimental facts, and have suppressed those which are not in favor of quantum mechanics.

And what actually are the dimensions of the photon.

It is known about the photon that:

a) approximate time of emission is $\tau \approx 10^{-8}$ s ;

b) the velocity of emission of the photon is equal to its velocity of motion, equal to the velocity of light $c = 3.10^8$ m/s^{-1}.

c) the diameter of the photon cross section is $D \approx 10^{-7}$ m;

d) the length of the photon is

$$\ell_v = \tau.c = 10^{-8}.3.10^8 = 3 \text{ m}; \tag{7-5}$$

With frequency of light waves $\nu = 10^{15}$ Hz , the photon is carrier of N waves of length

$$\lambda = \frac{c}{\nu} = \frac{3.10^8}{10^{15}} = 3.10^{-7} \text{ m}; \tag{7-6}$$

and

$$N = \frac{\ell_v}{\lambda} = \frac{3}{3.10^{-7}} = 10^7 \text{ number of waves} \tag{7-7}$$

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[*] According to A. M. Hazem's book "Field, waves, particles and their models", publ. "Prosveshtenie". M. 1979. (chapter 5, paragraph 2, p. 78)

[**] The notion of quant means (denotes) a limited quantity (quantity – a portion of energy), quantity of mass – portion of mass. In physics all formulae are only with quantized (limited in their value quantities) quantities (limited quantities). *Physics does not use unlimited (non-quantized) quantities.* ***I.e., the whole physics is quantized – it is a quantum physics.***

This fact makes it apparent that the length of the photon is 3 m, i.e. the photon is far from a quantity of microscopic dimensions, which fact poses questions before quantum mechanics. And hence the question, why has this fact been suppressed and the photon has been treated as a microquantity with dimensions below those of the atom.

8. THE STATEMENT THAT THERE ARE DE BROGLIE'S WAVES IS FLAWED

Here we proceed from the assumption that the essence of de Broglie's statement is the one presented in the paragraphs of Chapter 5 in the book "Quantum Physics. Berkeley Physics course". Vol. IV by E. H. Wichmann, McGraw-Hill Book Company, 1967.

1. In § 1. he writes: "The material particles have wave properties. This simple experimental fact is widely known."

2. In § 35. he writes: "*De Broglie's waves are not waves, which move along with the classical particle and lead it.* ***De Broglie's waves and the particle - this is the same object****. And there is nothing else. The reality is that the particles are a natural fact and have the properties of waves."*

3. In § 29. he writes: "The electrons have wave properties, but they are not waves in the classical sense, because the electronic wave packet cannot be split, in contrast to the classical wave packet."

4. In § 4. he writes: *"It is sensible that the velocity of the particle with mass m be identified with the group velocity."*

5. In § 5. he writes: "We assume that the dependence $W_0 = \hbar.\omega$, which holds true for the photon, holds true for the material particles as well. Then

$$\hbar.\omega = W_0 = \frac{m_0.c^2}{\left[1-\left(\frac{v^2}{c^2}\right)\right]^{1/2}} = W_T; \tag{8-1}$$

where: $\hbar = \frac{h}{2.\pi}$ is Planck constant; ω – angular frequency; v – velocity of a body with mass m_0 at rest; c – velocity of light; W_T is the full energy of a body with mass m_0 at rest and at velocity v.

6. In a systemized form, the quantities of de Broglie's waves, according to E. H. Wichmann are:

$$\text{a) } \lambda_B = \frac{h}{m.v};\ \text{b) } v_B = \frac{m.v^2}{h};\ \text{c) } k_B = \frac{\omega_B}{v} = \frac{2.\pi.m.v}{h};\ \text{d) } W_0 = h.v_B = m.v^2; \tag{8-2}$$

The emphasis is on the text: "***De Broglie's waves and the particle - this is the same object***" i.e. ***"de Broglie's waves are not emitted waves moving outside the body, but they coincide with the body itself"***

According to the above definitions, the energy of de Broglie's waves W_0 (8-2)d and the full energy of the body

$$W_T = m_0.\left(1-\frac{v^2}{c^2}\right)^{-1/2}.c^2; \tag{8-3}$$

are not equal. And since the value W_T is experimentally confirmed, and

$$W_0 = m_0\left(1-\frac{v^2}{c^2}\right)^{-1/2}.v^2 \ll W_T; \tag{8-4}$$

since

$$k_W = \frac{W_0}{W_T} = \frac{v^2}{c^2} \ll 1; \tag{8-5}$$

At a velocity of the electron in the atom, say, $v = 5.10^6$ m/s , k_w , it is

$$k_W = \frac{25.10^{12}}{9.10^{16}} = 2,77.10^{-4}; \tag{8-6}$$

The length of de Broglie's waves for this electron is

$$\lambda_B = \frac{h}{m_0.v} = \frac{6,62.10^{-34}}{9,1.10^{-31}.5.10^6} = 4,27.10^{-8} \text{ m;} \tag{8-7}$$

and its frequency is

$$\nu_B = \frac{v}{\lambda_B} = \frac{5.10^6}{4,27.10^{-8}} = 1,17.10^{14} \text{ Hz;} \tag{8-8}$$

therefore, the energy of de Broglie's waves of the electron is

$$W_{Be} = h.\nu_B = 6,62.10^{-34}.1,17.10^{14} = 7,75.10^{-20} \text{ J;} \tag{8-9}$$

That electron, with energy $W_{Be} = 7,75.10^{-20}$ J , in case of collision into a solid body, according to chapter 5, paragraph 13 of Wichmann's book, should emit a photon with energy $W_f = 1,2.10^{-15}$ J . Quite naturally, it cannot do that. ***This fact is the proof that the electrons in the atom cannot be considered as de Broglie's waves.*** Besides, according to the definition of Wichmann "de Broglie's waves and particles – this is one and the same object", i.e. de Broglie's waves are not emitted waves, but in reality, the particles are a natural fact and they have the properties de Broglie's waves. ***Therefore, since de Broglie's waves are not emitted waves, but coincide with the body, a method should be found to measure them, which method should be radically different from the method of the emitted and independently existing waves; such a method has not been given in quantum mechanics.***

In the book G. L. Trigg "Crucial Experiments in Modern Physics. Van Nostrand Reinhold Company. New York. London. 1971, in the article by Davisson C. J. Germer L. The Physical Review. 30 (1922) there is text that states: "Of course, these results lead us to the thought of ideas which are in the basis of the theory of wave mechanics and we are trying to clarify whether really the length of a beam of X-rays, which we associate with a beam of electrons, are a de Broglie's quantity $h/m.v$. It turns out that such a comparison is possible to make." In Trigg's book, below Fig. 10.7 it is written: "Davisson and Germer write in Nature magazine: If the falling electron beam were replaced by a monochromatic beam of X-rays, we would observe very similar phenomena... That is why they (Davisson and Germer – P.P.;s note) sought correspondence between the lengths of the X-rays and ten electron beams."

