Chapter 8

THE PHYSICAL METRIC; THE UNITS OF DIALECTICAL PHYSICS AND CRUCIAL FAULTS OF THE MODERN SYSTEM OF UNITS

1. The characteristic periods-quanta of the dialectical field

1.2. *Basis and superstructure of the field of affirmation-negation* $\hat{D}$

The World is a complicated contradictory system-totality with an infinite series of mutually intersected material-ideal levels of matter-space-time. Life and Reason on Earth are the manifestation of one of its material-ideal levels with its own history, a part of which occurs on Earth.

The wave triad of matter-space-time, as a qualitative system, led to the formation of the triad of reference qualitative measures, which are represented by the gram (*g*), the centimeter (*cm*), and the second (*s*). Formally, it is possible to accept in the capacity of a reference triad any units of mass, length, and time, but as we will show below, just the above mentioned unit measures have the fundamental “magic” feature, being the ideal quanta of cognition of the Universe.

As was mentioned above, a quantitative-qualitative facet of the wave triad of matter-space-time is the ***physical quantitative-qualitative field-space*** $\hat{\mathfrak{R}}$**,** expressing the motion-rest of the physical time and, consequently, remaining fields-spaces of the Universe. This is the field-space of zero dimensionality, localized in the physical space of the Universe and, at the same time, being beyond it. This ideal field-space induces, in the ideal space of thought, the numerical field $\hat{\boldsymbol{D}}$, which is the field of measures of dialectical judgements.

Any number *Z* of the $\hat{\boldsymbol{D}}$-field is the system of its basis *B* and superstructure $\{S\}$:

$$Z = B^{\{S\}}. \tag{1.1}$$

When it is necessary to note that *B* is the basis of the number *Z*, we write $B = bas(Z)$.

The superstructure (or adbasis in Greek-Latin) $\{S\}$ represents any quantitative, or quantitative-qualitative, symbols characterizing the number *Z* with its basis. The symbols can be before, after, above, and under the basis. The basis is a core and the superstructure is an envelope of the number.

The main symbols of superstructure are "+", "–", exponents, indexes, *log*, *ln*, etc.

We express the superstructure $\{S\}$ of number *Z* with basis *B* by the following equality

$$\{S\} = ad_B(Z) \qquad \text{or} \qquad \{S\} = \sup_B(Z)\,. \tag{1.2}$$

If adbasis $\{S\}$ is an exponent *m* of number *Z* with basis *B*, i.e., $Z = B^m$, then the number *Z* is an exponential structure with basis *B* and superstructure *m*:

$$Z = \exp_B(m)\,, \qquad m = ad_B(Z)\,, \qquad \text{or} \qquad m = \log_B Z\,. \tag{1.3}$$

In the simplest case, the basis of number *Z* is a measure *Yes* or *No*. Multiplicative algebra of such basis is expressed in dialectics by the following qualitative equalities:

$$Yes \cdot Yes = Yes\,, \quad No \cdot No = Yes\,, \quad Yes \cdot No = No\,, \quad No \cdot Yes = No\,. \tag{1.4}$$

Multiplicative algebra of the signs of superstructure, "+" and "–":

$$(\pm)\cdot(\pm) = +\,, \qquad (\pm)\cdot(\mp) = -\,, \tag{1.5}$$

is the *algebra of affirmation*. Therefore, such signs "+" and "–" are the signs of the affirmative feature, or briefly *Yes*.

According to dialectical logic, if algebra of the signs of superstructure *Yes* (1.5) exists, then the algebra of signs of superstructure *No* (the *algebra of negation*), symmetrical and opposite to the algebra (1.5), must be present as well:

$$(\mp)\cdot(\mp) = -\,, \qquad (\mp)\cdot(\pm) = +\,. \tag{1.6}$$

The algebra of signs of affirmation is inherent in electric interactions: the interaction of charges of the same sign defines repulsion and the interaction of charges of the opposite signs defines their attraction. On the contrary, the algebra of signs of negation describes magnetic interactions of currents: the interaction of currents of the same sign (direction) defines attraction and the opposite currents their repulsion. Of course, a choice of the signs of results of interaction is relative, to some extent, but the polar opposition of the algebras, which describe interactions of charges and currents, is absolute.

Euler's formula $e^{i\varphi} = \cos\varphi + i\sin\varphi$ is valid for numbers of the $\hat{\boldsymbol{D}}$-field. Therefore, a number of affirmation-negation with the basis *B* is presented in the following way

$$\hat{Z} = r\exp_B(i\varphi) \tag{1.7}$$

or

$$\hat{Z} = rB^{i\varphi} = re^{\ln B\cdot i\varphi} = r(\cos(\ln B\cdot\varphi) + i\sin(\ln B\cdot\varphi))\,. \tag{1.7a}$$

The condition of periodicity, $\ln B\cdot\varphi = 2\pi m$, where *m* is an integer unequal to zero, defines the fundamental period-quantum of a number with basis *B*:

$$\Delta = 2\pi\log_B e\,. \tag{1.8}$$

Under the condition $\varphi = t/e_t$, where e_t is the unit of a variable parameter *t*, the number (1.7a) becomes a local number-wave. Introducing the designation $\omega = 1/e_t$, we can present the wave in the following way:

$$\hat{Z} = rB^{i\omega t} = re^{\ln B \cdot i\omega t} = r(\cos(\ln B \cdot \omega t) + i\sin(\ln B \cdot \omega t)). \qquad (1.9)$$

Local numbers-waves with the basis *B* are characterized by the relative Δ and absolute Δ_t periods-quanta:

$$\Delta = \frac{\Delta_t}{e_t} = 2\pi \log_B(e), \qquad \Delta_t = 2\pi \log_B(e) \cdot e_t. \qquad (1.10)$$

A nonlocal (traveling) wave-beam with the basis *B* has the following structure

$$\hat{Z} = rB^{i(\omega t - ks)} = r(\cos(\ln B \cdot (\omega t - ks)) + i\sin(\ln B \cdot (\omega t - ks))) \quad (1.11)$$

or

$$\hat{Z} = re^{\ln B \cdot i(\omega t - ks)} = \hat{r}(\cos(\ln B \cdot \omega t) + i\sin(\ln B \cdot \omega t)), \qquad (1.11a)$$

where $k = \frac{2\pi}{\lambda} = \frac{1}{\bar{\lambda}}$ is the wave number along the beam *s* in some space $\hat{P}$ and

$\hat{r} = re^{-i\ln B \cdot ks}$ is the modulus of number-wave.

Obviously, in $\hat{P}$-space along the beam *s*, the following relative and absolute, s_Δ and $s_{\bar{\lambda}}$, spatial periods-quanta characterize the wave-beam *s*:

$$s_\Delta = 2\pi \log_B e = \Delta, \qquad s_{\bar{\lambda}} = \Delta \cdot \bar{\lambda}. \qquad (1.12)$$

The periods-quanta (1.12) of the wave numerical field $\hat{\boldsymbol{D}}$ are inseparably linked with the qualitative reference units: the gram, the centimeter, and the second. The periods and the triad of reference measures represent by themselves the two facets of a single process in the Universe.

1.2. *The Law of the Decimal Base*

Dialectics regards the World as the Material-Ideal Formation. Ideal processes occur in the informational material-ideal dialectical fields submitting to the quantitative-qualitative code of the Universe.

A material facet of the Universe is described on the basis of physical laws, which we term the ***first kind laws***. The laws reflecting an ideal side of the Universe, related to the non-physical laws, should be called the ***second kind laws***.

There are the arguments to assume that the numerical wave field of affirmation-negation, with some *fundamental basis B* and *period* $2\pi \log_B e$, is one of the elementary levels of the informational field of the ideal facet of the Universe, expressed by the second kind laws.

The structure of human hands prompts the choice of the *fundamental basis B*, which was accepted by man to be *equal to ten*. The *fundamental periods-*

quanta of fields of decimal basis, relative and absolute, will be equal, correspondingly, to

$$\Delta = 2\pi \lg e, \qquad \Delta = 2\pi \lg e \cdot e_t. \tag{1.13}$$

Here, e_t is the unit of a physical quantity, defined on the basis of the decimal base, $e_t = 10^{\pm n} \cdot e_M$, where *n* is a natural number and e_M is the basic unit measure of the physical quantity, built on the basis of reference units.

The fundamental quantum (1.13) defines the quantum-period of half-wave (the wave half-period – half-quantum)

$$\Delta(1/2) = \pi \lg e \cdot e_t \approx 1.3644 \cdot e_t. \tag{1.14}$$

The reference measures are closely connected with the perception of the World by man, which follows the *Law of Decimal Base*. This law and its fundamental period are related to the second kind laws.

If an interval of possible random scattering of a measure is taken and divided into sixteen equal intervals (metameasures), then nature most often selects the left or right tenth metameasure. Let us call the left tenth metameasure, the subdominant, and the right one, the dominant. When the interval is divided into eight metameasures, then the third metameasure represents the subdominant and the fifth metameasure – the dominant.

The choice of dominants and subdominants occurs unconsciously. This phenomenon was noticed long ago. In art, a similar selection of measures was called the *Golden Section Law*, which is formally (conventionally) regarded as an irrational ratio. In fact, under the name of the golden section law is hidden the *Law of Decimal Base*. At that, when the dominant selects the fundamental half-period, a length of the interval quite often is equal to $1.6\pi \lg e$. This exhibits itself, for example, in the appearance of books. The size (by height) of most Russian book covers is equal to the great span with the canonical measure

$$L = \frac{8}{5}\pi \lg e \; dm \approx 21.83 \; cm. \tag{1.15}$$

Usually, the fifth metameasure distinguishes book titles.

We will now look, how the fundamental measures have been formed. Let us begin with the measures of mass.

1.3. *The gram*

A formation of folk measures of mass and volume rests on comparison of masses and volumes of liquid and free-flowing substances. Nature compelled people to compare the mass and volume of water with other substances. In the epoch of initial land cultivation, water (wine as well as beer) and grain were the main factors determining ancient natural measures.

Water generated the formula, which relates mass and volume

$$M = \varepsilon_0 V_0 = \varepsilon_0 \varepsilon V \,, \qquad (1.16)$$

where M is the mass of water equal to the mass of a substance; V_0 is the volume of the water; V is the volume of the substance; $\varepsilon_0\varepsilon$ is the volumetric density of the substance, ε_0 is the absolute volumetric density of water and $\varepsilon = V_0 / V$ is the relative volumetric density of substance.

A comparison of water and other substances, in mass and volume, generated the relative volumetric density ε and permeability $\mu = 1/\varepsilon$ ***independent of the concrete choice of units of mass and volume***. Consequently, most people on Earth, comparing the liquid and grain, have ***created, independently of each other, the equal (rational) multiple measures***.

The research of cereals allow asserting: mean values of the volumetric relative permeability μ of grain were approximately equal to the fundamental half-period $(1/2)\Delta$:

$$\mu = \pi \lg e = 1.364376354 \approx 1.3644 \,. \qquad (1.17)$$

Accordingly, the relative volumetric density was

$$\varepsilon = 1/\mu = 0.732935599 \approx 0.73 \,. \qquad (1.18)$$

Hence, the relations between the mass of grain M and its volume V are as follows:

$$V = 1.3644 \mu_0 M \,, \qquad M = 0.7329 \varepsilon_0 V \,. \qquad (1.19)$$

If we will assume that $\varepsilon_0 = 1\ g/cm^3$, then

$$V = 1.3644 cm^3 g^{-1} M \,, \quad M = 0.7329 g cm^{-3} V \,. \qquad (1.19a)$$

From this point of view, we will now analyze some of the Old English measures, taking into account that the volumetric density of cereals in England was within $\varepsilon_0\varepsilon \approx 0.73 - 0.79\ kg \cdot l^{-1}$. With the volumetric density equal to $0.75\ kg \cdot l^{-1}$, the Old English bushel of free-flowing substances, defined the unit of mass of one bushel, was equal to $1\ bu_m \approx 27.28\ \ kg \approx 10^4 \cdot \Delta\ g$. A tenth part of this unit is equal to the fundamental measure, which was at the base of Oriental measures. Through liquids (water, wine, and beer), the bushel of mass formed an equal (in value) bushel with a volume of 27.28 *l*. Three pecks were virtually equal to this bushel. Further, like the pounds of volume 0.373242 *l* with the volumetric density defined by the formula (1.19), British apothecaries' and monetary pounds gave rise to the pounds with the mass 0.273 *kg*. One hundred of these pounds composed a bushel of mass. Five bushels of mass generated a barrel 136.4 *kg*. A Japanese koku of grain of 136.88 *kg*, a British tierce of meat of 137.89 *kg*, an Australian bale of wool of 136 *kg*, and numerous barrels of petroleum products are related to the same spectrum of measures.

Other examples: in Iran, a barrel is equal to 136.4 *kg*, in Brazil, 136.7 *kg*, on Bahrain Islands, 136.3 *kg*, in Kuwait, 137.8 *kg*, etc. Resting on the USA wine barrel 119.24 *l* and the British barrel of bulky materials (grain) 163.65467 *l*, we find the average relative density of cereals in the folk British metrological system:

$$\varepsilon = \frac{119.24}{163.65467} \approx 0.73 .$$

This value is very close to the canonical measure (1.19). Therefore, throughout very long history of material and spiritual British culture, measures similar to most ancient Oriental measures must have developed. The East does not seem to pay a decisive role here, otherwise the Ancient Roman ounce, virtually equal to the fundamental period of 2.7288 *dg*, should have been at the basis of British measures.

In ancient Babylon, minas of mass, proportional to Roman ounces, were widely spread:

1 mina = 15 ounces = 409.3129 *g*
1 mina = 18 ounces = 491.1755 *g*
1 mina = 20 ounces = 545.7505 *g*.

In ancient Egypt, a kedet was the main unit of mass:

1 kedet = 1/3 ounce = 9.09584 *g* ≈ 9.096 *g*.

In ancient Rome, a libra of mass was equal to the twelve ounces:

1 libra = 12 ounces = 327.4503 *g*.

Different pounds were also used there:

1 pound = 10 ounces = 272.8753 *g*,
1 pound = 30 ounces = 818.6258 *g*,
1 pound = 35 ounces = 955.0634 *g*,
1 pound = 60 ounces = 1637.2516 *g*.

In ancient Greece, a metret (a unit of volume) was equal to 1000 ounces, or to the volume:

1 metret = 27.2878 *l*,
1 metret = 100 kotylas (cups).

Kotylas gave rise to an amphora:

1 amphora = 72 kotylas = 16 pecks = 36 mugs = I9.647 *l*.

An amphora of mass was a unit of monetary weight:

1 talent = 60 minas = 19.647 *kg*,
1 mina = 100 drams = 600 obols = 327.4503 *g*.

In ancient Attic, a talent of a larger mass was used:

1 talent = 80 minas = 26.196 *kg*.

