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This brief memorandum records what the writer considers to be a useful discovery in the fundamental properties of matter.

The essence of the disclosure, arrived at by dimensional methods, is that the quantum and classical theories of particle physics are unified by a universal constant, A, which is defined as:

$$A = 6.8 \times 10^{22} \text{ cm}^2/\text{g sec} \left(\text{or } \frac{\text{cm}^2 \text{ sec}}{\text{g sec}^2} = \frac{\lambda^2 v_m^2}{M v} \right)$$

and states that a maximum relationship exists between a particulate's "radius" (λ), its intensity of magnetization (v_m), ⁽¹⁾ its rest mass (M) and its angular velocity (v). The importance of this constant is believed to lie in its property of relating simultaneously the dimensions of motion and electro-magnetism for all "particles", whether submicroscopic or astronomical in character.

An additional universal constant, B, establishes a value of importance to the definition of the thermo-dynamic properties of matter, i.e.,

$$B \approx \frac{1.05 \times 10^{-1}}{\text{sec } ^\circ A^2} \left(\text{or } \frac{v_m}{^\circ A^2} \right),$$

a minimum relationship which exists between a particle's magnetic field intensity (v_m) and its "equivalent" ⁽²⁾ temperature ($^\circ A$). Constants A and B, together with C, the maximum velocity ⁽³⁾ of a given mass particulate, and π , would thus constitute perhaps the four most fundamental aspects in the relationships of matter and motion and/or the phenomena of mass, space, time, and temperature. Knowing that B, C, and π exist, it would be possible to write an all-embracing constant approximating

$$Z = \frac{\pi A}{BC} \approx 6.8 \times 10^{13} \text{ cm sec } ^\circ A^2/\text{g} \left(\text{or } \frac{\text{cm sec}^2 ^\circ A^2}{\text{g sec}} = \frac{\lambda v_m ^\circ A^2}{M v^2} \right)$$

⁽¹⁾ A measure of a particle's polar field in gauss, with sec^{-1} units.

⁽²⁾ A particle's $Mv^2/2$ x Boltzman's Constant.

⁽³⁾ The velocity of light.

which would contain all the important dimensions of physical phenomena in their simplest forms.

The two constants which define the fundamental differences in the physics of the quantum and classical particles are:

$$E = 1.245 \times 10^{-25} \text{ g} \left(\text{or } \frac{\text{g sec}}{\text{sec}} = \frac{M\mathcal{V}}{\mathcal{V}_m} \right),$$

a minimum relationship existing between a submicroscopic particulate's mass (M), angular velocity ($\mathcal{V}$), and intensity of magnetization ($\mathcal{V}_m$), and

$$D = 1.75 \times 10^{20} \left(\text{or } \frac{\mathcal{V}_m}{\mathcal{V}} = \frac{\text{sec}}{\text{Sec}} \right),$$

a maximum relationship of an astronomical particulate's intensity of magnetization ($\mathcal{V}_m$) and its angular velocity ($\mathcal{V}$).

As shown in Table 1, all other fundamental constants, such as h , G , Σ , μ , K , R , etc., are found to be simple functions⁽¹⁾ of the above constants. Fig. 1 is presented to show the intrinsic⁽²⁾ interrelationships of radius (λ), angular velocity ($\mathcal{V}$), intensity of magnetization ($\mathcal{V}_m$), and temperature ($^{\circ}A$) to the particulate mass. Inspection will show that all of the constants in Table 1 are then simple functions of these particulate values and dimensions of M , λ , $\mathcal{V}$, $\mathcal{V}_m$ and $^{\circ}A$.

Whereas it may be possible to visualize without too much difficulty the meaning of M , λ , $\mathcal{V}$, and $^{\circ}A$, it is recognized that the meaning and dimensions of $\mathcal{V}_m$ would be completely lost without a degree of explanation. In essence, $\mathcal{V}_m$ is equivalent to the B of the familiar electro-magnetic equation, and definition $B = \mu H$, whose practical unit of measurement is the gauss. According to a previous study by the writer the gauss has a definitive and fundamental cgs value of $1.755 \times 10^7 \text{ sec}^{-1}$ with "frequency" dimensions, which may be interpreted as a practical measurement of a magnetic field in terms of one magnetic pole

⁽¹⁾Close approximates numerically and exact dimensionally.

⁽²⁾i.e., at a particle's intrinsic energy at the velocity of light, or Mc^2 .