Davisson and Germer's analys is made of X-rays with a length wave according to de Broglie: $\lambda = h/m.v$. ***They, however, did not take into consideration that the velocity of the electron is*** $v_e = 10^6$ m/s^{-1}, ***while the velocity of X-rays is*** $v_R = c = 3.10^8$ m/s ***and also that the electron can never have a velocity*** $v_e = 3.10^8$ m/s^{-1}. ***But the fact is that electrons have a velocity about*** $v_e \approx 10^6$ m/s^{-1} ***and X-rays have a velocity*** $c = 3.10^8$ m/s , ***at the same wave length*** $\lambda_B = h/m_v$ ***or frequency*** $\nu_B = \frac{v_c}{\lambda_B} = \frac{m.v_e^2}{h}$, ***and for X-rays the frequency is*** $\nu_R = \frac{c}{\lambda_B} = \frac{m.c.v_e}{h}$.

Thence their energies are

$$\text{a) } W_B = n.\nu_B = m.v_e^2; \text{ b) } W_R = h.\nu_R = m.c.v_e; \tag{8-10}$$

or

$$W_B \ll W_R; \tag{8-11}$$

Therefore, there is no reason to make analogy between the hypothetical de Broglie's waves and X-rays. I.e. the fact of incongruity of their energies rejects any possibility for de Broglie's waves to exist. This is a serious lapse in Davisson and Germer's method, and therefore, it does not prove that electrons and and bodies in general are with de Broglie's waves, i.e. there are not and there cannot be de Broglie's waves. Here the most decisive fact against de Broglie'd waves is their non-compliance with the law of energy conservation, described by equation (8-5).

In this sense, Davisson-Germer method, which is considered to have proved de Broglie's waves, because it proves the presence of emitted electromagnetic waves (X-rays), does not prove de Broglie's waves of electrons that move along with the electrons. I.E. UNTIL PRESENT DAY, NO METHOD HAS BEEN

FOUND WHICH ALLOWS DE BROGLIE'S WAVES TO BE MEASURED, NOR IS THERE ANY EVIDENCE THAT THESE WAVES DO EXIST. AND THIS FACT (DAVISSON-GERMER EXPERIMENT) ALSO PROVES THAT DE BROGLIE'S WAVES AND SCHRÖDINGER'S EQUATION HAVE NOTHING IN COMMON, BECAUSE THERE IS NO PROOF OF THE EXISTENCE OF DE BROGLIE'S WAVES.

THE IDEAS SET FORTH ABOVE PROVE THAT THE ELECTRONS IN THE ATOM, EVEN AS INDEPENDENT ENTITIES, CANNOT BE CONSIDERED AS DE BROGLIE'S WAVES, AND THIS FACT ENTAILS THAT SCHRÖDINGER'S EQUATION DOES NOT REFLECT ANY PHYSICAL REALITY.

The use of Schrödinger's equation to obtain the above "reliable" results in inverted commas is a result of ascribing unreal properties to de Broglie's waves. For example, W. Pauli in his article "Die allgemeinen Prinzipen – der Wellenmechanik"-In& Handbuch der Physik. Bd.24. Teil 1.1933 , in §-1. writes:

"*The final crucial turn in quantum theory occurred thanks to the discovery of the waves of de Broglie's matter, advancement of matrix mechanics of Heisenberg and the appearance of the general wave-mechanic differential equation of Schrödinger, which made it possible to connect these two circles of ideas...*"

"The notion of light quanta was introduced to enable the computation of the exchange of the energy of momentum between light and substance." …"**The laws for conservation of energy and momentum are strictly observed.**" … "If momentum $p = \frac{\hbar.\omega}{c}$ is determined to the light quantum, and the energy is $\hbar\omega\left(\hbar = \frac{h}{2.\pi}\right)$. Proceeding from the vector $\left|\vec{k}\right| = \frac{\omega}{c}$, we can write:

$$\vec{p} = \hbar.\vec{k}\ ;\ W = \hbar.\omega\ ; \qquad \text{(I)} \qquad (8\text{-}12)$$

... "that normal matter has wave properties, too, moreover, here the wave vector and the frequency of the waves are determined by the relations (I) as well, which are now considered to be universal (P. P.'s italics). Existence of the waves-particles dualism and the reliable veracity of the correlation (*I*) for matter as well - this is the actual content of de Broglie' s hypothesis about the waves of matter."

However, there is a discrepancy here (in Pauli) between science and reality, since for electromagnetic waves the energy is

$$W_c = h.\nu = m.c^2\ ; \qquad (8\text{-}13)$$

while for de Broglie's waves the energy is

$$W_{\text{B}} = h.\nu_{\text{B}} = m.v^2 = 2W_{\text{k}} = 2\left(\frac{mv^2}{2}\right) << W_c\ ; \qquad (8\text{-}14)$$

I. E. THE CORRELATION (I) DOES NOT HOLD TRUE FOR DE BROGLIE'S WAVES. IT WOULD BE VALID, IF THE VELOCITY V = C. AND WHEN ONLY THE LENGTH OF THE WAVE IS USED FOR COMPARISON, THE UNREALITY IS CONSPICUOUS.

Moreover, it has not been proved that de Broglie's waves can be attracted by the atomic nucleus so as to move around it and within the atom.

Schrödinger, in his first publication in Amn. Physic. 1926. 79.361. as well as later in the article "The wave theory of the mechanics of the atoms and the molecules" in Phys. Rev.1926.28.1049. l §-1, wrote: "The theory, which is set fourth on the following pages is based on the very interesting and profound research of L. de Broglie on the so called „phase waves" and is applicable to the motion of the material particles, in particular to the electron and the proton."

E. H. Wichmann* in Ch. 7 "The wave mechanics of Schrödinger", § 7, wrote: "**The theory of Schrödinger is based on the wave equation, which is known under the name of Schrödinger's equation. His solution is de Broglie's wave „bound" with the particle".**

Wichmann in Ch. 9. „Elementary particles and their interactions" under the title „Basic ideas of the quantum theory of field", in §-32, wrote: "The classical idea of two particles interacting with forces corresponds to the quantum mechanical idea of interaction between de Broglie's waves. This means that de Broglie's waves of one particle exert influence on the propagation of de Broglie's waves of the other particle." In §-40, he wrote: "If the interaction between the particles is implemented through a field, this field must be in the form of freely propagating and energy-carrying waves". And in §-41, he wrote: "**In quantum physics, we formulate a theory of the field which in essence is de Broglie's waves of the particles.**"

* E. H. Wichmann Quantum Physics. Berkeley Physics course. Vol. IV. McGraw-Hill Book company.