In the Middle Ages, a pound with the mass of 233.769 *g* was used in Europe. As a unit of volume, it determined the golden section of the fundamental pound 272.88 *g*:

$$233.769\ cm^3 \cdot 0.73\ g \cdot cm^{-3} = 170.651\ g = \frac{5}{8} \cdot 272.88\ g .$$

The Russian metrological spectrum of mass is closely related with the wheat grain, which in Russia was called pirog. This word has been originated from the Old Russian name of wheat, pyro. According to historical and archaeological data, the Russian metrological spectrum of mass has been represented by the series:

1 pirog (pie) (a wheat corn)		= 42.625 *mg*
1 polupochka (a half-bud)	= 2 pirogs	= 85.25 *mg*
1 pochka (a bud)	= 4 pirogs	= 0.l705 *g*
2 pochkas	= 8 pirogs	= 0.3411 *g*
4 pochkas	= 16 pirogs	= 0.6822 *g*
8 pochkas	= 32 pirogs	= 1.3644 *g*
12 pochkas	= 48 pirogs	= 2.0466 *g*
16 pochkas	= 64 pirogs	= 2.7288 *g*
20 pochkas	= 80 pirogs	= 3.4110 *g*
24 pochkas	= 96 pirogs	= 4.0932 *g*

The Chinese lan of mass, 37.35 *g*, corresponds to the lan of volume of 0.03735 *l*, defining the fundamental period of mass, 27.3 *g*, with the relative volumetric density 0.73. The average relative volumetric density of Chinese rice, equal to the ratio of a dan of liquid capacity to a dan of grain capacity,

$$\varepsilon = \frac{103.546\, l}{122.535\, l} = 0.845,$$

gave rise to another series of measures based on rice. We can see that in China as well, which is located far from Great Britain, the dialectics of measures is similar to that of European and Oriental measures.

1.4. *The centimeter*

Perception of space and its fundamental length of one centimeter by man is closely related with the fundamental period Δ, that is an effect of the decimal code of the Universe (Fig. 8.1).

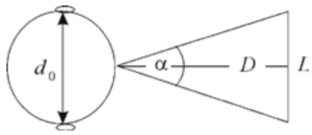

Fig. 8.1. A geometrical scheme of eyesight parameters; D_0 is a diameter of human skull with the characteristic average value $D_0 \approx 137$ *mm* (based on anthropological data); D is the average distance of the best eyesight, D ≈250 *mm*; L is the average distance of the effective field of eyesight, L ≈137 *mm*; α is the angular size of the field of visual perception, $\alpha \approx 30^0$.

As known, keenness of eyesight of man – the least distance between two points $s_{\min}$, which is able to distinguish man, – is about one angle minute, i.e.,

$$s_{\min} \approx \frac{\pi}{180 \cdot 60} D \approx 7.3 \cdot 10^{-3} cm \qquad (1.20)$$

or $$1 cm \approx 137 s_{\min}, \qquad (1.20a)$$

where $D = 25 cm$ is the average distance of the best eyesight (Fig. 8.1).

Thus, it is possible to suppose that for most people a tendency towards the ideal equality takes place:

$$1\ cm = 50 \cdot 2\pi \lg e \cdot s_{\min} \qquad (1.21)$$

Thus, the measures of length on the basis of centimeter follow the fundamental period-quantum of the Decimal Code of the Universe.

$$1\ mm = 5 \cdot 2\pi \lg e \cdot s_{\min},$$

$$1\ dm = 5 \cdot 2\pi \lg e \cdot 10^2 s_{\min}, \qquad (1.22)$$

$$1 m = 5 \cdot 2\pi \lg e \cdot 10^3 s_{\min}.$$

In this sense, the measures (1.22) are the "magic" units.

In turn, millimeters, centimeters, decimeters, and meters determine the fundamental physical parameters, which are also closely related with the fundamental period Δ, and lie at the base of folk metrology.

As an example, let us consider the Old Russian system of measures whose spectrum should mainly be described by the following formula:

$$M = 2^k 3^l 5^m 7^n \Delta, \qquad (1.23)$$

where numbers 2, 3, 5 and less frequently 7 are ordinal units of count and $k, l, m, n \in Z$. This spectrum has the universal character and is peculiar to ancient measures of many nations.

The first natural units of the simplest measures of length were fingers and their joints, palms, spans, feet, elbows and other parts of human body. In the Old Russian metrology, a foot of about 2.73 *dm* and a finger of 2.73 *cm*, equal to a tenth of the foot, were the constitutive measures. And all remaining measures were built on the basis of these fundamental measures.

The measure equal to the one foot is the typical size of bricks, books, icons and architecture details in XI-XII centuries. A vershok of two fingers has defined a width of bricks, a foot of 12 fingers (32.8 *cm*) was also the characteristic format of bricks at that time. There were also a palm of three vershoks and a foot of three palms (30.8 *cm*), etc.

The main derivative units of the foot were:

1) A *vershok-osmushka* (VII-IX centuries) of 3.42 *cm*, equal to one eighth of a foot. The scales of Old Ladoga with marked points at the distances of this vershok were well known. 2) A *stopa* of two feet. This measure was found in measuring rulers of Ancient Novgorod. 3) A *lokots* (elbow) = 3 feet = 81.9 *cm*.

4) A series of measures with the same name the *sazhen*, multiple to the different number of feet (for example, a sazhen of 4, 5, 6, 7, 8, 9, … feet) and the fractional parts of them.

The sazhen = 5 feet = 3 elbows = 137 *cm* was the most widely used unit of length. Jakov's arquebus as cast in 1492 had the length of a firearm barrel equal to 1.37 *m*. The distance between rowlocks in most of boats had often the length 1.37 *m*. The measure of 1.37 *m* was the typical length of oars in XIV century.

The sazhen = 10 feet = 2.73 *m* was known as a *grand* (*slanting*) *sazhen*. It has been defined in the following way. A lace with the length of a grand sazhen has been folded in two and its middle point pressed by a hand to the shoulder, then ends of the lace have to touch a floor. Note, according to anthropology data a shoulder is on average at the height of 1.37 *m*.

Every sazhen defined its own numerous multiple measures, as for example, a thousand of sazhens of four feet constituted a *verst* of 1.093 *km* and a thousand of sazhens of eight feet formed a *verst* of 2.185 *km* etc.

Let us now go to the other extremity of the Eurasian continent and dwell upon the Chinese metrology. Chinese measures of length are closely related to rice. The first information about the cultivation of rice appeared in 2800 BC. The transverse dimension of a rice corn varies within *d* = 1.2 – 3.5 *mm*. The subdominant and dominant of this range are 2.06 *mm* and 2.64 *mm*, respectively. Apparently, ten subdominants gave rise to an inch of 2.06 *cm*. Chinese feet were formed certainly on the basis of this measure, that is confirmed by the following estimations:

1 foot = l2 inches = 24.72 *cm*,
1 foot = 16 inches = 32.96 *cm*,
1 foot = 18 inches = 37.08 *cm*.

These feet are in accordance with the ancient Chinese feet. In particular, a long Chinese foot is equal to 37.5 *cm*. A foot of 16 inches is close to a building foot of 32.28 *cm*. A foot of 12 dominant inches (31.68 *cm*) coincides actually with a landmark or the engineering foot of 31.97 *cm*. A mean Chinese foot is about 32.8 *cm*. If we divide it into 16, we will obtain one of the ancient Chinese inches. And in a case, when the foot is divided into 12, we arrive at the inch close to the fundamental measure of 2.73 *cm*.

1.5. *The centimeter and the second*

For the sake of the standard representation of numerical values of measures, let us agree that all physical constants be presented by eight or more signs after a decimal point, because most of them were defined with such precision.

In the year 2000, a star day *T* will be equal to $23^{h}56^{m}04^{s}.10056$. An angular speed of Earth’s revolution, corresponding to this day, $\omega_Z = 7.29211501 \cdot 10^{-5} s^{-1}$, hence, a daily radius T_R is

$$T_R = \frac{1}{\omega_Z} = \frac{T}{2\pi} = 1.37134425 \cdot 10^4 s . \qquad (1.24)$$

Thus, the daily radius is in the vicinity of the fundamental half-period, and if the new canonical second $\underline{s}$ is introduced, according to the equality

$$1\underline{s} = 1.00510702 s\,, \tag{1.25}$$

then a duration of the period will be exactly equal to the fundamental quantity

$$T_R = \frac{T}{2\pi} = 2^{-1}\Delta \cdot 10^4 \underline{s} = 1.36437635 \cdot 10^4 \underline{s}\,, \tag{1.26}$$

and the angular speed of Earth's revolution will also be the fundamental one,

$$\omega_Z = \frac{1}{T_R} = 2 \cdot \frac{1}{\Delta} \cdot 10^{-4} \underline{s}^{-1}\,. \tag{1.27}$$

In accordance with the formula (2.64), the gravitational field is characterized by the gravitational frequency ω_g, coupled with the gravitational constant G by the equality

$$\omega_g = \sqrt{4\pi\varepsilon_0 G} = 9.15697761 \cdot 10^{-4} s^{-1}, \tag{1.28}$$

where $G = 6.67259000 \cdot 10^{-8} cm^3 \cdot g^{-1} \cdot s^{-2}$ and $\varepsilon_0 = 1 g \cdot cm^{-3}$, and the gravitational period

$$T_g = \frac{2\pi}{\omega_g} = 0.68616366 \cdot 10^4 s\,. \tag{1.29}$$

The gravitational period defines the gravitational wave radius of the cylindrical gravitational field

$$\lambda\!\!\!^{-}_g = \frac{c}{\omega_g} = 3.273923676 \cdot 10^{13} cm\,. \tag{1.30}$$

The wave radius divides the solar gravitational field into the nearest and distant wave zones, between which is a ring of small planets called asteroids.

The value of the gravitational wave radius is in the vicinity of $\frac{6}{5}\Delta = 2 \cdot 3 \cdot 5^{-1}\Delta$ – the distinctive value of ancient measures. If we introduce the canonical centimeter $c\overline{m}$, according to the equality

$$1c\overline{m} = 0.999823004 cm\,, \tag{1.31}$$

the gravitational wave radius will take the fundamental value

$$\lambda\!\!\!^{-}_g = \frac{c}{\omega_g} = 2 \cdot 3 \cdot 5^{-1}\Delta \cdot 10^{13} c\overline{m} = 3.27450325 \cdot 10^{13} c\overline{m}\,. \tag{1.32}$$

On the other hand, the gravitational period is in the vicinity of a quarter of the fundamental period Δ, and if to introduce the canonical second

$$1\underline{\underline{s}} = 1.00582754 s\,, \tag{1.33}$$

we will arrive at the fundamental measure of the gravitational period

$$T_g = \frac{2\pi}{\omega_g} = 2^{-2}\Delta \cdot 10^4 \underline{\underline{s}} = 0.68218818 \cdot 10^4 \underline{\underline{s}} \tag{1.34}$$

and the fundamental gravitational frequency

$$\omega_g = \frac{8\pi}{\Delta}\cdot 10^{-4}\underline{\underline{s}}^{-1} = \frac{4}{\lg e}\cdot 10^{-4}\underline{\underline{s}}^{-1} = 9.210340372\cdot 10^{-4}\underline{\underline{s}}^{-1}, \qquad (1.35)$$

which determines the fundamental value of the gravitational constant

$$G = \frac{\omega_g^2}{4\pi\varepsilon_0} = \frac{4\pi}{(0.5\Delta)^2\varepsilon_0}10^{-8}\underline{\underline{s}}^{-2} = 6.75058634\cdot 10^{-8} cm^3\cdot g^{-1}\cdot\underline{\underline{s}}^{-2}. \qquad (1.36)$$

The canonical second (1.33) and the centimeter (1.31) define the canonical measure of the speed of light

$$c = ƛ_g\omega_g = 96\pi\cdot 10^8 c\overline{m}\cdot\underline{\underline{s}}^{-1} = 3.015928947\cdot 10^{10} c\overline{m}\cdot\underline{\underline{s}}^{-1}. \qquad (1.37)$$

Since $1\underline{\underline{s}} \approx 1\underline{s}$, equalities

$$T_R = 2T_g \quad \text{and} \quad T = 2\pi T_R = 4\pi T_g \qquad (1.38)$$

point to the relation of Earth's time circumference (day) and its radius with the gravitational constant and the quarter of the fundamental period.

2. SI and QuGCS units

At the modern stage of development of physics, one cannot do without philosophy. This is why, in this book, much attention is devoted to dialectics (the dialectical philosophy and its logic), without which the fruitful development of physics is impossible.

An idea of existence of the first and second kind laws, which naturally originate from the fundamentals of dialectical philosophy, allows one to describe the World more correctly. The second kind laws acted upon in the metrology of nations of Earth and without these laws it is impossible to build the reliable foundation of physics. This demands essential changes in the theoretical metrology. In this connection, we propose the reference system of units on the basis of the gram (g), the centimeter (c), and the second (s) – *GCS*, which does not contain the fractional powers of the units.

Let us agree to regard the *physical quantities* and *physical parameters* not only as synonyms, but also as the notions with a different sense.

Every *qualitative definition* of some physical notion A, based on a series of its characteristic properties x, y, z, …, is supplemented with the *quantitative formula*, representing a short mathematical expression of the notion:

$$A = Def\,(x, y, z,...)\,. \qquad (2.1)$$

The left part of the formula is the nomination (name) of this physical notion, the right part is its *abstract physical quantity* (or its abstract measure), which is characterized by the definite numerical value. In a series of the cases, it makes sense (for the sake of severity of logical expressions) an abstract physical quantity to be called the *physical parameter*, or briefly, the parameter, and a concrete physical measure of the parameter to be called the *physical quantity*, or simply, the value of the parameter.

In *GCS* system, the ***dimensionality of any physical quantity N is defined by only the integer powers of reference units***:

$$\dim N = g^k \cdot cm^l \cdot s^m\,, \qquad (2.1a)$$

where $k, l, m \in Z$. The reference units: *g*, *cm*, and *s* is the metrological basis, in which it is possible to create any triad of ***base qualitative units***.

The ***quantitative measures*** of *GCS* system are related with the fundamental World periods-quanta, reflecting the decimal code of representation of quantitative measures in the Universe:

$$\Delta = 2\pi \lg e \qquad (\textit{Yes}\text{-measure}),$$
$$i\Delta = i2\pi \lg e \qquad (\textit{No}\text{-measure}). \qquad (2.1b)$$

The p***eriods-quanta of the field of affirmation*** (*Yes*-subfield) ***and negation*** (*No*-subfield) ***of the decimal code of the Universe*** (2.1b) ***form the basis of the quantitative system of measures***, supplementing the *GCS* system. We denote this quantitative system by the letters *Qu* (from the Latin, *Quantum*). It is the foundation of metrology of Earth's nations.

The combination of *Qu* and *GCS* systems results in the complete system of objective units, *GuGCS*. This system describes all informational material of contemporary physics on the basis of only three basic units: *g*, *cm*, and *s*.

The modern system *SI* contains seven basic units. The four of them are *kg*, *m*, *s* and *A* (ampere). We will analyze in detail only the unit of electric current, ampere (*A*). The remaining three quantitative measures, as the units of thermodynamic temperature, kelvin (*K*), amount of substance, mole (*mol*), and luminous intensity, candela (*cd*), also, as the ampere, were introduced in a series of base units erroneously. We will not consider them here.