Table 1

Proposed Universal Constants of Resistance and Temperature to Unify the Laws of Motion and Magnetism in Quantum and Classical Theories:

$$A = 6.8 \times 10^{22} \text{ cm}^2 \text{ sec g}^{-1} \text{ sec}^{-2}, \text{ and } B = 1.05 \times 10^{-1} \text{ sec}^{-1} \text{ } ^\circ\text{A}^{-2}$$

(Other universal constants are revealed as functions of these constants and quantum and classical constants which relate the rotational and magnetic properties of particle actions and reactions.)

(h) Submicroscopic Particles	(Gh) Submicroscopic & Astronomical Particles	(G) Astronomical Particles
	(A) $6.8 \times 10^{22} \lambda^2 \nu_m^{-1} \nu^{-1} (\text{cm}^2 \text{ sec g}^{-1} \text{ sec}^{-2})$	
	(B) $1.05 \times 10^{-1} \nu_m \text{ } ^\circ\text{A}^{-2} (\text{sec}^{-1} \text{ } ^\circ\text{A}^{-2})$	
(E) $1.245 \times 10^{-25} M \nu \nu_m^{-1} (\text{g} \cdot \text{sec} \cdot \text{sec}^{-1})$	(C) $[C =] 3 \times 10^{10} \lambda \nu (\text{cm sec}^{-1})$	(D) $1.75 \times 10^{20} \nu_m \nu^{-1} (\text{sec} \cdot \text{sec}^{-1})$
(1) $[h =] 2\pi E^2 A = 6.624 \times 10^{-27} M \lambda^2 \nu (\text{g cm}^2 \text{ sec}^{-1})$	(\pi) 3.1416	(13) $[G =] ACD^{-2} = 6.67 \times 10^{-8} \lambda^3 \nu_m^{-1} (\text{cm}^3 \text{ g}^{-1} \text{ sec}^{-2})$
(2*) $[\xi_e =] eA^{-1} C^{-1} E^{-1} = 3.6 \times 10^{-36} M \lambda^3 \nu_m^{-1} \nu^{-1} (\text{g} \cdot \text{sec} \cdot \text{sec} \cdot \text{cm}^{-3})$	(9) $AC = 2.04 \times 10^{33} \lambda^3 \nu_m^{-1} (\text{cm}^3 \text{ g}^{-1} \text{ sec}^{-2})$	(14) $[\mu_a =] AD^{-1} C^{-1} = 1.29 \times 10^{-8} \lambda \nu_m^{-1} \nu^{-1} (\text{cm} \cdot \text{sec} \cdot \text{g}^{-1} \text{ sec}^{-1})$
(3*) $[\mu_e =] AEC^{-1} e^{-1} = 3.08 \times 10^{14} \lambda \nu_m^{-1} \nu^{-1} (\text{cm} \cdot \text{sec} \cdot \text{g}^{-1} \text{ sec}^{-1})$	(10) $0.5\pi B^2 CA^{-1} = 7.57 \times 10^{-15} M \nu \lambda^{-1} \text{ } ^\circ\text{A}^{-4} (\text{g cm}^{-1} \text{ sec}^{-2} \text{ } ^\circ\text{A}^{-4})$	(15) $0.5 B^2 C^2 DA^{-1} = 1.275 \times 10^{16} M \nu^2 \nu_m \text{ } ^\circ\text{A}^{-4} (\text{g sec}^{-2} \text{ sec}^{-1} \text{ } ^\circ\text{A}^{-4})$
(4*) $[hc/2\pi e^2 =] E^2 ACe^{-2} = 3.8 \times 10^{37} \lambda^3 \nu_m^{-1} (\text{cm}^3 \text{ g}^{-1} \text{ sec}^{-2})$	(11) $1.25 B^2 C^2 A^{-1} \pi^{-1} = 5.735 \times 10^{-5} M \nu^3 \text{ } ^\circ\text{A}^{-4} (\text{g sec}^{-3} \text{ } ^\circ\text{A}^{-4})$	
(5*) $[2 \times k =] Ee^{-1} = 1.37 \times 10^{12} \nu \nu_m^{-1} (\text{sec} \cdot \text{sec}^{-1})$	(12) $1.25 B^2 C^{-1} A^{-1} = 2.11 \times 10^{-36} M \lambda^3 \text{ } ^\circ\text{A}^{-4} (\text{g cm}^{-3} \text{ } ^\circ\text{A}^{-4})$	
(6) $[K =] 0.4(\pi^2 ABC^2 E^3)^{1/2} = 1.38 \times 10^{-16} M \lambda^2 \nu^2 \text{ } ^\circ\text{A}^{-1} (\text{g cm}^2 \text{ sec}^{-2} \text{ } ^\circ\text{A}^{-1})$		
(7) $(EAB^{-1})^{1/2} = 2.84 \times 10^{-1} \lambda \text{ } ^\circ\text{A} (\text{cm } ^\circ\text{A})$		
(8*) $0.5E^3 A^2 e^{-1} C^{-1} = 1.63 \times 10^{-13} \lambda^3 \nu_m (\text{cm}^3 \text{ sec}^{-1})$		
(16) $0.5E^3 A^2 n^{-1} \nu^{-1} = 1.685 \times 10^{-16} \lambda^3 \nu_m (\text{cm}^3 \text{ sec}^{-1})$		