Conclusion to item 8

Since the essence of the theory of the wave, quantum mechanics, depends on de Broglie's waves, and their existence is questionable, this theory should be given a second thought in the spirit of actual facts, the most fundamental of which are the theories of Max Planck and Niels Bohr, which result from the classical electrodynamics

P.S. *The rejection of the theory of de Broglie's waves is another fragment on the road of history of physics.*

9. FLAWS IN HEISENBERG'S INEQUALITY

This inequality states: The impreciseness in the definition of the coordinate in Δx microphysics is connected with the impreciseness in the definition of the momentum Δp of the particle, or the impreciseness in the definition of its energies ΔW is function of the impreciseness of the time Δt, and two variants are given a) and b) of Heisenberg's inequality.

$$\text{a) } \Delta p.\Delta x \geq h \text{ ; b) } \Delta W.\Delta t \geq h \text{ ; c) } W_f = h.\nu = h/\Delta t; \tag{9-1}$$

But when we take into the account the fact that in the wave processes, the frequency $\Delta\nu$ is equal to $1/\Delta t\left(\nu = \frac{1}{T}\right)$, i. e. $\Delta\nu.\Delta t = 1$ then, applying it in (9-1)a, we have

$$\text{a) } \Delta p.\Delta x = \Delta p.\Delta v.\Delta t \geq h \text{ ; b) } \Delta p.\Delta v = \Delta W = \frac{h}{\Delta t} \geq h.\Delta\nu \text{ ; } c) \rightarrow \Delta W \Delta t > h \text{ ;} \tag{9-2}$$

but the expression (9-2)b when using only of the equation (=) is equal to

$$\text{a) } \Delta W = h.\Delta\nu \text{ ; } \rightarrow \text{b) } W_{\text{f}} = h.\nu \text{ ;} \tag{9-3}$$

i. e. *this is a notation, according to quantum mechanics, of the law of the energy of the photon W_f and at the same time is a notation of the conservation of the energy of the photon.*

In this sense, so that energy of the electron W_f can increase, according to (9-2)b, additional energy ΔW_{f} is needed, a fact which is rejected by the law of energy conservation. That is why if such data are obtained in measurement, they are considered invalid.

Here arises the question, since it was proved in item 7 by P. Ehrenfest as far back as in 1914 that energies according to classical physics also propagate in portions (quanta)

$$W = H.\nu; \tag{9-4}$$

analogous to the photon (9-3)b, does Heisenberg's inequality hold also true for macro processes, for their portions of energy are described by a formula of the same structure, or if not, why. This reasonable question is generally connected with physics on micro and macro level, but there is no answer.

But since Heisenberg's inequality (9-1) has been disproved

a) by the law of energy conservation;

b) due to the fact that if we measure Δp or ΔW equation (9-1), then we always know in which place Δx or at what time Δt the measurement was made, and

c) that the law of energy conservation is always true, it follows that the law of Heisenberg's inequality should drop out of physics.

MOREOVER, SINCE SO FAR THERE HAS NOT BEEN A SINGLE EXPERIMENTAL VALIDATION OF THIS LAW, THEREFORE, ACCORDING TO THE PRINCIPLE OF PHYSICS, THERE IS NO REASON TO ACCEPT IT AS A REAL TRUTH.

P.S. *Heisenberg's inequality is another fragment on the road of history of physics, because it is a conventional, not an experimental truth.*

10. FLAWS IN SCHRÖDINGER'S EQUATION

Since this equation, in accordance with the ideas set forth in item 8 concerning the flaws in de Broglie's waves, according to Schrödinger and Wichmann, is based on the existence of de Broglie's waves, which are not a reality, it follows that Schrödinger's equation is also flawed.

Some general reasons which determine the fact that it cannot give a solution with specific numerical values for probabilities in specific unequivocal boundary conditions, for example about the state of electrons in the atom, are:

1. ***In principle, it is impossible to give real boundary conditions for the quantities associated with the states of the electrons, such as: a) the radius; b) the potential and c) the kinetic energy. And they are components of Schrödinger's equation without which no specific, real solution can be obtained***.

2. In principle, there is no real method for measuring the specific real numerical values of the probabilities.

3. *There are no known experimental data, validating that this equation describes real phenomena, referring to the electrons in the atom or a specific comparison of* ***obtained specific experimental numerical values for specific boundary conditions with experimental data on the same conditions, as it is done for all real physical laws and theories.***

4. There is no experimental validation of the formulations, which are used in this equation, such as:

1. that the electrons in the atom are in the form of de Broglie's waves and that they, being waves, move in the closed space of the atom around its nucleus and that the electrons do not have a trajectory because they are waves.*

2. How could it be explained why, in Schrödinger's equation, there is a radius with the nucleus as its center since the claim is that the electrons do not have trajectories; the availability of this radius speaks exactly of the opposite.

3. That, for a short time, the energy of the electrons as waves can have values greater than those determined by the law of energy conservation. And there are no experimental data that for the electrons, as de Broglie's waves, the law of energy conservation does not hold true.

Inferences

1. There are no numerical experimental data proving that Schrödinger's equation describes real physical phenomena (facts) in the atom as numerical values of probabilities, i.e. there are not and there cannot be any specific experimental data validating it; therefore, it should be rejected.

2. IT IS A SERIOUS PHYSICAL ERROR TO CLAIM THAT HEISENBERG'S INEQUALITY MOTIVATES THAT THE LAW OF ENERGY CONSERVATION IS NOT OBLIGATORY FOR A SHORT TIME, FOR SCHRÖDINGER'S EQUATION, THAT IS WHY THERE ARE NO EXPERIMENTAL DATA VALIDATING THIS EQUATION.

CONCLUSION

With the present situation of interpretation of Schrödinger's equation, there is no reason to assume that this equation reflects real physical facts (phenomena) in the atom except the reasoning of a number of scientists without any facts, i.e. it is a conventional (conformist) truth rather than an experimental one. That is why it should not be used as a physical law, there is no place for it in physics, and alongside with that, for quantum mechanics, either.

P.S. Schrödinger's equation is another fragment on the road of history of physics because it is conformist) truth rather than an experimental one.