The dimensionality of other important units in *SI* is represented by half-integer powers of three basic units, which are hidden in the *nominative dimensionality* of *phenomenological measures*. The last is defined by the units of mass *M*, length *L*, time *T*, and electric current *I*:

$$\dim A = M^k \cdot L^l \cdot T^m \cdot I^n\,, \qquad (2.1c)$$

where $k, l, m, n \in Z$. Here, the unit of current *I*, regarded as the basic unit, is actually the derivative (dependent) unit, because it is the function of the first three basic units:

$$I = I(M, L, T) = M^{1/2} \cdot L^{3/2} \cdot T^{-1}\,. \qquad (2.1d)$$

The function (2.1d) is phenomenological, because objects and processes with such measures as $M^{1/2}$ and $L^{3/2}$ ($kg^{1/2}$ and $m^{3/2}$) do not exist in nature! Such structure of the unit of current is the effect of misunderstanding of the nature of charges and unfounded rationalizations, containing the errors.

During the last decades, it is normal to disregard the function (2.1d). Thus, the solution of the problem on the fractional powers of reference units is moved aside, which does not promote the normal development of science. Thus, an appearance of the fourth basic unit (the ampere) among the three really basic units (of mass, length, and time) is the acknowledgement of ideological bankruptcy of the phenomenological approach in physics.

Let us agree to refer the physical measures and their units to the class of the ***phenomenological units*** if they were formed, explicitly or implicitly, with the participation of the unit of current the *ampere* (whose dimensionality contains half-integer powers of such reference units as the gram and the centimeter). The remaining units, formed on the basis of dimensionalities (2.1a) of *QuGCS* system, we refer to the class of the ***theoretical (objective) units***.

Of course, there is not a clear boundary between the phenomenological quantities with the integer powers of reference units, which were formed on the basis of phenomenological measures with the half-integer powers of reference units, and the corresponding theoretical quantities. However, phenomenological measures with integer powers of reference units can differ from their theoretical measures in the numerical factor. Such difference will express the definite quantitative error of a phenomenological quantity, in question.

The theoretical units with integer powers of reference units are the effect of the basic law of cognition – the *law of comparison*. The comparison generates integer powers of theoretical (correct or objective) units. The latter are the objective units, because they are formed on the basis of real comparison, but not on the basis of formal irrational operations, which are based on a free game of notions. Any freedom is restricted by the requirements of objectivity, i.e., freedom is realized necessity. This is true because freedom is not subjected to the objective nature of phenomena and, therefore, is able to generate the phenomenology of the kind (2.1d).

Of course, the objective measures, as any measures in dialectics, by virtue of an approximate character of the description of nature, reflect the nature with the different extent of accuracy.

Let us agree to denote the *metrical measures* (which we define on the basis of measures of the corresponding theoretical units) by the index *m*.

The theoretical measures (units) obtained in *QuGCS* system (which does not contain the half-integer powers of reference units) will be denoted by the index "0" before the symbol of the unit.

We will also present the formula of dimensionality of parameters (2.1a) by the symbolic *vector of dimensionality D* in a set of reference measures:

$$D(k, l, m) = g^k \cdot cm^l \cdot s^m \,, \tag{2.1e}$$

where *k*, *l*, *m* are integers. The qualitative vector $D(k, l, m)$ defines the structure of the nomination of a physical unit.

The *quantitative* measure of a physical quantity Q_u can be presented in the following way

$$Q_u = r \cdot \Delta \cdot 10^n , \qquad (2.1f)$$

where 10^n is the decimal scale and *n* is an integer number; *r* is (in a general case) any number.

If *r* is a rational number, the measure Q_u defines characteristic values of a quantitative spectrum of the parameter, repeating the ancient measures, which are multiple to the fundamental period.

For the complete representation of the structure of a parameter, we will introduce the fourth and fifth *quantitative* coordinates in the vector of dimensionality, separating them from the *qualitative* coordinates by a semicolon:

$$D(k, l, m; r \cdot \Delta, n) = Q_u \; g^k \cdot cm^l \cdot s^m , \qquad (2.1g)$$

where Δ is the quantitative measure of a parameter

$$\Delta = \pm 2\pi \lg e, \quad \pm 2\pi \lg e \cdot i . \qquad (2.1h)$$

All parameters with the equal qualitative coordinates, i.e., with the same qualitative dimensionalities, belong to the one class. In this sense, the qualitative vector of dimensionality $D(k, l, m)$ is the determinant of a class. Each class is presented by a group of qualitatively related quantities, having some differences.

Physical parameters of different classes reflect the qualitatively different properties of processes and objects of study. Therefore, the same property of an object cannot be presented by means of measures of different classes. If this happens, then it means that the theory, describing such a quality of a process or an object, is still in a stage of development and its basis contains errors.

The definite correlation takes place between measures of physical parameters, expressed in phenomenological and theoretical units. If some objective factor of an arbitrary process is described on the basis of *phenomenological units* by a parameter A_{ph} , then its measure has the form

$$A_{ph} = Q_{ph} \cdot M_{ph} , \qquad (2.2)$$

where M_{ph} is the subjective phenomenological unit with fractional powers of the reference units, *g*, *cm*, and *s*; Q_{ph} is the quantitative value of the parameter in a system of the phenomenological units.

The theoretical measure of the same parameter, expressed in *objective units*, is characterized by the objective measure A_o:

$$A_o = Q_o \cdot M_o , \qquad (2.2a)$$

where M_o is the objective theoretical unit with the integer powers of the reference units, *g*, *cm*, and *s*; Q_o is the quantitative value of the parameter in a system of the theoretical (objective) units.

If phenomenological and theoretical measures and units are proportional each other, then the ratio of phenomenological and theoretical measures to their units will be an invariant magnitude:

$$\frac{A_o}{M_o} = \frac{A_{ph}}{M_{ph}} = invariant\,; \tag{2.2b}$$

consequently, their numerical values will be equal:

$$Q_o = Q_{ph}\,. \tag{2.2c}$$

The system *QuGCS* is able adequately to describe notions of any longitudinal and transversal subfields, which form the complicated longitudinal-transversal fields of matter-space-time.

As was already noted, the subatomic longitudinal-transversal field of exchange is called in physics the "*electromagnetic field*". From the point of view of semantics, the name the "electromagnetic" field is deprived of a sense. Following one version, it literally means the "*amber-magical*" field. This is, roughly speaking, the "alias" or the pseudonym. We should refrain from the pseudonym, because the last initially generates the erroneous concepts and directions of research. Moreover, on the basis of the pseudonym, cognition of the nature of "electromagnetic phenomena" becomes impossible.

The "electromagnetic field" is the longitudinal-transversal wave field of the subatomic level of exchange and, at the same time, it is the field-space of the triad of matter-space-time.

It would be more correctly to call the "electromagnetic" field the longitudinal-transversal "electric" field, whose intensity of rest-motion should be described by the vector of velocity of exchange $\hat{\mathbf{E}}$ (the "strength" vector) of the following logical structure *Yes-No*:

$$\hat{\mathbf{E}} = \hat{\mathbf{E}}_0 + \hat{\mathbf{E}}_\tau\,, \tag{2.3}$$

where $\hat{\mathbf{E}}_0$ is the vector of the longitudinal "electric" subfield and $\hat{\mathbf{E}}_\tau$ is the vector of the transversal "electric" subfield.

To the equal degree, the "electromagnetic" field can be called the longitudinal-transversal "magnetic" field with the corresponding vectors of the longitudinal $\hat{\mathbf{B}}_0$ and transversal $\hat{\mathbf{B}}_\tau$ "magnetic" subfields:

$$\hat{\mathbf{B}} = \hat{\mathbf{B}}_0 + \hat{\mathbf{B}}_\tau\,. \tag{2.3a}$$

Through this approach, the central charge of exchange of an electron is, in the first nomination (2.3), the "electric" charge-monopole, in the second nomination (2.3a), the "magnetic" charge-monopole of the *central* part of the longitudinal-transversal field. By virtue of this, the elementary *central exchange* can be presented in the language of electric or magnetic charges as

$$F = \frac{q_E Q_E}{4\pi\varepsilon_0 r^2} \qquad \text{or} \qquad F = \frac{q_M Q_M}{4\pi\varepsilon_0 r^2}\,. \tag{2.3b}$$

It is natural that here

$$q_E = q_M\,, \tag{2.3c}$$

because we deal with the same charges having the different names.

The actual charge is the longitudinal-transversal ("electric" or "magnetic") charge of the field of the subatomic level (see (3.69) and (3.70) of Chapter 7). The transversal charges in a general case differ from the central ("electric" or "magnetic") charges.

For the more complete description of the fields (2.3) or (2.3a), it is necessary to take into account also the axial subfields $\hat{\mathbf{E}}_z$ or $\hat{\mathbf{B}}_z$:

$$\hat{\mathbf{E}} = \hat{\mathbf{E}}_\mathbf{0} + \hat{\mathbf{E}}_\tau + \hat{\mathbf{E}}_z, \qquad \hat{\mathbf{B}} = \hat{\mathbf{B}}_\mathbf{0} + \hat{\mathbf{B}}_\tau + \hat{\mathbf{B}}_z. \qquad (2.3d)$$

All these subfields have the potential-kinetic character and only with some degree of simplification the "electric" field can be referred to the potential field and the "magnetic" one – to the kinetic field.

The physicist studies the longitudinal-transversal field of exchange of the *subatomic microlevel* "from above" (because he towers over this field in laboratory conditions); therefore, he clearly sees its longitudinal and transversal sides. But at the same time, he is inside the cosmic longitudinal-transversal field. Being on the Earth, he feels only the longitudinal side of the field, but does not perceive its transversal component, which is represented by the shells of the gravitational field of the Sun and its planets.

In such a situation, when "complexes of sensations" do not help, it is necessary to turn to reason and dialectics. Only they will lead the researcher to the understanding of the fact that the gravitational field is also the longitudinal-transversal field, analogous to the longitudinal-transversal field of the subatomic level.

When we speak about dialectics, we mean the best achievements of the Greek, Chinese, Indian, European, and German (in the person of Hegel) philosophy. It is possible to say that dialectics is the quintessence of worldly human thought, the theoretical experience of mankind, which should not be substituted for all kinds of temporal fashionable trends. Another matter if these new concepts (trends) enrich the world experience.

3. Correlation of the parameters of exchange with the parameters of electric fields

3.1. *The errors of mixture of CGSE and CGSM parameters*

The longitudinal-transversal character of the "electric" field (or, that is the same, the "magnetic" or "electromagnetic" field) has induced the following three systems of units:

1. *Yes*-system (*CGSE*) for the description of the longitudinal subfield ("electric field");

2. *No*-system (*CGSM*) for the description of the transversal subfield ("magnetic field");

3. *Yes-No*-system. The formal logic was unable to understand this system on the basis of its notions.

We will call the last system, for brevity, the "circulational system". It was impossible to comprehend the circulational system *Yes-No* on the basis of a naïve formal-logical rule of the excluded third. Therefore, physics referred (and refer) all notions of electromagnetism to either *Yes*-system (*CGSE*) or *No*-system (*CGSM*). Thus, physics, in principle, is unable to form deliberately the notions of the type *Yes-No*. The circulational system *Yes-No* is based on *CGS* units. Hence, conditionally, it can be called CGS-system, although this is not quite correctly, because CGS-system was built for the description, above all, non-electromagnetic phenomena.

The circulational system *Yes-No*, through the equality (2.109) (Chapter 7) for the cylindrical field, united in a single whole both (*CGSE* and *CGSM*) systems:

$$\Gamma = \frac{1}{c} I \,, \tag{3.1}$$

where Γ is the circulation of the vector $H = \varepsilon_0 \varepsilon_r B = \dfrac{B}{\mu_0 \mu_r}$ (see (2.66) of Chapter 7) – the parameter of the *transversal* subfield; whereas *I* is the parameter of the *longitudinal* subfield.

Parameters of the circulational system, formed on the basis of the formal analogy with the parameters of *Yes* (*CGSE*) or *No* (*CGSM*) systems, were called the parameters in the "magnetic system" with corresponding names of the systems, *Yes* and *No*. As a result, the confusion with notions and their ambiguity have appeared. This is extremely inconvenient and undesirable.

The development of notions of the conjugated subfields, *Yes* and *No*, was not proceeded quite symmetrical. As a result, the relevant parameters for the description of both, the longitudinal and transversal subfields, have obtained the same names, although in essence they are very different. This further complicated the logical situation in the field theory.

Since the circulation Γ is inseparable from the current *I*, it can be conditionally called the current circulation, i.e., the circulation related to the given current. Just this inseparable relation of the circulation and current led to the erroneous name. The circulation was termed the "current in the magnetic system" and denoted by the symbol I_m or simply by the same symbol of current *I*. This confusion remains in electrodynamics at present.

In reality, the circulation Γ is the parameter, which connects in a single whole the electric and magnetic features. It belongs equally to both, the *CGSE* and *CGSM* systems; therefore, it cannot be called the current in the "magnetic system". Let us rewrite (3.1) as

$$\Gamma = \frac{dq}{cdt} \,. \tag{3.1a}$$

The differential of the basis length $dz = cdt$, along the axis of the cylindrical field, defines the linear density of charge q_z, representing by itself the circulation Γ:

$$\Gamma = \frac{dq}{dz} = q_z . \qquad (3.1b)$$

Joining together (3.1) and (3.1b), we have

$$I = c\Gamma = cq_z . \qquad (3.1c)$$

In the longitudinal-transversal field, in the equilibrium process, the transversal (tangential) and longitudinal (axial) exchanges are equal. The equality of masses and charges of the longitudinal and transversal subfields express it:

$$M_\tau = M_n = M , \qquad q_\tau = q_n = q . \qquad (3.2)$$

Thus, the linear density of charge q_z is related to the equal degree to both the transversal charge and the longitudinal charge.

Although the circulation Γ was called the current in the magnetic system of units, some physicists of the 19th and the first half of the 20th centuries have understood the inaccuracy of the similar identifying. At present, the form of the law of total current, in *SI*, demonstrates these errors:

$$\oint(\mathbf{H}d\mathbf{l}) = I . \qquad (3.3)$$

Such form has not a single-valued sense.

If the right part of the formula (3.3) contains the current in the "magnetic system", I_m, then we must write that

$$\oint(\mathbf{H}d\mathbf{l}) = I_m \qquad \text{or} \qquad \oint(\mathbf{H}d\mathbf{l}) = \frac{1}{c}I . \qquad (3.3a)$$

It is usual to call the last equality the law of total current in Gaussian units. It is the correct form of the presentation of this law; although here the circulation is not called explicitly by its name and has no its own designation. In metrology, this equality is written as

$$\oint(\mathbf{H}_m d\mathbf{l}) = \frac{1}{c}I , \qquad (3.3b)$$

where the index *m* shows that the strength *H* is the strength "in the magnetic system".