[Dimensions]

M = grams (mass)
 λ = centimeters (wave-length, radius of body, or orbit)
 ν = seconds⁻¹ (wave, rotational, or orbital frequency)
 ν_m = seconds⁻¹ (magnetic or precessional frequency)
 (unit of measure = gauss = $1.755 \times 10^7 \text{ sec}^{-1}$)
 $^\circ\text{A}$ = degree Absolute (temperature)

*e = $9.12 \times 10^{-28} \text{ g} \cdot \text{electronic mass}^{-1}$.

(2) = dielectric constant governing electron statics in vacuo.

(3) = magnetic permeability constant governing electron magnetics in vacuo.

(5) = fine structure constant⁻¹ for the electron. Ratio of angular velocity to the magnetic or precessional velocity.

(6) Boltzman's constant.

(7) Wien's displacement law constant.

(8) Magnetic moment of electron, Bohr magneton. Note that this is also equal to $h\mu_e/4\pi$.

(10) Radiation density constant.

(11) Stephan-Boltzman constant.

(14) Proposed constant relating the mass, radius, angular velocity, to the magnetic field (precessional velocity) of astronomical bodies.

(15) Proposed constant to prescribe temperatures of astronomical bodies.

(16) 1.9 nuclear magnetons associated with the neutron, n, where ν is equal to $1.59 \times 10^{10} \text{ cm sec}^{-1}$, indicating a temperature- and/or energy-level of formation equal to $1.53 \times 10^{12} \text{ } ^\circ\text{A}$ or $4.22 \times 10^{-4} \text{ g cm}^2 \text{ sec}^{-2} \approx 264 \text{ Mev}$. The equivalent ν for the proton at 2.79 nuclear magnetons would be $\approx 1.085 \times 10^{10} \text{ cm sec}^{-1}$. Note that the proton value is approximately the weighted average of the electron and neutron moments.

Fig. 1. The Intrinsic Properties of Matter in Terms of M , λ , ν , ν_m , and $^\circ A$ as Functions of the Proposed Universal Constants A , B , C , D , and E .

$(1.755 \times 10^7 \text{ cm}^2 \text{ sec}^{-1})$ per square centimeter or unit magnetic moment per cubic centimeter. The writer's recent investigation of Blackett's⁽¹⁾ postulation of an empirical relation between the polar magnetic moments and the angular momenta of astronomical bodies has led to the conclusion that the frequency dimension for the gauss is of great fundamental significance. Investigation of Blackett's empirical relation in terms of

$$\mathcal{V}_m = B = \mu H = \mu \cdot M \lambda^1 \mathcal{V}, \text{ or}$$

$$\lambda^3 \mathcal{V}_m = \mu \cdot H \lambda^3 = \mu \cdot M \lambda^2 \mathcal{V},$$

revealed that this constant μ had the identical dimensions of the magnetic permeability constant μ_e , previously determined by the author to be $3.08 \times 10^{14} \text{ cm g}^{-1}$. Where $\mathcal{V}_m$, M , λ , and $\mathcal{V}$ for astronomical bodies were the cgs values for intensity of magnetization, mass, radius, and angular velocity it was then shown that the constant μ had to have a value in the order of $1.2 \text{ to } 1.5 \times 10^{-8} \text{ cm g}^{-1}$, or more precisely

$$1.29 \times 10^{-8} \text{ cm sec/g sec} \left(\text{or } \frac{\lambda \mathcal{V}_m}{M \mathcal{V}} \right),$$