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* In his book *General Physics,* D. C. Giancoli, 1894, in paragraph 40.5 is calculated the length of the de Broglie's wave of an electron in the atom as $\lambda_B = 1,2.10^{-10}$ m and frequency $\nu_B = 4,9.10^{16}$ Hz .. But nothing is given about their measured real values, although these values are measurable since photons have length $\ell_f = 3$ m , moreover, the frequency $\nu = 4{,}910^{16}$ Hz is measurable, and yet it has not been measured. Furthermore, no method (algorithm) has been given in physics about how to measure the values, frequency, length of the wave and energy of de Broglie's waves. Since in Wichmann's Berkeley Physics course, Quantum Physics, volume IV. Mc. Graw, Hill Rock company. 1967, paragraph 35 states: "De Broglie's waves and the particle – this is the same object." I.e. these waves are indistinguishable in an object.

11. FLAWS IN N. BOHR'S STATEMENT THAT THE STATIONARY ORBITS OF ELECTRONS IN ATOMS CONTRADICT CLASSICAL PHYSICS AND THAT THEY ARE ONLY A QUANTUM EFFECT

11.1. Initial conditions

11.1.1. The simplest atomic structure of the hydrogen atom is used as a model in the analysis. The hydrogen atom has the main features of emission of electromagnetic waves, in the form of photons; such are in all atoms, where, however, the number of other electrons exerts influence.

Here the electric charges of the nucleus $q_я$ and of the electron q_e have equal values and opposite signs $\left(|q_я| = |q_e|\right) > 0, q_e < 0$.

We proceed from the electromagnetic laws of classical electrodynamics, such as.

First. ***When an electric charge (q_e) moves, a magnetic field (H) in induced around it proportional to its velocity (v), and the magnetic energy (W_H) is proportional to the square of H and the square of v ($W_H \equiv H^2 \equiv v^2$).***

Second. ***When an electric charge moves at acceleration ($\vec{a}$), it emits electromagnetic energy (wave) with power N, which is proportional to the square of the acceleration $\vec{a}\left(N \equiv a^2\right)$ and the square of the electric charge Q_e^2.***

The electron moves in a circular orbit with radius *r* and *n* revolutions per second at velocity

$$\text{a) } v = 2.\pi.n.r \text{ ; b) } r = \frac{v}{2.\pi.n} ; \tag{11.1-1}$$

11.1.2. In this model, the electron is characterized by:

1. The electric field $\vec{E}_e$ with density of the electrostatic energy w_e, the electrostatic energy W_E and mass m_{e0} at rest of the electron, which are respectively:

$$\text{a) } \vec{E}_e = \frac{q_e.\vec{r}_0}{4.\pi.\varepsilon_0.r^2} \text{ ; b) } w_E = \frac{\varepsilon_0.E_e^2}{2} = \frac{q_e^2}{2.\varepsilon_0.\left(4.\pi.r^2\right)^2} ; \tag{11.1-2}$$

$$\text{a) } W_E = \int_{r_{e0}}^{\infty} w_e.dV = \int_{r_{e0}}^{\infty} w_e.4.\pi.r^2.dr = \frac{q_e^2}{4.\pi.\varepsilon_0.r_{e0}} = q_e^2.k_e \text{ ; b) } k_e = \left(4.\pi.\varepsilon_0.r_{e0}\right)^{-1} ; \tag{11.1-3}$$

$$\text{a) } m_{e0} = \frac{W_E}{c^2} = q_e^2.k_m \text{ ; b) } k_m = \left(4.\pi.\varepsilon_0.r_{e0}.c^2\right)^{-1} ; \tag{11.1-4}$$

2. The magnetic field $\vec{H}$, the density of the magnetic energy w_H and the magnetic energy of the electron W_{He} respectively at $v \ll c$ are

$$\text{a) } \vec{H} = \varepsilon.\left[\vec{v}.\vec{E}_e\right] = \frac{q_e.v\vec{i}}{4.\pi.r^2} ; \text{ b) } \vec{i} = \left[\vec{v}_0.\vec{r}_0\right] ; \text{ c) } \vec{v}_0.\frac{\vec{v}}{|\vec{v}|} ; \tag{11.1-5}$$

$$w_H = \frac{\mu_0.H^2}{2} = \frac{\mu_0.q_e^2v^2}{2.\left(4.\pi.r^2\right)^2} = \frac{q_e^2v^2}{2.\left(4.\pi.r^2\right)^2.\varepsilon_0.c^2} \text{ ; b) } \mu_0 = \frac{1}{\varepsilon_0.c^2} ; \tag{11.1-6}$$

$$W_{HE} = \int_{r_{e0}}^{\infty} w_H.dV = \frac{q_e^2.v^2}{8.\pi.\varepsilon_0.c^2}.\int_{r_{e0}}^{\infty} \frac{dr}{r^2} = \frac{q_e^2.v^2}{4.\pi.\varepsilon_0.r_{e0}.c^2.2} = \frac{m_{e0}.v^2}{2} ; \tag{11.1-7}$$

These laws (11-1-5), (11-1-6) and (11-1-7) are also experimentally validated for the electrons in the atoms of conductors through which runs electric current, which is a flux of electric charges (electrons) from the atoms of the electric conductor or electronic flux, regardless of their flawed treatment as de Broglie's waves in quantum mechanics.

where: μ_0 is the magnetic constant of vacuum; r_{e0} - computational radius of the electron.

3. The electric field of the nucleus $\vec{E}_я$, which generates attractive force of the electrons toward the nucleus, which is a centripetal force with numerical value

$$\vec{F}_c = q_e \cdot \vec{E}_я = \frac{q_e^2 \cdot \vec{r}_0}{4\pi\varepsilon_0 \cdot r^2} = \frac{q_e^2 \cdot \vec{r}_0}{4\pi\varepsilon_0 \cdot r^2} \cdot \frac{r_{e0} \cdot c^2}{r_{e0} \cdot c^2} = m_{e0} \cdot \vec{a}_c = mass \times acceleration;\ \vec{r}_0 = \frac{\vec{r}}{|\vec{r}|}; \tag{11.1-8}$$

$$m_{e0} = \frac{W_E}{c^2} = \frac{q_e^2}{4\pi\varepsilon_0 . r_{e0} . c^2};\ \text{b)}\ \vec{a}_c = \frac{v^2}{r} = (2\pi n)^2 . \vec{r} = \frac{r_{e0} . c^2 . \vec{r}_0}{r^2} = \frac{\vec{F}_c}{m_{e0}};\ \rightarrow \left[m.s^{-2} \right]; \tag{11.1-9}$$

where: m_{e0} is the mass of the electron at rest (v = 0); $\vec{a}_c$ - centrifugal acceleration of the mass of the electron, which moves at velocity v along circular orbital; r_{e0} - the classical radius of the electron; c - the velocity of electromagnetic waves (light) in vacuum; ε_0 - the dielectric constant of vacuum.