The vector of phenomenological strength H_m is, strictly speaking, the vector of "induction or displacement" of the magnetic field, because it describes the analogous qualities of the field, inherent for the vector of "induction or displacement" of the electric field *D*.

The linguistic, nominative, error creates the definite confusion and incomprehension of the role and meaning of the vector *H* in the phenomenological theory of electromagnetism. Folk wisdom says that things must be called by their own names. In science, this must take place all the more.

For the sake of definiteness, we will denote the vector of phenomenological strength H_m by the symbol H_e. It will allow avoiding the definite ambiguity of electromagnetic notions. Further, we will denote by the index *e* the other phenomenological parameters as well.

In such a case, we have

$$\oint(\mathbf{H}_e d\mathbf{l}) = \frac{1}{c} I \ . \qquad (3.3c)$$

We introduce the vector of "circulational strength" $\mathbf{H}_\gamma$ in accordance with the equality

$$\mathbf{H}_\gamma = c\mathbf{H}_e \ . \qquad (3.3d)$$

An analogous equality for the vector $\mathbf{B}_\gamma$ is

$$\mathbf{B}_\gamma = c\mathbf{B}_e \ . \qquad (3.4)$$

The physical parameters, generated by the circulation and denoted by the index γ, are not equal to the vectors (with the same name) of electric and magnetic systems. They are the circulational parameters of the field and their essence will be considered below.

Follow the formula (3.3d), the law of total current must take the form

$$\oint(\mathbf{H}_\gamma d\mathbf{l}) = I \ . \qquad (3.5)$$

In the course of development of phenomenology, relating to the electromagnetic phenomena, the two laws of total current have appeared, which are equal in form, but different in content:

$$\oint(\mathbf{H} d\mathbf{l}) = I_m \ , \qquad \oint(\mathbf{H}_\gamma d\mathbf{l}) = I \ .$$

Both laws were/are misapprehended as one law, but expressed in the different systems. This is a great fallacy. Such a formal description (remaining up to now) was/is the cause of the mess in thoughts of physicists.

On the basis of the relation between current and circulation (3.1), it is possible to introduce the "circulational charge" q_γ, which occasionally is called erroneously the magnetic charge:

$$q_\gamma = \frac{1}{c} q \ , \qquad (3.6)$$

where

$$q_\gamma = \int I_\gamma dt = \int \Gamma dt \ . \qquad (3.6a)$$

By virtue of mixture of the notions, circulation and current, the two classes of conjugated units, on the basis of *CGSE* and *CGSM* systems, are formed. Being different in essence, they have the same nomination. It is necessary to refer the most of these units to the circulational Γ-system (Fig. 8.2).

Let us denote the phenomenological quantities of the systems, *CGSE* and *CGSM*, by the general symbols, A_e and A_m. The corresponding circulational quantities (which are called erroneously as the quantities of the magnetic system *CGSM*) will be denoted by the symbol A_γ. Then, the correlation between the aforementioned different quantities, in a general case, takes the form

$$A_\gamma = c^n A_e \qquad \text{or} \qquad A_e = c^{-n} A_\gamma \,, \tag{3.7}$$

where c is the base wave speed and $n = \pm 1, \pm 2$.

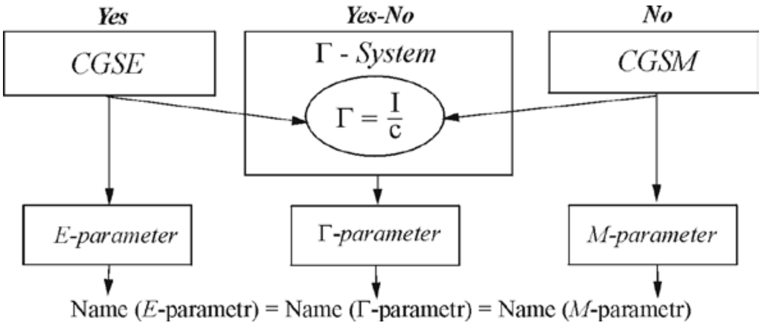

Fig. 8.2. A graph of the formation of notions: the *Yes*, *No*, and *Yes-No* systems of units.

The identification of conjugated phenomenological parameters (whose dimensionalities are represented by half-integer powers of reference units) is the fundamental error, leading to the incognizability of atomic phenomena and, accordingly, fundamentals of the World in the large.

3.2. *The origin of dimensionalities with fractional powers of gram and centimeter*

According to the equation (2.57) (Chapter 7), it is natural to accept in the capacity of the measure of exchange (of a motator with the field of matter-space-time at the field level ($\varepsilon_r = 1$)) the following expression

$$W = \int_r^\infty F dr = \int_r^\infty \frac{Q^2}{4\pi\varepsilon_0 r^2} dr = \frac{Q^2}{4\pi\varepsilon_0 r} = Q\varphi \,, \tag{3.8}$$

where φ is the potential, defined by the equality (2.54) (Chapter 7), and $\varepsilon_0 = 1\, g / cm^3$.

The energy of exchange (3.8) corresponds, in *CGSE* (*CGSM*) system, to the energy W_e (W_M) of the theory of electrostatic (or magnetostatic) field:

$$W_e = \frac{q_e^2}{r} \qquad (W_M = \frac{q_M^2}{r}), \tag{3.8a}$$

where q_e is the electric (Coulomb) charge.

Assuming $W = W_e$, we arrive at the following correspondence of the exchange charge Q and the Coulomb charge q_e:

$$Q = \sqrt{4\pi\varepsilon_0} \cdot q_e \,, \qquad q_e = Q / \sqrt{4\pi\varepsilon_0} \,. \tag{3.9}$$

The analogous relation takes place for the current

$$I = \sqrt{4\pi\varepsilon_0} \cdot I_e\,, \qquad I_e = I / \sqrt{4\pi\varepsilon_0}\,. \qquad (3.10)$$

On the basis of (3.8) and (3.9), we obtain the relations between the exchange and electric potentials:

$$W = Q\varphi = q_e\left(\sqrt{4\pi\varepsilon_0}\,\varphi\right) = q_e\varphi_e \qquad (3.11)$$

and, hence, $\varphi_e = \sqrt{4\pi\varepsilon_0}\,\varphi\,, \qquad \varphi = \varphi_e / \sqrt{4\pi\varepsilon_0}\,,$ (3.12)

$$U_e = \sqrt{4\pi\varepsilon_0}\,U\,, \qquad U = U_e / \sqrt{4\pi\varepsilon_0}\,, \qquad (3.13)$$

where U is the electric voltage.

The correlation between the electric strength vector E_e and the physical vector of exchange E, defined from the equality

$$F = QE = \sqrt{4\pi\varepsilon_0}\,q_e E = q_e E_e\,, \qquad (3.14)$$

is $E_e = \sqrt{4\pi\varepsilon_0}\,E$ or $E = E_e / \sqrt{4\pi\varepsilon_0}\,.$ (3.15)

The analogous relations take place for the "magnetic induction" vector B:

$$B_e = \sqrt{4\pi\varepsilon_0}\,B \quad \text{or} \quad B = B_e / \sqrt{4\pi\varepsilon_0}\,. \qquad (3.16)$$

B-Vector describes the properties of the magnetic field, analogous to the properties of the electric field presented by the electric strength vector *E*. By this reason it is necessary to call *B*-vector the *magnetic strength vector*. The nominative error produces the definite inconveniences and cannot be justified.

Thus, the following relation between the theoretical and phenomenological parameters takes place:

$$A_e = (\sqrt{4\pi\varepsilon_0})^k A\,, \qquad (3.17)$$

where k is the integer. If k is the even number, then the dimensionality of an electric measure A_e does not have fractional powers of reference units. However, in this case as well, we obtain the erroneous measures, excluding the cognition of electromagnetic phenomena.

Phenomenological measures with fractional powers of reference units led to a whole series of the corresponding phenomenological formulae. An analysis of experiments, based on these formulae, revealed the incorrect values of many fundamental parameters of the microworld.

4. The "leading" theoretical and phenomenological measures and their correlation

4.1. *The units of current. The phenomenological and objective ampere.*

Let us agree to denote the unit of an arbitrary physical quantity X by the symbol $E(X)$. This is especially convenience, when the unit has no name.

The unit of current the *ampere* was accepted at the First International Congress of Electricians in Paris in 1881 (FICE'1881). The ampere was defined as one tenth of the unit of "current in the magnetic system of units (*CGSM*)". Thus, actually, as follows from the above considered, the talk at the Congress was about the circulation in *CGS* (*CGSE* and *CGSM*) system:

$$E(I_e) = \frac{E(I_\gamma)}{10}. \tag{4.1}$$

The following relation connects the circulation Γ with the current I (see (2.109) of Chapter 7),

$$\Gamma = \frac{I}{c} = \frac{1}{c}\frac{dQ}{dt} = \frac{1}{c}\frac{d^2M}{dt^2}. \tag{4.2}$$

Using the relation (3.10) we arrive at the phenomenological equality similar in form to (4.2):

$$\Gamma_e = \frac{I_e}{c} = \frac{1}{c}\frac{dQ_e}{dt} = \frac{1}{c}\frac{d^2M_e}{dt^2}, \tag{4.2a}$$

where $$\Gamma = \sqrt{4\pi\varepsilon_0}\cdot\Gamma_e \quad \text{and} \quad I_e = \frac{dQ_e}{dt} = \frac{d^2M_e}{dt^2}. \tag{4.3}$$

The mass M_e, entering in these equalities, is connected with the physical mass by the relations:

$$M = M_e\sqrt{4\pi\varepsilon_0} \quad \text{and} \quad M_e = M/\sqrt{4\pi\varepsilon_0}, \tag{4.4}$$

where $$\dim M_e = g^{1/2}cm^{3/2}. \tag{4.4a}$$

We see, thus, that the unconditionally senseless unit of mass, $1g^{1/2}cm^{3/2}$, lies (in a latent form) in the basis of electromagnetic theory. Of course, an understanding of physics of the microworld on the basis of such unit is impossible.

Let us call this unit the "electric" gram and denote by the symbol

$$1g_e = 1g^{1/2}cm^{3/2}. \tag{4.5}$$

The "electric" (phenomenological) gram defines the phenomenological unit of "electric" charge

$$1e_e = 1g_e/s = 1g^{1/2}cm^{3/2}\cdot s^{-1}. \tag{4.5a}$$

Because the electric (Coulomb) and magnetic laws have the same form, the phenomenological, "electric" and "magnetic", grams are equal. Therefore, the unit magnetic charge is characterized by the same measure (4.5a):

$$1e_m = 1g_e/s = 1g^{1/2}cm^{3/2}\cdot s^{-1}. \tag{4.5b}$$

The charges, (4.5a) and (4.5b), define the units of currents, electric longitudinal and magnetic transversal:

$$1i_e = 1e_e/s = 1g_e/s^2 = 1g^{1/2}cm^{3/2}\cdot s^{-2}, \tag{4.6}$$

$$1i_m = 1e_m/s = 1g_m/s^2 = 1g^{1/2}cm^{3/2}\cdot s^{-2}. \tag{4.6a}$$

Hence, the units of "electric" and "magnetic" currents (as well as of charges) are equal.

Thus, the following four reference units constitute the basis of modern systems of units:

the ***gram***, *g*
the ***centimeter***, *cm*
the ***second***, *s* (4.7)
the "***electric***" ***gram***, $1g_e = 1g^{1/2}cm^{3/2}$
(or the ***electric charge***, $e_e = g_e / s$
or the ***electric current***, $i_e = g_e / s^2$).

The reference units (4.7) form the four base units of *SI* :

the ***kilogram***, *kg*
the ***meter***, *m* (4.7a)
the ***second***, *s*
the "***electric***" ***kilogram***, 1 kg_e = 1000 g_e

The electric gram defines the electric unit of current I_e,

$$E(I_e) = 1\dim(c\Gamma_e) = 1\dim\left(\frac{d^2M_e}{dt^2}\right) = 1g^{1/2}\cdot cm^{3/2}\cdot s^{-2} = 1g_e\cdot s^{-2}, \qquad (4.8)$$

and the unit of circulation, corresponding to the unit (4.8),

$$E(\Gamma_e) = \frac{E(I_e)}{c} = 1\dim\left(\frac{d^2M_e}{cdt^2}\right) = 1g^{1/2}\cdot cm^{1/2}\cdot s^{-1} = 1g_e\cdot cm^{-1}\cdot s^{-1}, \qquad (4.9)$$

which forms the unit of electric current the *ampere*:

$$1A_e = \frac{c}{10\,cm/s}g^{1/2}\cdot cm^{3/2}\cdot s^{-2} = 2.99792458\cdot 10^9\,g_e\cdot s^{-2} \approx 3\cdot 10^9\,g_e\cdot s^{-2}\,. \qquad (4.10)$$

The phenomenological basis (4.7) can be presented by the equivalent basis with use of the phenomenological unit of current the *ampere*:

the ***kilogram***, *kg*
the ***meter***, *m* (4.11)
the ***second***, *s*
the ***ampere***, $1A_e = 2.99792458\cdot 10^6\ kg_e\cdot s^{-2}$.

The above-enumerated measures constitute the official basis of *SI* system, which contains the objective kilogram, *kg*, and the *fictitious absurd kilogram*, *kg_e*, *hidden in the ampere*. Such erroneous basis converts scientists into a community of the blind, because it makes impossible seeing the real nature of phenomena. This is why, this basis must be abandoned immediately. It became a significant brake for the development of modern high technologies and resulted in the vast (invisible for uninitiated) addition economical costs.

Let us determine, on the basis of the expressions, (4.2) and (4.2a), the objective physical measure of current in $1\,{}_0A$:

$$1_0 A = \sqrt{4\pi\varepsilon_0} \cdot c \frac{E(\Gamma_e)}{10} = \sqrt{4\pi\varepsilon_0} \cdot \frac{c}{10} 1 g^{1/2} \cdot cm^{1/2} \cdot s^{-1} = \sqrt{4\pi} \cdot \frac{c}{10} g \cdot cm^{-1} \cdot s^{-1} \quad (4.12)$$

or

$$1_0 A = \sqrt{4\pi} \cdot \frac{c}{10\, cm/s} g \cdot s^{-2} = \sqrt{4\pi} \cdot \frac{2.99792458 \cdot 10^{10}\, cm/s}{10\, cm/s} g \cdot s^{-2}. \quad (4.12a)$$

For simplification of the presentation of formulae of measures, we introduce the qualitative basis speed

$$c_0 = c \cdot s \cdot cm^{-1} = 2.99792458 \cdot 10^{10}, \quad (4.13)$$

the factor $\sqrt{4\pi}$ will be presented by the symbol η_0,

$$\eta_0 = \sqrt{4\pi}. \quad (4.14)$$

Now, the formulae of the phenomenological and objective *ampere* can be presented as

$$1A_e = \frac{c_0}{10} g_e \cdot s^{-2}, \quad (4.15)$$

$$1_0 A = \frac{c_0 \eta_0}{10} g \cdot s^{-2}. \quad (4.15a)$$

The objective *ampere* and its metric measure are equal to

$$1\,{}_0A = 1.062736593 \cdot 10^{10} g \cdot s^{-2},$$

$$1\,{}_mA = 1 \cdot 10^{10} g \cdot s^{-2}. \quad (4.16)$$

It should be noted that the value (4.16) is a very big unit.