signifying a most interesting relation of the body's magnetic field to its rotational motion. From the fact that $\mathcal{V}_m$ was a measure of a force- or energy-field operating in essence at right angles to the direction of angular motion, and also obeying the right-hand-rule of electro-magnetics, it was concluded that $\mathcal{V}_m$ represented a gyromagnetic vibrational frequency similar in many respects to the precessional frequency common to the phenomena of gyroscopic motion of spherical solids. [(Philosophically it could thus be envisioned that $\mathcal{V}$ and $\mathcal{V}_m$ represent the inverse condition of two dimensions of time, similar directionally to two dimensions of space. Through not in the scope of this discussion, such an analogy to the gyromagnet or gyroscope, and the inverse of time as a frequency expression, would logically lead to the concept of a third dimension of time oriented at right angles to the other two dimensions of rotation and magnetic field. Such a third dimension could logically be associated with the revolutionary or translational frequency of the body in relation to neighboring bodies,

⁽¹⁾P. M. S. Blackett, Nature, 159:4046:658 (1947).

such as to the mass center about which it is a satellite. Such a planetary phenomenon of frequency is fundamentally prescribed, or is inherent in, the constants h (orbital electron motion) and G (harmonic frequency relation of planetary motion).]

When placed in proper perspective to the author's previous concepts regarding electron behavior and the associated electro-magnetic and electro-static phenomena of motion, it was realized that the relative conditions shown in Fig. 1 and Table 1 were valid. Such a correlation of the properties of electrons and astronomical bodies has led to certain conclusions or verifications regarding the fundamentals of electron physics, e.g.

(1) The Compton wave-length ($h/ec = 2.43 \times 10^{-10}$ cm) is equivalent to 2π times the actual electron radius.

(2) The fine structure constant ($2\pi(ec)^2/hc = 7.298 \times 10^{-3}$) is in reality the ratio of the electron's ν_m/ν , i.e. the ratio of its "magnetic frequency" to its rotational frequency.

(3) The magnetic moment of the electron, the Bohr magneton, is equal to one-half the cube of the electron radius times its magnetic frequency, i.e., $0.5\lambda^3\nu_m = h\mu_e/4\pi = 1.63 \times 10^{-13} \text{ cm}^3 \text{ sec}^{-1}$, etc.

Tabulations of cgs Data and Dimensional Relationships

Certain data, which may provide some insight into the dimensional methods employed, are presented in the following pages in random order.

The table on page 9 summarizes cgs data used in the interpretation of Blackett's empirical relations. Those on pages 10 and 11 record cgs data relative to astronomical bodies, where body and orbital radii are treated as wave-lengths (λ) and angular velocities as wave-frequencies (ν) and where G is treated in terms of $\lambda^3\nu^2M^{-1}$.

The table on page 12 summarizes the interrelationships of presently employed units of electricity and magnetism. That on page 13 records the same interrelationships after conversion to mechanical and dimensional equivalents by the writer's dimensional method. These values result from the simple assumption

or expedient that electronic charge be given mass (gram) dimensions and values equivalent to the number of electron rest masses implied in the charge units. The table on page 14 summarizes the fundamental equations in use for the four systems of measurement.

It may be added that the three above tables were prepared prior to the revelation of the alleged significance of ν_m in the scheme of magnetic theory. The concept of ν_m may permit further definition of the various phenomena in terms of

$$\nu = RI, \lambda^2 \nu \nu_m = \lambda^2 \nu_m M^{-1} \times M \nu = 1.755 \times 10^{15} \text{ cm}^2 \text{ sec}^{-2} \quad \text{Electrical}$$

$$B = \mu_e H, \nu_m = \lambda \nu_m M^{-1} \nu^{-1} \times M \lambda^{-1} \nu = 1.755 \times 10^7 \text{ sec}^{-1} \quad \text{Electromagnetic}$$

$$F = \frac{Q_1 Q_2}{\sum_e r^2}, M \lambda \nu \nu_m = \frac{M \cdot M}{M \lambda^{-3} \nu_m^{-1} \nu^{-1} \times \lambda^2} = 1.0 \text{ g cm sec}^{-2} \quad \text{Electrostatic}$$

$$F = \frac{m_1 m_2}{\mu_e r^2}, M \lambda \nu \nu_m = \frac{(\lambda^2 \nu_m)_1 (\lambda^2 \nu_m)_2}{\lambda \nu_m M^{-1} \nu^{-1} \times \lambda^2} = 1.0 \text{ g cm sec}^{-2} \quad \text{Magnetostatic}$$

The considered fundamental significance implied in the above relationships will be treated in some detail in a subsequent memo devoted to the writer's interpretations of the electrical and magnetic systems.