11.2. Emission of a photon by electrons in atoms

11.2.1. *General formulations in emission and absorption of photons*

1. The electron has electric charge $q_e = -1,6.10^{-19} C$.

2. The mass of the electron at the velocity in the orbital of the atom is

$$\text{a)}\ v_e \approx 10^6 m.s^{-1} \ll c;\ \text{b)}\ m_e = \left(1,11.10^{-4}\right).m_{e0} \approx m_{e0} = q_e^2 . k_m;\ \ m_{e0} . \left(-1,11.10^{-4}\right) \approx m_{e0} = q_e^2 . k_e;$$
$$\text{c)}\ k_m = \left(4\pi\varepsilon_0 . r_{e0} . c^2\right)^{-1}; \tag{11.2-1}$$

3. In the atom of hydrogen, its nucleus has charge $q_я = -q_e = +1,6.10^{-19} C$.

4. The electric potential V_e and the potential energy W_{ep} of the electron, which is in the orbital at distance $r_e = n^2 . r_0$

$$\text{a)}\ r_e = n^2 . r_0;\ \text{b)}\ n = 1,2,3... \text{ integer}; \tag{11.2-2}$$

where: r_0 is the lowest value of the radius of the electron in the atom, and then:

$$\text{a)}\ V_e = \frac{q_e}{4.\pi.\varepsilon_0 . r_e};\ \text{b)}\ W_e = \frac{q_e . q_я}{4.\pi.\varepsilon_0 . r_e}; \tag{11.2-3}$$

which are quantized, because they are functions of q_e and $q_я$, which are quantized electric charges, because q_e is the smallest quantum (quantity) of electric charge, the result is:

$$\text{a)}\ q_e = V_e . 4.\pi.\varepsilon_0 . r_e;\ \text{b)}\ q_e . q_я = W_{ep} . 4.\pi.\varepsilon_0 . r_e;\ \text{c)}\ r_e = n^2 . r_0; \tag{11.2-4}$$

From (11.2-4), it is evident that the distances r_e according to classical physics should also be quantized because the charges q_e are quantized.

5. The force, Coulomb's law, is a derivative of W_{cp} relative to r_e

$$\text{a)}\ F_k = F_e = \frac{dW_e}{dr} . \vec{r}_0 = \frac{q_e . q_я . \vec{r}_0}{4.\pi.\varepsilon_0 . r_e^2};\ \vec{r}_0 \frac{\vec{r}_e}{|\vec{r}_e|}; \tag{11.2-5}$$

6. It follows from (11.2-4) that the energy

$$\text{a)}\ d\vec{W}_e = F_k . d\vec{r};\ \text{b)}\ W_e = -\int_{\infty}^{r_e} \frac{q_e . q_я . \vec{r}_0 . d\vec{r}_e}{4.\pi.\varepsilon_0 . r_e^2} = \frac{q_e . q_я}{4.\pi.\varepsilon_0 . r_e} = \frac{q_e . q_я}{4.\pi.\varepsilon_0 . n^2 . r_0}; \tag{11.2-6}$$

therefore, the force F_k is quantized as well.

7. The full energy W_n of the electron in the atom at velocity $v_e \ll c$ is a sum of the potential energy W_{ep} and the kinetic (magnetic) energies $W_k = \frac{m_{e0} v_e^2}{2}$

$$W_n = W_{ep} + W_k = -\frac{q_e^2}{8.\pi.e_0.r_n};\ r_n = n^2.r_0; \tag{11.2-7}$$

It is evident from (11.2-7) that the full energy of the electron in the atom according to classical physics is quantized, too.

8. Forces and energies during absorption and emission of a photon with energy W_f and mass $m_f = W_f / c^2$ of the photon.

A hydrogen atom is interpreted; whose full energy in stationary mode is W_n (11.2-7).

In a stationary mode, the electron moves along a stationary orbital with $r = r_n = const.$ owing to which the centripetal $\vec{F}_i$ and centrifugal $\vec{F}_j$ are numerically equal, but with opposite directions, i. e.

$$\text{a)}\ \vec{F}_i + \vec{F}_j = 0\ ;\ \rightarrow\ \text{b)}\ \left|\vec{F}_i\right| = \left|\vec{F}_j\right| = \left|\vec{F}_n\right|\ ; \tag{11.2-8}$$

Forces $\vec{F}_i$ and $\vec{F}_j$ are derivatives of their energies W_n and W_k; therefore, their energies are equal as well and are

$$W_e = W_k = \frac{q_e^2}{8.\pi.e_0.r_n} = \frac{m_{e0} v^2}{2}; \tag{11.2-9}$$

Therefore, the radius is

$$r_n = \frac{q_e^2}{8.\pi.e_0.m_{e0}.v_e^2} = n^2.r_0; \tag{11.2-10}$$

And the values of forces $\vec{F}_i$ and $\vec{F}_j$ or $\vec{F}_n$ are equal to

$$\left|\vec{F}_n\right| = \left|\vec{F}_i\right| = \left|\vec{F}_j\right| = \left|\frac{\mathrm{d}W_n}{\mathrm{d}r}\vec{r}_0\right| = \left|\frac{\vec{v}_e\,\mathrm{d}\vec{P}_e}{\mathrm{d}t}\right| = \left|m_{e0}\frac{\mathrm{d}\vec{v}_e}{\mathrm{d}t}\right| = \left|m_{e0}.\vec{a}_n\right|\ ; \tag{11.2-11}$$

To these forces correspond equal in values centripetal $\vec{a}_i$ and centrifugal $\vec{a}_j$ accelerations, which have opposite directions

$$\begin{gathered}\text{a)}\ \left|\vec{a}_i\right| = \left|\vec{a}_j\right| = \left|\vec{a}_n\right| = \left|\frac{v_n}{r_n}\vec{r}_0\right| = \left|-\omega^2 r_n\right|;\ \text{b)}\ \vec{a}_i + \vec{a}_j = 0; \\ \text{c)}\ \omega = 2\pi\nu;\ \text{d)}\ v_n = \omega r_r;\ \text{e)}\ \vec{r}_0 = \frac{\vec{r}_n}{\left|\vec{r}_n\right|}\end{gathered} \tag{11.2-12}$$

where: ω is the angular frequency of the electron at radius of the orbital r_n; ν - frequency of the revolutions of the electron along the orbital with radius r_n.