The following phenomenological *ampere* (in *Si* units) corresponds to the objective *ampere* (4.16):

$$1A_e = \frac{1\,{}_0A}{\sqrt{4\pi\varepsilon_0}} = \frac{c_0}{10} g^{1/2} \cdot cm^{3/2} \cdot s^{-2} = 2.99792458 \cdot 10^9 \; g_e \cdot s^{-2} \quad (4.17)$$

or

$$1A_e = \frac{c_0}{10} e_e \cdot s^{-1}. \quad (4.17a)$$

Using the equality $\Gamma_e = \frac{I_e}{c}$, we determine the phenomenological "circulational" *ampere*, which was erroneously called the "magnetic" *ampere*:

$$1A_\gamma = 1\frac{(c_0/10)\, e_e/s}{c_0\, cm/s} = \frac{1}{10} e_e \cdot cm^{-1} \quad \text{or} \quad 1A_\gamma = 1A_e \frac{1}{c}. \quad (4.18)$$

From this we find the objective "circulational" *ampere* ${}_0A_\gamma$ and its metric measure ${}_mA_\gamma$:

$$1_0 A_\gamma = \frac{1}{c} 1_0 A_e = \frac{\eta_0}{10} g \cdot cm^{-1} \cdot s^{-1}, \quad (4.18a)$$

$$1_m A_\gamma = 1\, g \cdot cm^{-1} \cdot s^{-1}. \quad (4.18b)$$

The circulational *ampere* is the unit of circulation Γ, called the *bio*. The circulational metric *ampere* ${}_mA_\gamma$ and the metric *bio* ${}_mBi$ are the same:

$$1_m Bi = 1_m A_\gamma = 1 g \cdot cm^{-1} \cdot s^{-1}. \qquad (4.18c)$$

4.2. *The units of charge. The phenomenological and objective coulomb.*

The *coulomb*, phenomenological and objective, is defined on the basis of the *ampere*:

$$1C_e = 1A_e \cdot s = \frac{c_0}{10} g^{1/2} \cdot cm^{3/2} \cdot s^{-1} = 2.99792458 \cdot 10^9 g_e \cdot s^{-1}, \qquad (4.19)$$

$$1_0 C = 1_0 A \cdot s = \frac{c_0 \eta_0}{10} g \cdot s^{-1} = 1.062736593 \cdot 10^{10} g \cdot s^{-1}. \qquad (4.19a)$$

The metric measure of the objective *coulomb* is

$$1_m C = 1 \cdot 10^7 kg \cdot s^{-1} = 1 \cdot 10^{10} g \cdot s^{-1}. \qquad (4.19b)$$

Besides, we can conditionally speak about (as it took place in the first half of the 20th century) the “circulational” (“magnetic”) *coulomb*. The “circulational” *coulomb* is the unit of linear density of the associated mass. According to (3.6), the phenomenological “circulational” *coulomb* is

$$1C_\gamma = 1C_e \frac{1}{c} = \frac{1}{10} g_e \cdot cm^{-1}. \qquad (4.20)$$

The objective measures of the “circulational” *coulomb* are

$$1_0 C_\gamma = 1_0 C \frac{1}{c} = \frac{\eta_0}{10} g \cdot cm^{-1} = 3.544907701 \cdot 10^{-1} g \cdot cm^{-1}, \qquad (4.20a)$$

$$1_m C_\gamma = 1 g \cdot cm^{-1}. \qquad (4.21)$$

4.3. *The units of potential. The phenomenological and objective volt*

The phenomenological unit of potential the *volt* was accepted (at the First International Congress of Electricians in Paris in 1881) as 10^8 units of “potential in *CGSM* system”. As follows from above, this definition is incorrect because the *volt* is actually the unit of “circulational” potential.

Let as clarify the correlation between the *potential of exchange* and the circulation (pseudo)potential on the basis of the expression for energy (3.11):

$$W = Q\varphi = q_e\left(\sqrt{4\pi\varepsilon_0}\varphi\right) = q_e\varphi_e = \frac{q_e}{c} \cdot (c\varphi_e) = q_\gamma \varphi_\gamma, \qquad (4.22)$$

where

$$\varphi_e = \frac{\varphi_\gamma}{c}, \qquad \varphi = \frac{\varphi_e}{\sqrt{4\pi\varepsilon_0}}. \qquad (4.23)$$

The potential φ_γ represents some characteristic value of current in the spherical field of exchange; therefore, it has the dimensionality of the phenomenological unit of electric current:

$$E(\varphi_\gamma) = 1\dim\left(\frac{cW}{q_e}\right) = 1 g^{1/2} \cdot cm^{3/2} \cdot s^{-2} = 1 g_e \cdot s^{-2}. \quad (4.24)$$

Taking into account this equality and following the definition the *volt*, we have

$$1V_e = \frac{10^8 E(\varphi_\gamma)}{c} = \frac{1}{299.792458} g^{1/2} \cdot cm^{1/2} \cdot s^{-1} \approx \frac{1}{300} E(\varphi_e) \quad (4.25)$$

or $$1V_e = \frac{10^8 E(\varphi_\gamma)}{c} = \frac{1}{299.792458} g_e \cdot s^{-1} \cdot cm^{-1} = \frac{1}{299.792458} i_e \cdot cm^{-1} \cdot s \quad (4.25a)$$

or $$1V_e = \frac{10^8}{c_0}\frac{g_e}{cm \cdot s} = \frac{10^8}{c_0} e_e \cdot cm^{-1} = \frac{10^8}{c_0} i_e \cdot cm^{-1} \cdot s. \quad (4.25b)$$

In the literature on metrology, it is common to present the *volt* by the approximate equality. By this way, the relation of the volt with the base speed *c* is hidden. The *volt* objective is

$$1_0 V = \frac{10^8 E(\varphi_\gamma)}{\sqrt{4\pi\varepsilon_0} \cdot c} = 9.4096901 \cdot 10^{-4} cm^2 \cdot s^{-1}. \quad (4.26)$$

In a shortened form, the expressions for the objective and metric *volt* are

$$1_0 V = \frac{1 \cdot 10^8}{\eta_0 c_0} cm^2 \cdot s^{-1}, \quad (4.27)$$

$$1_m V = 1 \cdot 10^{-3} cm^2 \cdot s^{-1}. \quad (4.27a)$$

4.4. *The phenomenological and objective units of E-vector*

According to the formulae (3.15), the phenomenological unit of the electric vector *E* is

$$E(E_e) = \sqrt{4\pi\varepsilon_0} \cdot E(E) = 1 g^{1/2} \cdot cm^{-1/2} \cdot s^{-1}, \quad (4.28)$$

or $$E(E_e) = 1(g_e / s)\, cm^{-2} = 1\, e_e \cdot cm^{-2}, \quad (4.28a)$$

where $E(E) = 1\, cm \cdot s^{-1}$ is the objective unit of *E*-vector.

The analogous phenomenological unit of the magnetic strength vector *B* (known as the magnetic induction) was called the *gauss* (*G*). Logically, it must be called the *magnetic gauss* and the unit of *E*-vector (4.28), the *electric gauss*. However, because these phenomenological units refer to the one class of phenomenological units and reflect the similar properties of the field, we will simply call them the *gauss*. Thus, taking into consideration the above stated, we will write the formula of the phenomenological *gauss* as:

$$1G_e = 1g^{1/2}\cdot cm^{-1/2}\cdot s^{-1} = 1\,e_e\cdot cm^{-2}\,. \qquad (4.29)$$

Now, the objective *electric gauss* will be presented as

$$1_0\,G = \frac{E(E_e)}{\sqrt{4\pi\varepsilon_0}} = \frac{1g^{1/2}\cdot cm^{-1/2}\cdot s^{-1}}{\sqrt{4\pi\varepsilon_0}} = \frac{1}{\eta_0}\,cm\cdot s^{-1}\,, \qquad (4.30)$$

and its metric measure is

$$1_m\,G = 1\,cm\cdot s^{-1}\,. \qquad (4.30a)$$

The phenomenological units of strength (or of the rate of electric exchange) – *volt*/*m* and *volt*/*cm* – are very small parts of the *gauss*:

$$1V_e\,/\,m = \frac{10^8 E(\varphi_\gamma)}{c\cdot 100\,cm} = \frac{1}{29979.2458}\,g^{1/2}\cdot cm^{-1/2}\cdot s^{-1} \approx \frac{1}{30000}\,e_e\cdot cm^{-2}\,, \qquad (4.31)$$

$$1V_e\,/\,cm = \frac{10^8 E(\varphi_\gamma)}{c\cdot cm} = \frac{1}{299.79458}\,g^{1/2}\cdot cm^{-1/2}\cdot s^{-1} \approx \frac{1}{300}\,e_e\cdot cm^{-2}\,. \qquad (4.31a)$$

For example, the objective measure of the vector of velocity of exchange in the "electric" field at the discharge in air with the strength of $50\,kV\,/\,cm$ is

$$_0E = 50\cdot 10^3\cdot\frac{1}{300}\cdot\frac{1}{\sqrt{4\pi}}\,cm\cdot s^{-1} \approx 47\,cm\cdot s^{-1}\,.$$

4.5. *The phenomenological and objective units of B-vector*

The two units determine the velocity-strength B (known as the magnetic field induction): the *gauss* and the *tesla*.

Because B-vector is the vector of the rate of exchange in the magnetic field, its objective unit is $E(B) = 1cm\cdot s^{-1}$. Using this, we obtain the phenomenological magnetic *gauss*

$$1G_e = E(B_e) = 1\,\mathbf{dim}\left(\sqrt{4\pi\varepsilon_0}\cdot B\right) = 1\,g^{1/2}\cdot cm^{-1/2}\cdot s^{-1} = 1\,e_e\cdot cm^{-2} \qquad (4.32)$$

and the objective measure of the magnetic *gauss* with the metric measure:

$$1_0G = \frac{E(B_e)}{\sqrt{4\pi\varepsilon_0}} = \frac{1}{\eta_0}cm\cdot s^{-1} = 2.820947918\cdot 10^{-1}\,cm\cdot s^{-1}\,, \qquad (4.33)$$

$$1_m G = 1\,cm\cdot s^{-1}\,. \qquad (4.34)$$

By definition, the phenomenological magnetic *tesla* is equal to 10^4 *gauss*:

$$1T_e = 1\cdot 10^4 G_e = 1\cdot 10^4\;e_e\cdot cm^{-2}\,. \qquad (4.35)$$

The phenomenological unit T_e corresponds to the following objective *tesla* with the metric measure:

$$1_0T = 1\cdot 10^4\,{}_0G = \frac{10^4}{\eta_0}\,cm\cdot s^{-1} = 2.820947918\cdot 10^3\,cm\cdot s^{-1}\,, \qquad (4.36)$$

$$1\,{}_mT = 1\cdot 10^4\,{}_mG = 1\cdot 10^4\ cm\cdot s^{-1}\,. \tag{4.36a}$$

According to the equation (3.3c), the *gauss* and the *tesla* define the corresponding “circulational” *gauss* and *tesla*:

$$1G_\gamma = c\cdot G_e\,, \qquad 1T_\gamma = c\cdot T_e = c\cdot 10^4\ e_e\cdot cm^{-2}\,. \tag{4.37c}$$

4.6. *The phenomenological and objective units of B flux -vector*

Following the definition of the flux, $d\Phi = B\cdot dS\cdot\cos\alpha$, its phenomenological unit, called the *maxwell* (Mx_e), is

$$1Mx_e = 1Gs_e\cdot cm^2 = 1\,e_e\,. \tag{4.38}$$

The following objective units of the flux correspond to this phenomenological unit:

$$1\,{}_0Mx = 1\,{}_0Gs\cdot 1m^2 = 2.820947918\cdot 10^{-1}\ cm^3\cdot s^{-1}\,, \tag{4.38a}$$

$$1\,{}_mMx = 1\ cm^3\cdot s^{-1}\,. \tag{4.38b}$$

The phenomenological unit of the flux, the *weber* electric (*Wb*), is equal, by definition, to the product $tesla\times m^2$:

$$1Wb_e = 1T_e\cdot 1m^2 = 1\cdot 10^8\,Mx_e\,. \tag{4.39}$$

The phenomenological *weber* defines the following, objective and metric, measures:

$$1\,{}_0Wb = 1\,{}_0T\cdot 1m^2 = 2.820947918\cdot 10^7\,cm^3\cdot s^{-1} = 1\cdot 10^8\,{}_0Mx\,, \tag{4.39a}$$

$$1\,{}_mWb = 1\,{}_mT\cdot 1m^2 = 100\ m^3\cdot s^{-1} = 1\cdot 10^8\ {}_0Mx\,. \tag{4.39b}$$

The “circulational” units of the flux (taking into account (3.3c)) are represented by the following equalities:

$$1Mx_\gamma = cMx_e\,, \qquad 1Wb_\gamma = cWb_e\,. \tag{4.40}$$

4.7. *The phenomenological and objective units of resistance R*

On the basis of Ohm’s law, $R = U/I$, and the formulae, (4.17a) and (4.25b), we find the phenomenological unit of resistance, the *ohm*:

$$1\Omega_e = \frac{1V_e}{1A_e} = \left(\frac{10^8}{c_0}\,e_e\cdot cm^{-1}\right)\Big/\left(\frac{c_0}{10}\,e_e\cdot s^{-1}\right) = \frac{10^9}{c_0^2}\,cm^{-1}\cdot s \tag{4.41}$$

or

$$1\Omega_e = \frac{10^9}{c_0^2}\,cm^{-1}\cdot s = 1.112650056\cdot 10^{-12}\ cm^{-1}\cdot s\,. \tag{4.41a}$$

At the First International Congress of Electricians (1881), the *ohm* was defined as 10^9 units of resistance in the magnetic system (*CGSM*). This definition is not correct because it rests on Ohm’s law in the magnetic system, i.e., on

Ohm's law for circulation. However, it is still not understood in metrology. Thus, we deal with

$$\Gamma = \frac{U_\gamma}{R_\gamma}. \qquad (4.42)$$

From this law, we define the following correlation between the electric and "circulational" resistance:

$$R_\gamma = \frac{U_\gamma}{\Gamma} = \frac{cU_e}{I_e / c} = c^2 \frac{U_e}{I_e} = c^2 R_e \qquad \text{and} \qquad R_e = \frac{R_\gamma}{c^2}. \qquad (4.43)$$

Hence, the unit of "circulational" resistance is

$$E(R_\gamma) = 1\dim(c^2 R_e) = 1\, cm \cdot s^{-1}. \qquad (4.44)$$

Following the recommendations of the aforementioned Congress, we find the circulational *ohm*

$$1\Omega_\gamma = 10^9 \ cm \cdot s^{-1} \qquad (4.45)$$

and the phenomenological measure of the electric *ohm*, defined on the basis of the electric Ohm's law,

$$1\Omega_e = \frac{10^9 E(R_\gamma)}{c^2} = \frac{10^9}{c_0^2} cm^{-1} \cdot s. \qquad (4.46)$$

Using formulae of the objective units, *volt* (4.27) and *ampere* (4.15a), we arrive at the formula of the objective *ohm*:

$$1_0\Omega = \frac{1_0 V}{1_0 A} = \left(\frac{10^8}{\eta_0 c_0} cm^2 \cdot s^{-1}\right) \Big/ \left(\frac{c_0 \eta_0}{10} \ g \cdot s^{-2}\right) = \frac{10^9}{\eta_0^2 c_0^2} (g \cdot cm^{-3})^{-1} cm^{-1} \cdot s \qquad (4.47)$$

or

$$1_0\Omega = \frac{10^9}{\eta_0^2 c_0^2 \varepsilon_0} cm^{-1} \cdot s, \qquad (4.47a)$$

where $\varepsilon_0 = 1\, g \cdot cm^{-3}$. Thus, we have

$$1_0\Omega = \frac{10^9}{\eta_0^2 c_0^2 \varepsilon_0} cm^{-1} \cdot s = 8.854187817 \cdot 10^{-14} \mu_0 \ \ cm^{-1} \cdot s. \qquad (4.47b)$$

The objective *ohm* defines the metric *ohm*,

$$1_m\Omega = 1 \cdot 10^{-14} \mu_0 \ \ cm^{-1} \cdot s. \qquad (4.47c)$$

4.8. *The phenomenological and objective units of capacity C*

We will present the electric capacity through the symbol C (note that the symbol for the coulomb is *C*). On the basis of the ratio $\mathsf{C} = Q/U$, we find the phenomenological unit of the electric capacity

$$1\mathsf{C}_e = \frac{Q_e}{U_e} = \frac{e_e}{e_e \cdot cm^{-1}} = 1\, cm. \qquad (4.48)$$

As the practical measure, the FICE '1881 accepted the *farad*; its formula is

$$1F_e = \frac{1C_e}{1V_e} = \left(\frac{c_0}{10}\, e_e\right) / \left(\frac{10^8}{c_0}\, e_e \cdot cm^{-1}\right) = \frac{c_0^2}{10^9}\, cm \qquad (4.49)$$

or

$$1F_e = \frac{c_0^2}{10^9}\, cm = 8.987551787 \cdot 10^{11}\, cm\,. \qquad (4.49a)$$

The phenomenological *farad* has been defined as 10^{-9} units of capacity in the "magnetic" system. Of course, this definition is related to the "circulational" *farad*, i.e., to the physical quantity of the other nature. The circulational capacity is related to the electric capacity as

$$\mathsf{C}_\gamma = \frac{Q_\gamma}{U_\gamma} = \frac{Q_e / c}{cU_e} = \frac{\mathsf{C}_e}{c^2} \qquad \text{and} \qquad \mathsf{C}_e = c^2 \mathsf{C}_\gamma\,. \qquad (4.50)$$

Obviously,

$$E(\mathsf{C}_\gamma) = \frac{E(\mathsf{C}_e)}{\dim(c^2)} = 1\frac{cm}{(cm/s)^2}\,. \qquad (4.51)$$

Following the aforementioned definition, the *farad*, defined on the basis of the "circulational" *farad*, is

$$1F_e = c^2 10^{-9} E(\mathsf{C}_\gamma) = \frac{c_0^2}{10^9}\, cm\,. \qquad (4.52)$$

This value corresponds to the formula (4.49).

The objective farad and its metric measure are:

$$1_0 F = \frac{1_0 C}{1_0 V} = \left(\frac{c_0 \eta_0}{10}\, g \cdot s^{-1}\right) / \left(\frac{10^8}{\eta_0 c_0}\, cm^2 \cdot s^{-1}\right) = \frac{c_0^2 \eta_0^2}{10^9}\, \varepsilon_0 \;\; cm \qquad (4.53)$$

or

$$1_0 F = \frac{c_0^2 \eta_0^2}{10^9}\, \varepsilon_0\; cm = 4\pi F_e = 1.129409067 \cdot 10^{13}\, g \cdot cm^{-2}\,, \qquad (4.53a)$$

$$1\,{}_m F = 1 \cdot 10^{13}\, g \cdot cm^{-2}\,. \qquad (4.53b)$$

4.9. *The phenomenological and objective units of inductance L*

Using the expression of the inductive voltage,

$$U_e = L_e \frac{dI_e}{dt}\,, \qquad (4.54)$$

we find

$$L_e = U_e / \frac{dI_e}{dt}\,. \qquad (4.55)$$

From this we define the unit of the phenomenological inductance,

$$E(L_e) = E(U_e) / E\left(\frac{dI_e}{dt}\right) = \frac{e_e \cdot cm^{-1}}{e_e \cdot s^{-2}} = 1\, s^2 \cdot cm^{-1}. \qquad (4.56)$$

On the basis of circulation, the expression, conjugated to the inductive voltage U_e (4.54), is

$$U_\gamma = L_\gamma \frac{d\Gamma}{dt}. \qquad (4.57)$$

Hence,

$$L_\gamma = U_\gamma / \frac{d\Gamma}{dt} = cU_e / \frac{d(I_e/c)}{dt} = c^2 L_e \qquad \text{and} \qquad L_e = L_\gamma / c^2. \qquad (4.58)$$

Thus, the unit of the "magnetic inductance" (more precisely, the circulational inductance) is

$$E(L_\gamma) = 1(cm \cdot s^{-1})^2 \cdot s^2 \cdot cm^{-1} = 1\,cm. \qquad (4.59)$$

The unit of inductance, the *quadrant*, called afterward the *henry*, was defined at the FICE '1881 as 10^9 units of inductance in the "magnetic system":

$$1H_\gamma = 10^9\,cm. \qquad (4.60)$$

This is the *henry* circulational. On the basis of (4.58), we arrive at the formula of the electric *henry*, which simultaneously is the *henry* magnetic:

$$1H_e = 1H_m = \frac{10^9 E(L_\gamma)}{c^2} = \frac{10^9}{c_0^2}\,cm^{-1} \cdot s^2 \qquad (4.61)$$

or $$1H_e = 1.112650056 \cdot 10^{-12}\,cm^{-1} \cdot s^2. \qquad (4.61a)$$

Taking into consideration the relation of objective and phenomenological measures of current and voltage (defined by the formulae, (3.10) and (3.13)), we present the expression (4.54) in the objective form

$$U_e = L_e \frac{dI_e}{dt} \quad \Rightarrow \quad \sqrt{4\pi\varepsilon_0} \cdot U = L_e \frac{d\left(I/\sqrt{4\pi\varepsilon_0}\right)}{dt} \quad \Rightarrow$$

$$U = \frac{L_e}{4\pi\varepsilon_0}\frac{dI}{dt} \quad \Rightarrow \quad U = L\frac{dI}{dt}.$$

These transformations give us the correlation between the theoretical and phenomenological inductance

$$L = \frac{L_e}{4\pi\varepsilon_0}. \qquad (4.62)$$

This equality defines the objective *henry*:

$$1_0 H_e = \frac{10^9}{4\pi\varepsilon_0 c_0^2}\,cm^{-1} \cdot s^2 = \frac{10^9}{4\pi c_0^2}\mu_0\,cm^{-1} \cdot s^2, \qquad (4.63)$$

or $$1_0 H = 8.854187816 \cdot 10^{-14}\,cm^2/(g/s^2), \qquad (4.63a)$$

and the *henry* metric

$$1_m H = 1 \cdot 10^{-13}\,cm^2/(g/s^2). \qquad (4.64)$$

5. The magnetic moments on the basis of current and circulation

Let us suppose that a process of exchange occurs in a cylindrical space of a round cross-section (for example, of a copper conductor). If we estimate this process using the value of the current of exchange *I*, then the wave field of current of exchange, with the azimuth symmetry, can be presented in the form

$$\hat{I} = I_0(k_r r)e^{-ikz}e^{-i\omega t}. \tag{5.1}$$

The following elementary relations take place between the axial gradient $\hat{I}_\lambda$, the rate of change of current $d\hat{I}/dt$ and the current itself:

$$\hat{I}_\lambda = \frac{d\hat{I}}{dz} = -ik\hat{I} = -i\omega\frac{\hat{I}}{c} = -i\omega\hat{\Gamma}, \qquad \frac{d\hat{I}}{dt} = -i\omega\hat{I}, \tag{5.2}$$

where the parameter

$$\hat{\Gamma} = \hat{I}/c \tag{5.3}$$

should be regarded as the axial (longitudinal) circulation, equal to the transversal circulation, because the transversal circulation is related to current by the same equality.

Obviously, an elementary quantum of circulation will have the form

$$\hat{\Gamma} = \frac{\hat{I}}{c} = \frac{i\omega\hat{e}}{c} = ik\hat{e}. \tag{5.4}$$

The transversal current, related to the deeper level of matter-space-time, always surrounds the longitudinal (axial) current. Because the longitudinal and transversal masses of exchange are equal, the longitudinal and transversal currents are equal as well.

If the axial current is closed, and a circuit of the current is a circular one, then the moment of current $\hat{P}_i$ and moment of circulation $\hat{P}_\gamma$ will be determined by the following formulae:

$$\hat{P}_i = \hat{I}\cdot S = \hat{I}\cdot\pi a^2, \tag{5.5}$$

$$\hat{P}_\gamma = \hat{\Gamma}\cdot S = \hat{\Gamma}\cdot\pi a^2. \tag{5.6}$$

Evidently,

$$\hat{P}_\gamma = \frac{\hat{I}}{c}\cdot S = \frac{\hat{P}_i}{c}. \tag{5.7}$$

The following correlation between the circulational (magnetic) and electric moments originates from the above formulas:

$$P_\gamma = \frac{\upsilon}{c}P_e, \tag{5.8}$$

where $P_e = ea$ is the moment of electron's charge. The correlation between the amplitude *a* of the wave at the level of superstructure and the wave radius $\lambda\!\!\!^{-}$ is

$$a = \frac{\upsilon}{c} \lambdabar . \quad (5.9)$$

Comparing (5.8) and (5.9), we arrive at the conclusion that the ***circulational moment*** P_γ is the ***charge*** *moment of superstructure* of the wave and the charge moment P_e is the moment of basis of the wave. With that, the "electric" moment is the limiting circulational moment, when $\upsilon \to c$.

The kinema of exchange of an electron, as an "electric" monopole, with the surrounding field-space at the basis level, has the form

$$F_c = eE . \quad (5.10)$$

At the level of superstructure, the kinema of exchange has the name the Lorentz force and is defined, in accordance with the relation of superstructure and basis (5.9), by the formula

$$F_\upsilon = \frac{\upsilon}{c} ie \cdot iE \qquad \text{or} \qquad F_\upsilon = \frac{\upsilon}{c} ie \cdot iB , \quad (5.11)$$

where $B = E$.

The vectors, E and B, are the different forms of presentation of the same field, which (as was noted above) can be called either the electric or magnetic field. Comparing the two forms of the kinema at the motion of an electron in the longitudinal-transversal field (Fig. 8.3), we have

$$\frac{\upsilon}{c} eB = m \frac{\upsilon^2}{a} .$$

From this, we obtain the value of the kinematic charge of an electron q_e in the longitudinal-transversal field:

$$q_e = m\omega = \frac{B}{c} e . \quad (5.12)$$

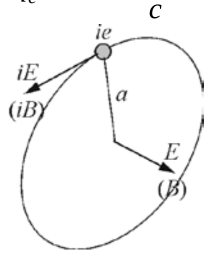

Fig. 8.3. A graph of motion of an electron in the longitudinal-transversal electric (magnetic) field.

It is easily to see that at $B = E \to c$, the *kinematic charge* of an electron q_e strives towards (in magnitude) the *exchange charge* of the electron *e*.

If we present the relation (5.12) in the form

$$\frac{q_e}{e} = \frac{B}{c} \quad (5.13)$$

and compare it with the fundamental wave relation

$$\frac{a}{\lambda\!\!\!^{-}} = \frac{\upsilon}{c},$$

then we can say that the charge *e* is the wave power of exchange of the electron at the level of basis.

Since $q_e = m\omega$ and $e = m\omega_e$, the equality (5.13) can be presented in the form of the ratio of the frequencies:

$$\frac{\omega}{\omega_e} = \frac{B}{c}, \tag{5.14}$$

where ω_e is the fundamental frequency of exchange (see (2.50) of Chapter 7) of an electron with the surrounding field of matter-space-time. This is the frequency of exchange at the level of basis or the basis frequency of exchange. So that the relation (5.14) shows that at $B \to c$ the frequency of superstructure (of the circular motion of an electron) ω moves towards, in magnitude, the basis frequency ω_e. In this sense, the basis frequency is the limiting frequency of superstructure.

On this basis, we can assert that the exchange moment of an electron p_e is the parameter of the basis of the wave, whereas the circulational moment of the electron is the wave superstructure at the orbit. Hence, the "electric" moment p_e is the limiting value of the circulational moment.

Let us now consider the essence of the *current moment*. According to the formula (2.50b) (Chapter 7), the current moment can be presented as

$$P_i = \upsilon e a = m\upsilon\omega_e a = mka\upsilon c = m_R \upsilon c, \tag{5.15}$$

where $m_R = mka$ is the active mass of an electron and *m* is its associated reactive mass. From the expression (5.15) it follows that the *moment of current* is the *energy of exchange of basis-superstructure*.

Thus, the comparison of moments of current and circulation shows that it is incorrectly to call them the "magnetic moments". *The moment of current is the energy and the moment of circulation is the charge moment of superstructure*. Strictly speaking, only the last should be called the magnetic moment.

We will now define the phenomenological values of the moments, taking into account the radius of the first Bohr orbit *a*, the speed on it υ, and the phenomenological charge of an electron *e* are equal, correspondingly, to

$a = 5.29177249 \cdot 10^{-11} m$, $\quad \upsilon = 2.187691417 \cdot 10^{6} m/s$,

$e_e = 1.60217733 \cdot 10^{-19} C_e$.