9. In a stationary mode, i.e. when the atom moves along a stationary orbit, the accelerations $\vec{a}_i$ and $\vec{a}_j$ are perpendicular to the velocity v_n of the electron upon the orbital with radius r_n, i. e.

$$\text{a)}\ \vec{a}_i \perp \vec{v}_n;\ \text{b)}\ \vec{a}_j \perp \vec{v}_n; \tag{11.2-13}$$

Therefore, the forces $\vec{F}_i$ and $\vec{F}_j$ are perpendicular to the velocity $\vec{v}_n$ as well, i. e.

$$\text{a)}\ \vec{F}_i \perp \vec{v}_n;\ \text{b)}\ \vec{F}_j \perp \vec{v}_n; \tag{11.2-14}$$

since

$$\text{a)}\ \vec{F}_i = m_{e0}.\vec{a}_i;\ \text{b)}\ \vec{F}_j = m_{e0}\vec{a}_j; \tag{11.2-15}$$

Because of this (11.2-15) and since $\mathrm{d}\vec{r}_n = \vec{v}_n \mathrm{d}t$, the work, which they do or the energy needed to change the energy of the electron, is zero, i. e.

$$\text{a)}\ \mathrm{d}\vec{A}_i = \mathrm{d}W_i = \vec{F}_i.\mathrm{d}\vec{r}_n = \vec{F}_i.\vec{v}_n.\mathrm{d}t.\cos(\pi/2) = 0;$$

$$\text{b)}\ \mathrm{d}\vec{A}_j = \mathrm{d}W_j = \vec{F}_j.\vec{v}_n.\mathrm{d}t = \vec{F}_j.\vec{v}_n.\mathrm{d}t.\cos(\pi/2) = 0; \qquad (11.2\text{-}16)$$

Because of this (11.2-16), according to classical electrodynamics, the energy of the electron does not change in stationary mode and it constantly moves along the same orbit and does not fall down onto the nucleus. The reason for this (11.2-16) is that the sum of the attractive (centripetal) force $\vec{F}_i$ and the centrifugal force $\vec{F}_j$ in stationary mode mutually neutralize – their sum is zero (11.2-8)a.

THIS CONCLUSION, WHICH HAS ALSO AN EXPERIMENTAL VALIDATION, DISPROVES N. BOHR'S CLAIMS THAT IT DOES NOT RESULT FROM CLASSICAL PHYSICS, THAT SUCH MOVEMENT OF THE ELECTRON IS POSSIBLE, BUT IS SOMETHING NEW, A FACT FROM THE QUANTUM MECHANICS. **BUT AS IT IS SEEN, IT IS A DIRECT CLASSICAL EFFECT FROM THE CLASSICAL ELECTRODYNAMICS.**

10. Therefore, in order to change the energy of an electron, which is in an atom orbital and moves at velocity $\vec{v}_e$ under the action of a force, it is necessary that the angle θ between the force $\vec{F}_i$, which acts upon it and its velocity *v* should be under an angle different from $\pi/2$, i. e.

$$\theta \neq \pi/2; \qquad (11.2\text{-}17)$$

or the acceleration $\vec{a}_i$ which is imparted to it should be under an angle θ different from $\pi/2$ relative to its velocity $\vec{v}_e$, so that the shift $\mathrm{d}\vec{r}_n = \vec{v}_n \mathrm{d}t$ should not be perpendicular to force $\vec{F}_i$ and the product of $\vec{F}_i$ by $\mathrm{d}\vec{r}_n$, which is equal to the work $\mathrm{d}A_i$ and the energy $\mathrm{d}W_i$ should be different from zero, i. e.

$$\mathrm{d}A_i = \mathrm{d}W_i = \vec{F}_{\cdot i}\mathrm{d}\vec{r}_n = \vec{F}_i.\vec{v}_n.\mathrm{d}t = F_i.v_n.\cos\theta.\mathrm{d}t \neq 0; \qquad (11.2\text{-}18)$$

In (11.2-18) two radically different solutions are possible depending on the value of the angle θ.

10.1. When the angle θ is less than $\pi/2$.

Then the force $\vec{F}_i$ (the acceleration $\vec{a}_i$) has a component (projection) $\vec{F}_i$ ($\vec{a}_i$)upon the direction of the velocity $\vec{v}_e$, owing to which it increases to $v_e' > v_e$, and along with it also increases the kinetic energy of the electron from W_k to $W_k' > W_k$. Since the sum of the kinetic W_k and the potential W_{ep} energies of the electron must remain constant, the potential energy, therefore, must decrease to $W_{ep}' < W_{ep}$, with a gain $\triangle W_k$ of the kinetic energy, and this means that the radius r_n of the orbital increases to $r_n' > r_n$ or, proceeding from (8.2-8) and (8.2-11), the result is

$$\text{a)}\ W_e' = \frac{q_e^2}{4.\pi.\varepsilon_0.r_n'} = \frac{m_{e0}.v_e'^2}{2};\ \text{b)}\ r_n' = \frac{2q_e^2}{4.\pi.\varepsilon_0.m_{e0}.v_e'^2} > r_n; \qquad (11.2\text{-}19)$$

i.e. at $\theta < \pi/2$ the electron moves to a higher orbital with $r_n' > r_n$ and its potential energy is lower.

Such is the case when the electron absorbs, from outside, a photon with energy

$$W_f = W_k' - W_k; \qquad (11.2\text{-}20)$$

10.2. When the angle θ is larger than $\pi/2$.

Then the projection of the force $\vec{F}_i$ (the acceleration $\vec{a}_i$) is upon the opposite direction of the velocity $\vec{v}_e$ of the electron, because of which the velocity decreases to $v_e'' < v_e$, and hence its kinetic energy decreases as well to $W_k'' = W_k$, and its potential energy $W_{ep}'' < W_{ep}$ increases, because of which the radius of its orbital decreases to $r_n'' < r_n$; by analogy to (8.2-15) and (8.2-18), for r_n'' we have

$$r_n" = \frac{2.q_e^2}{4.\pi.\varepsilon_0 m_{e0}.v_e"^2} < r_n ; \quad (11.2\text{-}21)$$

and it has a kinetic energy $W_k"$ $W_k^{"}$ and a potential energy $W_{ep}"$

$$\text{a) } W_k" = W_k - W_f = \frac{m_{e0}.v"_e^2}{2} ; \text{ b) } W_{ep}" = \frac{q_e^2}{4.\pi.\varepsilon_0.r_n"} \quad (11.2\text{-}22)$$

The decrease of W_k to $W_k"$ is by the energy of the photon W_f, which is emitted at $\theta > \pi/2$.

These are the mechanisms of absorption and emission of photons.

Conclusion.

The analyses in items 10.1 and 10.2 are made only through the laws of classical physics (mechanics and electrodynamics). And they show that the processes of electrons in atoms (molecules) are subject to the laws of classical physics.

THIS FACT IMPLIES THESE CATEGORICAL CLAIMS: A) THE MOVEMENT OF ELECTRONS AT $\vec{F}_i \perp \vec{v}_e$ IS ONLY ALONG STATIONARY ORBITS; AND B) THE EMISSION AND ABSORPTION OF PHOTONS BY ATOMS (MOLECULES) ARE CLASSICAL PHENOMENA.

It is another question that when electrons in atoms are more than one, they interact with each other and then there occurs interaction between more than two bodies (the nucleus and two or more electrons). This problem presently has no complete solution in physics. That is why N. Bohr's model cannot solve problems about atoms with two or more electrons

11.2.2. *An illustrative solution to the case of photon emission, according to classical electrodynamics*

In case of radial motion of an electron with acceleration $\vec{a}_c$ from orbit of radius r_i to a lower orbit of radius r_k along distance $\mathrm{d}\vec{r}$, under the action of resistance force $\vec{F}_c$, its magnetic energy decreases by

$$\mathrm{d}W_r = \vec{F}_c.\mathrm{d}\vec{r} ; \quad (11.2\text{-}23)$$

Or since its advancement by $\mathrm{d}\vec{r}$ toward an orbit of a shorter radius $r' = r - \mathrm{d}r$, and a lower velocity $v' = (2\pi n)^2.r < v = (2\pi n)^2.r$, therefore dW_r can be notated in this form

$$\text{a) } \mathrm{d}W_r = \vec{F}_c.\mathrm{d}\vec{r} = q_e.\vec{E}_я = m_{e0}.\vec{a}_c = m_{e0}.\frac{v^2}{r}; \text{ b) } \vec{a}_c = \frac{v^2}{c}; \quad (11.2\text{-}24)$$

This decrease of the magnetic energy of the electron is a result of the law of the classical electromagnetic theory, according to which in accelerated motion the electric charge emits electromagnetic energy in the form of electromagnetic waves (photons).

The electromagnetic energy emitted by the electron during its motion along orbit with radius r_i to orbital with radius $r_i > r_k$ is:

$$W_{rik} = \int_{r_i}^{r_k} \mathrm{d}W_r = -\frac{m_{e0}}{2}(2\pi n)^2\left(r_i^2 - r_k^2\right) = -\frac{m_{e0}}{2}\left(v_i^2 - v_k^2\right) = W_{ri} - W_{rk} = W_f ; \quad (11.2\text{-}25)$$

Here the specific case is under the firm condition of Bohr's model for the hydrogenous atom. In it, an electron of charge q_e moves in the electric field of the nucleus $E_я$, whose charge is equal in value and opposite by sign to the charge of the electron. The moment value, according to classical electrodynamics, of force F_e, which acts upon the electron and of its energy W_e at distance r of the electron from the nucleus, and by assigning $r = n^2.r_0$ (n = integer 1, 2, 3, …), r_0 is the minimal radius), these formulae are obtained:

$$\text{a) } F_e = q_e.E_я = \frac{q_e^2}{4\pi\varepsilon_0 r^2} ; \text{ b) } W_{en} = \int \mathrm{d}W_r = \int F_e.dr = \frac{q_e^2}{4.\pi.\varepsilon_0.r} = \frac{q_e^2}{4.\pi.\varepsilon_0.r_0.n^2} ; \quad (11.2\text{-}26)$$

When moving from an orbital of radius r_{n1} to an orbit of radius $r_{n2} < 2n_1$ since the electron moves with acceleration according to Maxwell's classical electromagnetic theory, it emits energy (photon) equal to

$$W_e = W_{en1} - W_{en2} = \frac{q_e^2}{4.\pi.\varepsilon_0}\left(\frac{1}{r_{n1}} - \frac{1}{r_{n2}}\right) = \frac{q_e^2}{4.\pi.\varepsilon_0.r_0}\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) = h.\nu\ ; \tag{11.2-27}$$

This electromagnetic energy is a pulse of electric energy, called photon with energies $W_f = W_{rik}$, mass m_f and momentum $\vec{p}_f$.

$$\text{a) } W_f = W_{rik} = h\nu\ ;\ \text{b) } m_f = \frac{W_f}{c^2}\ ;\ \text{c) } \vec{p}_f = m_f\vec{c} = \frac{W_f}{c}\vec{c}_0\ ;\ \ \vec{c}_0 = \frac{\vec{c}}{|\vec{c}|}\ ; \tag{11.2-28}$$

or by assigning

$$\text{a) } r_i = r_0 n_i^2\ ;\ \text{b) } r_k = r_0 n_k^2\ ;\ \text{c) } n = 1,2,....,\ n_k \neq n_i.1,2,3...\ ; \tag{11.2-29}$$

from the above classical electrodynamics law we obtain

$$W_{r_{ik}} = \int_{r_i}^{r_k} \mathrm{d}W_r = \frac{q_e^2}{4.\pi.\varepsilon_0}\left(\frac{1}{r_k} - \frac{1}{r_i}\right) = \frac{q_e^2}{4.\pi.\varepsilon_0.r_0}\left(\frac{1}{n_k^2} - \frac{1}{n_i^2}\right) = h.\nu\ ; \tag{11.2-30}$$

By taking into consideration the experimental law, known before 1880, about the frequency of the photon through Rydberg constant (R) is

$$\text{a) } \nu = \frac{R}{r_0}\left(\frac{1}{n_k^2} - \frac{1}{n_i^2}\right);\ \text{b) } \frac{\nu}{R} = \frac{1}{r_0}\left(\frac{1}{n_k^2} - \frac{1}{n_i^2}\right) = h\nu; \tag{11.2-31}$$

it follows that Planck constant is

$$h = q_e^2\left(4.\pi.\varepsilon_0.r_0.R\right)^{-1} = \text{const}. \tag{11.2-32}$$

12. QUANTUM MECHANICS HAS NO PLACE IN PHYSICS

These are the reasons to reject quantum mechanics as a science altogether and in particular as a science summarizing physics are:

First

The reliable part of present-day quantum mechanics is a further development upon classical electrodynamics concerning nuclear phenomena. This reliable, actual part cannot involve de Broglie's waves, Schrödinger's equation or Heisenberg's inequality.