The phenomenological *circulational moment* is

$$P_{e_\gamma} = \frac{\upsilon}{c} e_e a = \frac{e_e}{mc}\hbar = 6.186957127 \cdot 10^{-32}\ C_e \cdot m. \tag{5.16}$$

If we present this measure in the "magnetic" coulombs then, taking into account that $1C_e = c \cdot 1C_M$, we obtain

$$P_{e_\gamma} = \frac{\upsilon}{c} e_e a = \frac{e_e}{mc}\hbar = 1.854803085 \cdot 10^{-23}\ C_M \cdot m\ . \qquad (5.17)$$

The *moment of current*, representing the physical quantity of a quite other nature, is defined by the following measure

$$P_{e_\gamma} = \upsilon e_e a = \frac{e_e}{m}\hbar = 1.854803085 \cdot 10^{-23}\ A_e \cdot m^2\ . \qquad (5.18)$$

In accordance with the formulae, (4.17a) and (4.35), $1A_e = \frac{c_0}{10} e_e \cdot s^{-1}$ and $1T_e = 10^4\ e_e \cdot cm^{-2}$, we have

$$1A_e \cdot T_e \cdot m^2 = \frac{c_0}{10} e_e \cdot s^{-1} \cdot 10^4\ e_e \cdot cm^{-2} \cdot 10^4 cm^2 = c \cdot 10^7 erg = c \cdot 1J\ . \qquad (5.19)$$

Using this equality, the measure of the current moment can be presented as

$$P_{e_\gamma} = \upsilon e_e a = \frac{e_e}{m}\hbar = 1.854803085 \cdot 10^{-23} c\ \ J/T_e\ . \qquad (5.20)$$

If we will divide (5.20) by the speed *c*, we will obtain the moment of circulation (the "magnetic" orbital moment)

$$\boxed{P_{e_\gamma} = \frac{\upsilon}{c} e_e a = \frac{e_e}{mc}\hbar = 1.854803085 \cdot 10^{-23}\ \ J/T_e} \qquad (5.21)$$

Phenomenology ascribes to the Bohr orbit the half value of the "magnetic" orbital moment (5.21) and the second missing part of the later attributes to the electron's spin moment, in accordance with the spin hypothesis. However, the electron does not have the proper moment of such a value (see Sect. 8.4 of Chapter 9) and, accordingly, the spin hypothesis is incorrect.

The half value of the orbital moment has obtained the name the Bohr magneton:

$$\mu_{eB} = \frac{1}{2}\frac{\upsilon}{c} e_e a = \frac{e_e}{2mc}\hbar = 9.274015425 \cdot 10^{-24}\ \ J/T_e\ . \qquad (5.22)$$

The following half of the current orbital moment corresponds to this circulational moment:

$$\mu_{ei} = \frac{1}{2}\upsilon e_e a = \frac{e_e}{2m}\hbar = 9.274015425 \cdot 10^{-24} c\ \ J/T_e\ . \qquad (5.22a)$$

Physicists of the first half of the 20th century have rested on the measure (5.22), which is the value of the initial Bohr magneton. Unfortunately, in the scientific literature, the basis speed of the wave *c* (the speed of light) quite often is omitted in the formula (5.22a), which is presented as

$$\mu_{ei} = \frac{1}{2}\upsilon e_e a = \frac{e_e}{2m}\hbar = 9.274015425 \cdot 10^{-24}\ \ J/T_e\ , \qquad (5.23)$$

that is incorrect, because

$$\mu_{ei} = \frac{1}{2}\upsilon e_e a = \frac{e_e}{2m}\hbar \neq 9.274015425 \cdot 10^{-24}\ \ J/T_e\ . \qquad (5.24)$$

It is necessary to not use the equalities of the type (5.23).

The magnetic field, i.e., the transversal electric field appearing around a conductor with current, is the field of stellar systems of the microworld (micro-galaxies), whose cores are represented by electrons, as their centers. As a whole, this is the wave process, which is described by the wave of current (5.4) and the circular orbital moment (5.21).

To an equal extent, the central magnetic (electric) field is the field with discrete structures of the one level, where there are also electrons. And the transversal magnetic field is the field with discrete structures of the lower level, represented by the satellites of electrons and other elementary microobjects.

All above considered moments were presented by the phenomenological measures, which have the same numerical values as objective theoretical measures. For example, the theoretical circulational moment of the electron orbit in objective measures is

$$P_\gamma = \frac{\upsilon}{c} ea = \frac{e}{mc}\hbar = 1.854803085 \cdot 10^{-23} \quad J/{}_0T \,. \tag{5.25}$$

The objective *tesla*, according to (4.36), is defined by the measure

$$1_0 T = \frac{10^4}{\sqrt{4\pi}} cm \cdot s^{-1} = 2.820947918 \cdot 10^3 \quad cm \cdot s^{-1} .$$

Hence, taking into consideration that $1J = 10^7 erg$, we have

$$P_\gamma = \frac{\upsilon}{c} ea = \frac{e}{mc}\hbar = 6.575105741 \cdot 10^{-20} \ erg/{}_0Gs = 6.575105741 \cdot 10^{-20} \quad g \cdot cm \cdot s^{-1} \tag{5.26}$$

As we see, the objective circulational moment of the electron orbit (of the transversal field of exchange) is determined through the three basic units. If we will use the metric objective *tesla*, $1\,{}_mT = 10^4 \ cm \cdot s^{-1}$, and the metric unit of energy, the *joule*, then the circulational moment will be characterized by the new metric measure, but with the same, as (5.26), numerical value:

$$P_\gamma = \frac{\upsilon}{c} ea = \frac{e}{mc}\hbar = 6.575105741 \cdot 10^{-23} \quad J/{}_mT \,. \tag{5.26a}$$

Thus, the numerical value of objective measures is not changed under transition from the measure, expressed in reference units, to the new metric measure. This is a very important feature of metric measures of *QuGCS* system. The metric units of *QuGCS* system give the objective values of microparameters, whereas the measure (5.25) distorts the object measure of the circulational moment. This is stipulated by the fact that the objective *tesla* contains the factor $\sqrt{4\pi}$, having no relation to the moment, but reflecting the errors of the past.

Moreover, practically, all phenomenological measures contain the speed of light *c*. This fact once more stresses their artificial character. This is why, we should refuse such measures.

Finally, let us consider the circulation of basis and superstructure.

The relation between circulation and current is defined by the formula (5.3), $\hat{\Gamma} = \hat{I}/c$. We can present this equality in the following form:

$$\hat{\Gamma} = \frac{\hat{I}}{c} = \frac{\upsilon}{c}\frac{\hat{I}}{\upsilon} = \frac{\upsilon}{c}\hat{\Gamma}_c\,,$$

where

$$\hat{\Gamma}_c = \hat{I}/\upsilon \tag{5.27}$$

is the circulation of basis, because $\hat{\Gamma}$ is the circulation of superstructure.

The equality (5.27) defines the correlation between the density of basis circulation and the density of current of basis

$$\gamma_c = j_c/\upsilon\,. \tag{5.27a}$$

Since the density of current of basis $j_c = ne\upsilon$, the density of circulation will be defined by the expression

$$\gamma_c = ne\,, \tag{5.27b}$$

i.e., by the density of power of exchange (the density of charge) at the level of basis. Because the density γ_c is determined by the charge of an electron *e*, this charge, representing by itself the quantum of power of exchange, relates to the wave basis level. And in this sense, the electron charge is one of the limiting quanta of this level.

6. The different forms of Coulomb's law; the constants ε_{e0} and μ_{e0}

Let us compare the right form of the law of central exchange (2.60) (Chapter 7), $F = \frac{qQ}{4\pi\varepsilon_0 r^2}$, with the formal Coulomb's law:

$$F = \frac{q_e Q_e}{r^2}\,. \tag{6.1}$$

The necessity to take into account the spherical character of exchange (through the spherical angle of 4π steradian) was understood by some well-known physicists. In particular, **Heaviside Oliver** (1850-1925, British electronic engineer and physicist) has noted this fault and attempted to remove it. However, contemporaries did not want to hear his opinion and only afterwards was the missing factor 4π introduced in the formula (6.1). But unfortunately, simultaneously, the inverse factor $1/4\pi$ was added there as well:

$$F = \frac{q_e Q_e}{r^2} \quad\Rightarrow\quad F = \frac{q_e Q_e}{4\pi\left(\frac{1}{4\pi}\right)\cdot r^2} \quad\Rightarrow\quad F = \frac{q_e Q_e}{4\pi\varepsilon_{e0} r^2}\,, \tag{6.1a}$$

where the "electric constant" takes the value

$$\varepsilon_{e0} = 1/4\pi . \tag{6.2}$$

Since $\mu_{e0} = 1/\varepsilon_{e0}$, the "magnetic constant" is equal to

$$\mu_{e0} = 4\pi . \tag{6.3}$$

It is possible to attribute to the "magnetic constant" an appearance of a dimensionality. Remember that the *circulational henry*, determined according to (4.60) by the measure equal approximately to a quarter of Earth's meridian, is $1H_\gamma = 10^9 cm$. Using the *meter*, equal to 100 *cm*, it is possible to present the numerical unit in the form of the following equality:

$$1 = 10^{-7} H \cdot m^{-1} . \tag{6.4}$$

And now we can create the appearance of the dimensionality of the "magnetic constant" (which it has in *SI*):

$$\mu_{e0} = 4\pi \cdot 1 = 4\pi \cdot 10^{-7} H/m . \tag{6.5}$$

A majority of the constants were composed in such a spirit. Is the system necessary for science? Undoubtedly, it is not. Those who have realized such a "rationalization" have actually regarded nature as the subjective reality. They have operated with the unlimited freedom of a mathematical game. It should be noted that the vanguard philosophy of physics, which as before continues its destructive work, allows creating an appearance of correction of the errors, unremoving them. A chain of the formal transformations (6.1a) clearly shows it. Such transformations remind us the circus juggles. However, that is rightful and desirable in a circus, it is undesirable and inadmissible in science.

The following steps in transformations (6.1a) were devoted to the expression of the force in *newtons*, the length in *meters*, and charge in *phenomenological coulombs*, keeping the fractional powers of reference units.

Let us show these three historical steps:

(1) $$F = \frac{q_e Q_e}{4\pi\varepsilon_{e0} r^2} \quad \Rightarrow \quad F = 10^{-5} N/dyn \cdot \frac{q_e Q_e}{4\pi\varepsilon_{e0} r^2} \Rightarrow$$

(2) $$F = \frac{10^{-5} N/dyn}{\left(\frac{100\, cm}{m}\right)^2} \cdot \frac{q_e Q_e}{4\pi\varepsilon_{e0}\left(r/\frac{100\, cm}{m}\right)^2} \quad \Rightarrow$$

(3) $$F = \frac{10^{-5} N/dyn}{10^4 cm^2/m^2} \cdot \frac{q_e Q_e \left(\frac{c_0}{10} e_e / C_e\right)^{-2}}{4\pi\varepsilon_{e0}\left(\frac{c_0}{10} e_e / C_e\right)^{-2} R^2} \quad \Rightarrow \quad F = \frac{q_C Q_C}{4\pi\varepsilon_{e0} R^2},$$

where $R = \left(r/\frac{100\, cm}{m}\right)$ is the distance in *meters*; $q_C = \frac{q_e}{\frac{c_0}{10} e_e / C_e}$ is the charge in *coulombs* (see (4.19)).

Taking into account that $\dfrac{dyn\cdot cm^2}{e_e^2}=1$ and $\dfrac{C_e^2}{N\cdot m^2}=\dfrac{F_e}{m}$, the new value of ε_{e0} is

$$\varepsilon_{e0}=\frac{1}{4\pi}10^9\,\frac{dyn\cdot cm^2}{N\cdot m^2}\cdot\frac{100}{c_0{}^2}\frac{C_e^2}{e_e^2}=\frac{10^{11}}{4\pi c_0{}^2}\cdot\frac{C_e^2}{N\cdot m^2}=\frac{10^{11}}{4\pi c_0{}^2}\,F_e\cdot m^{-1}.$$

Thus, $$\varepsilon_{e0}=\frac{10^{11}}{4\pi c_0{}^2}\,F_e\cdot m^{-1}=8.854187818\cdot 10^{-12}\,F_e\cdot m^{-1}. \qquad (6.6)$$

Although all of this appears sound and rational, the errors were masked and not removed. Thus, those who were unable to solve the problem of metrology of electromagnetic phenomena have endeavored to hide it in the formal constructions. And we must recognize that they succeeded in this.

Taking into account that the *farad*, according to the formula (4.49), has the measure

$$1F_e=\frac{c_0^2}{10^9}\,cm=\frac{c_0^2}{10^{11}}\,m,$$

we see that the real value of the "*electric constant of vacuum*" is equal to

$$\varepsilon_{e0}=\frac{10^{11}}{4\pi c_0{}^2}\,\frac{F}{m}=\frac{10^{11}}{4\pi c_0{}^2}\,\frac{c_0{}^2}{10^{11}}\,\frac{m}{m}=\frac{1}{4\pi}. \qquad (6.7)$$

Obviously, the factor in the equation (6.1a), $4\pi\varepsilon_{e0}=1$, expresses nothing reasonable. In this way, only an imitation of the reform in metrology of electromagnetic processes, but not the reform itself, was carried out.

Nothing hindered, at that time, to compare the two forms of Coulomb' law,

$$F=\frac{qQ}{4\pi r^2} \qquad \text{and} \qquad F=\frac{q_eQ_e}{r^2},$$

and to obtain, at least, the correct numerical values of charges:

$$F=\frac{q_eQ_e}{r^2} \quad\Rightarrow\quad F=\frac{(\sqrt{4\pi}\cdot q_e)(\sqrt{4\pi}\cdot Q_e)}{4\pi r^2} \quad\Rightarrow\quad F=\frac{qQ}{4\pi r^2}, \qquad (6.8)$$

where $$Q=\sqrt{4\pi}\,q_e. \qquad (6.9)$$

It was very simple to perform such operation, but ones, with very acute hearing (but pretended to be deaf) did not hear of really deaf (but thinking) Heaviside. Their deafness is understandable: Heaviside's professionalism was higher than theirs.

A simple reform of (6.8) – (6.9), if only it would be realized, the explicit error could be removed in the description of the spherical field of exchange. Of course, the incorrect dimensionality of the electric charge, as before, would be incorrect, because the coefficient ε_0 in (6.8) and (6.9) is equal to the numerical (dimensionless) unit. But this problem could be solved later. As we see, the worth of scientific truth turned out to be lower than the ambitions of the legislators in science at that time. As a result, instead of the aforementioned extremely simple reform (6.8) – (6.9), science has toiled with the fictitious "rationalization" for decades, leaving unsolved the important problems of metrology of electromagnetic processes.

If we write Coulomb's law for "magnetic" charges,

$$F = \frac{q_m M_m}{r^2}, \tag{6.10}$$

we will arrive at the system of measures on the basis of these charges. Measures of magnetic charges are equal to the measures of electric charges. Therefore, all above-presented parameters and their measures in the equal are valid for the magnetic field. However, here as well their own "circulational" measures, incorrectly called the "magnetic" ones, appear.

7. The vectors, D and H

The longitudinal-transversal field of exchange is characterized by the vector of velocity-strength **E** and by the vector of density of momentum (of associated field mass of longitudinal exchange) **D**

$$\mathbf{D} = \varepsilon_0 \mathbf{E} \qquad \text{or} \qquad \mathbf{E} = \mu_0 \mathbf{D}. \tag{7.1}$$

The density of energy of the longitudinal exchange has the same form for all mass processes:

$$w = \frac{1}{2}\varepsilon_0 \varepsilon_r \upsilon^2. \tag{7.2}$$

If $\varepsilon_r = 1$, then the simplest expression for the density of energy is

$$w = \frac{1}{2}\varepsilon_0 \upsilon^2. \tag{7.2a}$$

It is natural to call this density of energy the *density of the energy of physical space*, because the unit density $\varepsilon_0 = 1\, g \cdot cm^{-3}$ is actually the coefficient of identity of measures of matter and space.

The expression (7.2a) is valid not only at the field level of the quantitative identity of matter and space, but also under the condition, when $\varepsilon_r \neq 1$.

In such a field-space of matter, the expression (7.2a) has the meaning of the *density of energy of space itself*. If we now denote the velocity of mass exchange by the symbol **E**, we will obtain the expression for the density of longitudinal energy in the following form:

$$w = \frac{1}{2}\varepsilon_0 E^2 = \frac{1}{2}ED = \frac{1}{2}\mu_0 D^2. \tag{7.3}$$

Evidently, the density of the transversal energy will be presented by the analogous equality

$$w = \frac{1}{2}\varepsilon_0 B^2 = \frac{1}{2}BH = \frac{1}{2}\mu_0 H^2, \tag{7.3a}$$

where **B** is the vector of transversal velocity-strength and **H** is the vector of density of the transversal momentum:

$$\mathbf{H} = \varepsilon_0 \mathbf{B} \qquad \text{or} \qquad \mathbf{B} = \mu_0 \mathbf{H}. \tag{7.4}$$

The formula of the density of longitudinal energy on the basis of the phenomenological vector $\mathbf{E}_e$ has the form

$$w = \frac{1}{2}\varepsilon_0 E^2 = \frac{1}{2}\varepsilon_0 \left(\frac{E_e}{\sqrt{4\pi\varepsilon_0}}\right)^2 = \frac{1}{2}\varepsilon_{e0} E_e^2 = \frac{1}{2}E_e D_e = \frac{1}{2}\mu_{e0} D_e^2, \tag{7.5}$$

where $\varepsilon_{e0} = \frac{1}{4\pi}$ is the phenomenological "electric constant", $\mu_{e0} = 4\pi$ is the phenomenological "magnetic constant", and D_e is the phenomenological vector of the "electric displacement"

$$\mathbf{D}_e = \varepsilon_{e0}\mathbf{E}_e = \frac{\mathbf{E}_e}{4\pi} \quad \text{or} \qquad \mathbf{E}_e = \mu_{e0}\mathbf{D}_e. \tag{7.6}$$

Thus, the vectors of strength and electric displacement (in the electric phenomenology) relate to the same class of phenomenological parameters, because they differ only quantitatively.

Analogously, we will transform the formula (7.3a):

$$w = \frac{1}{2}\varepsilon_0 B^2 = \frac{1}{2}\varepsilon_0 \left(\frac{B_e}{\sqrt{4\pi\varepsilon_0}}\right)^2 = \frac{1}{2}\varepsilon_{e0} B_e^2 = \frac{1}{2}B_e H_e = \frac{1}{2}\mu_{e0} H^2. \tag{7.7}$$

If one follows Coulomb's law for magnetic charges and the formula of density (7.4), then

$$\mathbf{H}_e = \varepsilon_{e0}\mathbf{B}_e = \frac{\mathbf{B}_e}{4\pi} \qquad \text{or} \qquad \mathbf{B}_e = \mu_{e0}\mathbf{H}_e. \tag{7.8}$$

Further, we will consider the vectors on the basis of circulational expressions. They generate the circulational vectors: $\mathbf{E}_\gamma$, $\mathbf{D}_\gamma$, $\mathbf{B}_\gamma$, $\mathbf{H}_\gamma$. Because

$$F = q_e E_e = \frac{q_e}{c}\cdot cE_e = q_\gamma E_\gamma, \tag{7.9}$$

hence, the "circulational" strength and the velocity-strength are related by the equality

$$\mathbf{E}_\gamma = c\mathbf{E}_e. \tag{7.10}$$

The analogous relation takes place also for the vector $\mathbf{B}_e$:

$$\mathbf{B}_\gamma = c\mathbf{B}_e. \tag{7.11}$$

Let us now carry out the following transformations with the formula (7.3):

$$w = \frac{1}{2}\frac{\varepsilon_{e0}}{c^2}(cE_e)^2 = \frac{1}{2}\varepsilon_{\gamma 0}E_\gamma^2 = \frac{1}{2}E_\gamma D_\gamma = \frac{1}{2}\mu_{\gamma 0}D_\gamma^2 . \tag{7.12}$$

Hence, we obtain the expressions for the circulational parameters, $\varepsilon_{\gamma 0}$ and $\mathbf{D}_\gamma$:

$$\varepsilon_{\gamma 0} = \varepsilon_{e0} / c^2 , \qquad D_{e\gamma} = \varepsilon_{\gamma 0}E_\gamma = \varepsilon_{e0} / c^2 \cdot cE_e = \frac{D_e}{c} . \tag{7.13}$$

The analogous relations take place for $\mathbf{H}_\gamma$ vector:

$$\mu_{\gamma 0} = c^2 \mu_{e0} , \qquad H_{e\gamma} = \varepsilon_{\gamma 0}B_\gamma = \varepsilon_{e0} / c^2 \cdot cB_e = \frac{H_e}{c} . \tag{7.14}$$

8. On the definition of the ampere in SI

As was shown earlier, the interchange of two cylindrical transversal spaces-fields in the simplest case ($\mu_r = 1$), according to (2.102) (Chapter 7), is expressed by the power of exchange

$$F = \frac{\mu_0 \Gamma^2 l}{2\pi R} , \tag{8.1}$$

and the transversal velocity-strength has the form

$$B = \frac{\mu_0 \Gamma}{2\pi R} \quad \text{or} \quad H = \frac{\Gamma}{2\pi R} . \tag{8.2}$$

The circulation defines the linear density of transversal charge Therefore, the total charge of a section of the cylindrical field of a length *l* will be equal to

$$Q_\tau = \Gamma l , \tag{8.3}$$

and the expression of power can be presented simply as

$$F = Q_\tau B . \tag{8.4}$$

Through a similar way, we can present the power of exchange between the two cylindrical longitudinal fields-spaces and express the velocity-strength as

$$F = \frac{\tau^2 l}{2\pi\varepsilon_0 R} , \qquad E = \frac{\tau}{2\pi\varepsilon_0 R} \quad \text{or} \quad D = \frac{\tau}{2\pi R} , \tag{8.5}$$

where τ is the linear density of charge.

We have as well

$$Q_n = \tau l , \qquad F = Q_n E . \tag{8.6}$$

In the longitudinal field-space, the linear density of the longitudinal charge τ is the longitudinal circulation, which is usually called the linear flux *N*:

$$N = \tau . \tag{8.7}$$

Taking into consideration that $\Gamma = \sqrt{4\pi\varepsilon_0} \cdot \Gamma_e$ (see (4.3)), the phenomenological variant of the exchange (8.1) is

$$F = \frac{\mu_0 \Gamma^2 l}{2\pi R} = \frac{4\pi\varepsilon_0 \mu_0 \Gamma_e^2 l}{2\pi R} = \frac{2\Gamma_e^2 l}{R}, \qquad (8.8)$$

and the linear power of exchange of cylindrical fields takes the form

$$\frac{F}{l} = \frac{2\Gamma_e^2}{R}. \qquad (8.9)$$

Identifying the circulation and current: $\Gamma_e = I_e$, that is absolutely incorrectly, the relation (8.9) can be presented as

$$\frac{F}{l} = \frac{2I_e^2}{R}. \qquad (8.9a)$$

The incorrect equality defines the phenomenological unit of electric current the *ampere*:

(8.10)

> "1 ***ampere*** *is the constant current that, if maintained in two straight parallel conductors of infinite length, of negligible circular cross section, and placed one meter apart in a vacuum, would produce between these conductors a force equal to* $2 \cdot 10^{-7}$ *newton per meter of length*."

The base of such definition is a phenomenological train of thought, which, however, does not enter explicitly in the definition: the *unit of electric current the* ***ampere*** *is equal to a tenth of the unit of current of the "magnetic system"* (where, as we know, $1A_\gamma = 0.1e_e\ cm^{-1}$). Therefore, taking into account (4.18) and that $\frac{dyn}{cm} = 10^{-3}\frac{N}{m}$, we arrive at

$$\frac{F}{l} = \frac{2 \cdot (0.1e_e / cm)^2}{100\, cm} = \frac{2 \cdot (0.1)^2}{100}\frac{dyn}{cm} = \frac{2 \cdot (0.1)^2}{100} \cdot 10^{-3} N/m = 2 \cdot 10^{-7} N/m. \qquad (8.11)$$

Thus, actually, the aforementioned definition says about the *circulational ampere*, i.e., about ***the unit of linear density of the phenomenological magnetic charge***, which, in accordance with (4.18), is equal to

$$1A_\gamma = \frac{1}{10}(e_e\ s^{-1})/(cm \cdot s^{-1}) = \frac{1}{10}e_e\ cm^{-1}. \qquad (8.12)$$

The square of the phenomenological unit of circulation is equal to the dyne: $(1e_e\ cm^{-1})^2 = 1\ dyn$.

Thus, the definition of the "*ampere*" (8.10) relates to the *phenomenological unit of circulation*. We call it the *bio* and denote by the symbol bi_e. Its definition can be as follows:

"*One tenth of the unit of circulation the* ***bio*** *is the circulation of the cylindrical field of rest-motion of matter-space-time at the subatomic level, whose power of interchange with the equal cylindrical field is* $2\cdot10^{-7}\ N$ *per meter of length. The axial field of these transversal cylindrical fields are localized in the space of two straight parallel conductors of infinite length, of negligible circular cross section, and placed one meter apart.*

(8.13)

The circulation of $0.1bi_e$ defines also the unit of magnetic current of 1 *ampere*, on the basis of the relation $I_e = c\Gamma_e$, and the unit of magnetic charge of 1 *coulomb* = 1 *ampere* × *second*. The magnetic current, as the current of the transversal electric (called magnetic) field, is represented by the cylindrical field. The value of the longitudinal current $I_{e\tau}$ is always equal to the value of the axial longitudinal current $I_{e\tau} = I_{e0} = I_e$ (Fig. 8.4); therefore, the *ampere* of the magnetic current is equal to the *ampere* of the electric current.

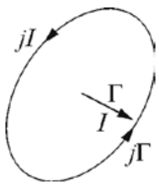

Fig. 8.4. A graph of the longitudinal-transversal field with objective measures of the longitudinal subfield of current *I* and circulation Γ and with measures of the transversal subfield of current *jI* and circulation $j\Gamma$, where *j* is the unit of negation of longitudinal parameters *I* and Γ.

The transversal magnetic fields-currents, but not the axial ones define the interchange between cylindrical fields.

Since the magnetic circulation $\Gamma_e = I_e / c$ represents the linear density of the transversal magnetic charge of cylindrical field, $\Gamma_e = q_Z$, the *bio* is simultaneously the unit of linear density of the transversal magnetic charge. The circulation of the magnetic current $\Gamma_e = I_e / c$ defines also the axial longitudinal circulation $\Gamma_{e0} = I_{e0} / c$ of the electric axial field, because they are equal."

The circulation of $0.1bi_e$ defines, at the part of length of 10 *cm*, the unit transversal magnetic charge:

$$Q_\tau = q_Z \cdot z = 0.1\,bi_e \cdot 10\,cm = 1\,bi_e \cdot cm = 1\,e_e, \qquad (8.14)$$

and at the part of length of $c_0\, cm$ (299792.458 *km*), the magnetic charge of 1 *coulomb*,

$$1\,C_e = 0.1\,bi_e \cdot \frac{c_0}{10}\,cm = \frac{c_0}{10}\,e_e = 2.99792458 \cdot 10^9\ e_e\,, \qquad (8.15)$$

which, in turn, defines the unit of magnetic (transversal) current of 1 *ampere*:

$$1\,A_e = 1\,C_e \cdot s^{-1} = c \cdot 0.1\,bi_e = \frac{c_0}{10}\,e_e \cdot s^{-1} = 2.99792458 \cdot 10^9\ e_e \cdot s^{-1}\,. \qquad (8.16)$$

Let us now present the phenomenological measures, defined by the above-described formulae, through the objective measures.

The *objective bio* (${}_0bi$) defines the density of magnetic charge

$$1\ {}_0bi = \sqrt{4\pi\varepsilon_0} \cdot 1\,bi_e = 3.544907702\ (g \cdot s^{-1}) \cdot cm^{-1} = 3.544907702\ e \cdot cm^{-1}\,, \qquad (8.17)$$

where $e = g \cdot s^{-1}$ is the objective measure of charge, i.e., the unit power of mass exchange.

The phenomenological measure (8.14) conceals the real magnitude of the magnetic charge:

$$Q_\tau = q_Z \cdot z = 0.1\ {}_0bi \cdot 10\ cm = 1\ {}_0bi \cdot cm = 3.544907702\ g \cdot s^{-1}\,. \qquad (8.18)$$

The relative value of the last, in the objective electron’s charges (see (1.3) of Chapter 9), is defined by the measure

$$Q_\tau = q_Z \cdot z = 1\ {}_0bi \cdot cm = 2.081942420 \cdot 10^9\,e\,. \qquad (8.19)$$

This value expresses the quantity of magnetic electron charges related with the particles, participating in formation of the transversal magnetic field. These particles are placed with the definite density along the axial line. The following quantum of length of the axial line accounts for every transversal electron charge in the case with one-centimeter axial length at the circulation of 1_0*bi*:

$$L_e = \frac{1\,cm}{Q_\tau / e} = 4.803206805 \cdot 10^{-10}\ cm\,/electron\ magnetic\ charge. \qquad (8.20)$$

The above-enumerated units relate to the transversal magnetic field. The units of the same nomination, but defined on the basis of the two infinite, in length, charged conductors of negligible circular cross section, relate to the longitudinal field. It is usual to call them the electric units.

Because formulae of the longitudinal and transversal *cylindrical fields* are identical in form, the measures of units of the longitudinal field will coincide with the measures of units of the transversal field. Standards of the longitudinal field are difficult for realization and, therefore, in reality, all relevant measures used by contemporary physics relate to the measures of the transversal magnetic field.

Quantitatively, the conjugated measures of the transversal and longitudinal fields are equal, although both fields differ qualitatively. The fact is that the longitudinal field is represented by one sublevel of matter-space-time and the other more “disperse” sublevel represents the transversal field. As quality and quantity, the qualitative transversal and quantitative longitudinal subfields, being essentially different, together form the single qualitative-quantitative field.

Natural measures of the ***quantitative field*** should be called ***quanta***, whereas the conjugated measures of the ***qualitative field*** should be called ***quals***. The ***qual*** is the negation of the ***quantum***: $qual = i \cdot quantum$.

Reference

[Leonid G. Kreidik and George P. Shpenkov, *Atomic Structure of Matter-Space*, Geo. S., Bydgoszcz, 2001, 584 p. Chapter 8: “*The Physical Metric; the Units of Dialectical Physics and Crucial Faults of the Modern System of Units*”, pages 363-408]