***This means that if we consider the fact that M. Planck's theory is a continuation (further development) of Maxwell's and Faraday's theories and that energy quantizing in the form of photon energies is a consequence of classical electrodynamics, where the electron has a quantum* of energy and all bodies are quanta of masses, the logical inference is* that the real theory of quantum electromagnetic processes, which has been experimentally confirmed, is rooted in classical physics only, or in classical electrodynamics, respectively, and is none of a reason to found a new kind of science, "quantum mechanics", or to formulate new principles. Suffice are the principles and laws of the extended (universal) electrodynamics.**

Second

There is no reason to argue that quantum mechanics is a general science (theory) of natural phenomena, since:

a) It interprets only micro phenomena of single objects, but not a whole ensemble of objects, what are the macro objects (macro phenomena) and it describes most often and almost virtually only, almost without any real, specific facts, their one-moment manifestations using probabilistic laws; **their laws of a lasting interval of time, however, are not given, when the laws, according to experiment, are determined for a photon ensemble, what is for instance the case of Stefan Boltzmann law.**

* The notion of quantum means (denotes) a limited quantity (quantity: a portion of energy), a quantity of mass: a portion of mass. All formulae in physics are only of quantized (limited in value quantities) quantities (limited quantities). *No unlimited (non-quantized) quantities are used.* ***I.e. the whole physics is quantized – it is quantum physics.***

b) **It does not interpret the integral laws of the ensembles of phenomena of micro objects, where the micro objects are structural elements of the structure of the ensembles, whose laws are determined and are a result (function) of manifesting micro objects.**

c) Moreover, the laws of the ensembles, as a whole structure, are determined with ignorable (insignificant) fluctuations and therefore they are considered to be determinist laws.

d) Furthermore, it cannot provide an algorithm for transition from micro objects (phenomena) to macroobjects (phenomena) which is a sure sign of lack of any connection to reality.

Third

Quantum mechanics essentially attempts to interprets micro phenomena, but essentially, it does not give any specific numerical values for micro electromagnetic manifestations of electromagnetic matter, nor does it give anything for macro manifestations.

Here a question arises, what would happen if quantum physic dropped off physics. The answer is, physics would not lose anything, and something more, it would win, because so far quantum physic has not contributed anything but some ideas. There is not a single numerical value, derived from quantum physics, which is used in the practical implementation of physics.

13. FLAWS IN THE TREATMENT OF THE NATURE OF THERMAL ENERGY AND ITS CARRIER

Isaac Newton, in the second edition of his book "Opticks..." (p. 324) of 1718, wrote:

"In Query 18 he explained that '[i]f in two large tall cylindrical Vessels of Glass two little Thermometers be suspended so as not to touch the Vessels, and the Air be drawn out of one of these Vessels, and these Vessels thus prepared be carried out of a cold place into a warm one; the Thermometer in vacuo will grow warm as much, and almost as soon as the Thermometer which is not in vacuo. And when the Vessels are carried back into the cold place, the Thermometer in vacuo will grow cold almost as soon as the other Thermometer. Is not the Heat of the warm Room convey'd through the Vacuum by the Vibrations of a much subtiler Medium (*he meant the ether, P.P.'s note*) than Air which after the Air was drawn out remained in the Vacuum?'"

I.e. regardless of the fact that during this experiment there are no air molecules in one vessel, but only vacuum, the rise of the temperature, which the thermometer in vacuum shows, occurs simultaneously with that in the air (the vessel with air). ***This fact gives us reason to conclude that molecules are not the only carriers of thermal energy, but so is the photon gas as well, which was called by Newton 'medium.'***

Apart from this experiment conducted by Newton, others can also be adduced to demonstrate that molecules are not carriers, but only media for propagation of thermal energy, as they only emit and absorb radiant thermal energy. Such is Stefan Boltzmann law, the sun rays toward the earth, and others.

The theory established in present-day physics that molecules are the only carrier of thermal energy cannot explain the fact described by Newton either by Clausius', or Carnot's, or Boltzmann's, or Gibs' or others' theories, nor can present-day theory give the laws of propagation and carrying out of work by thermal energy.

The answer to this experiment, in an implicit form, was given by Newton himself, in the written in "Opticks..." as far back as in 1704, which in a synthesized form, states:

"*All bodies emit and absorb light."*

"The changing of Bodies into Light, and Light into Bodies ..."

"... is very conformable to the Course of Nature ..."

Apparently, photons in the photon gas are also carriers of thermal energy, as they can go through the walls of glass vessels and heat a thermometer in vacuum, whereas molecules cannot.

And there is no place in nature without a photon gas (electromagnetic fields) and gravitational fields.

But it is impossible for a photon gas to exist without molecules because they emit and absorb photons. In the process of photon emission, the kinetic (magnetic) energy of electrons in molecules (atoms) converts into energy of electromagnetic waves in the form of photons. When photons are absorbed by atoms, electrons convert the photon energy into kinetic (magnetic) energy and thus they use the thermal energy of photons in the form of kinetic energy of electrons in atoms, which is no longer thermal energy. But there is photon gas among the atoms in the molecule, which is generated all the time by the atoms and molecules and it enters and is emitted outside.

In this sense, the dynamic form of thermal energy is carried by the photon gas (photons of the photon gas), and the carrier of the potential form of thermal energy and generator of thermal energy are atoms and molecules, which constantly, at short intervals of time emit and absorb photons; therefore, a rational thermal theory should be developed – thermodynamics – which should essentially be updated electrodynamics.

14. CONCLUSION TO THE SUPPLEMENT

The facts presented above reveal that a number of formulations in present-day orthodox physics are incongruent with experimental facts, run counter Newton's legacy, expressed by him in explicit and implicit (indirect) form.

The science of physics should be developed and perfected only in strict conformity with experimental facts, such as Newton's legacy and the scientific assumptions about the nature of reality. I.e. the decisive prerequisite of the power of knowledge is not the belief in infallibility of certain authoritative names, but the irresistible power of experimental facts through which the most reliable authority speaks to us, Nature herself.

And Einstein wrote: **"Our ideas of reality cannot be final, so we should always be ready to change our point of view, i. e. to change the axiomatic basis of physics so as to substantiate the new experimental data observed by us into a logically most perfect way", 1931.**

THE FLAWS IN MODERN PHYSICS, AS EXPOSED ABOVE, SHOULD BE ELIMINATED BY RATIONALIZING THE SCIENCE OF PHYSICS SO THAT SUCH FLAWS SHOULD BE ELIMINATED.

This book is such an attempt, aimed at helping and accelerating an update of physics, although many physicists of present-day generation would hardly abandon these flaws rooted deeply in their minds and would find it even harder to recognize the novelty presented to their attention.