Table 2

Calculated Values of the Magnetic Moments and Magnetic Induction of Astronomical Bodies From Use of a Proposed Permeability Constant, μ_{eg} Reference reports: Blackett, P. M. S. Nature, 159:4046:658 (1947)
Fuchs, J. Nature, 161:4094:599 (1948)

Body	Mass M (g)	Intrinsic Radius ⁽¹⁾ λ_g (cm)	Radius λ_r (cm)	Specific Volume $\lambda_r^3 M^{-1}$ (cm ³ g ⁻¹)	Angular Velocity v_r (sec ⁻¹)	Angular Momentum ⁽²⁾ $M \lambda_r^2 v_r$ (g cm ² sec ⁻¹)	Magnetic Field Intensity $M \lambda_r^{-1} v_r$ (g cm ⁻¹ sec ⁻¹)	Intensity of Magnetization ⁽³⁾ v_m (sec ⁻¹)	Magnetic Moment ⁽⁴⁾ $\lambda_r^3 v_m$ (cm ³ sec ⁻¹)
Mercury	3.35×10^{26}	2.44×10^{-2}	2.42×10^8	4.23×10^{-2}	8.28×10^{-7}	1.62×10^{37}	1.15×10^{12}	1.73×10^4	2.43×10^{29}
Venus	4.9×10^{27}	3.57×10^{-1}	6.1×10^8	4.63×10^{-2}	2.43×10^{-6}	4.4×10^{39}	1.95×10^{13}	2.92×10^5	6.6×10^{31}
Earth	5.98×10^{27}	4.36×10^{-1}	6.36×10^8	4.27×10^{-2}	7.29×10^{-5}	1.86×10^{41}	6.86×10^{14}	$1.03 \times 10^{7*}$	$2.79 \times 10^{33**}$
Mars	6.46×10^{26}	4.71×10^{-2}	3.4×10^8	6.06×10^{-2}	7.3×10^{-5}	5.46×10^{39}	1.39×10^{14}	2.09×10^6	8.2×10^{31}
Jupiter	1.9×10^{30}	1.38×10^2	7.0×10^9	1.8×10^{-1}	1.75×10^{-4}	1.62×10^{46}	4.76×10^{16}	7.16×10^8	2.43×10^{36}
Saturn	5.68×10^{29}	4.14×10^1	5.8×10^9	3.44×10^{-1}	1.7×10^{-4}	3.26×10^{45}	1.66×10^{16}	2.5×10^8	4.89×10^{37}
Uranus	8.73×10^{28}	6.36×10^0	2.55×10^9	1.9×10^{-1}	1.63×10^{-4}	9.25×10^{43}	5.6×10^{15}	8.4×10^7	1.39×10^{36}
Neptune	1.03×10^{29}	7.51×10^0	2.66×10^9	1.83×10^{-1}	1.1×10^{-4}	6.05×10^{43}	4.25×10^{15}	6.38×10^7	1.21×10^{36}
Sun	1.97×10^{33}	1.44×10^5	6.95×10^{10}	1.7×10^{-1}	2.9×10^{-6}	2.81×10^{49}	8.34×10^{16}	$9.32 \times 10^{8*}$	$4.22 \times 10^{41} \phi$
78 Virginus	4.6×10^{33}	3.36×10^5	1.4×10^{11}	6.0×10^{-1}	7.3×10^{-5}	6.6×10^{51}	2.4×10^{18}	$3.6 \times 10^{10*}$	9.9×10^{43}

(1) Equal to μ_g (7.29×10^{-29} cmg⁻¹) times M. μ_g is equal to Gc^{-2} . λ_g may be considered as the ultimate radius of the "mass center" at the intrinsic condition of centripetal energy, which for a given mass would be determined by MGc^{-2} .

(2) Equal to 2.5 times the conventional calculation of angular momentum = $0.4 MR^2 \omega$.

(3) Equal to μ_{eg} (1.5×10^{-8} cmg⁻¹ or $1.5 \times 10^{-8} \lambda_r v_m M^{-1} v_r^{-1}$) times magnetic field intensity, $\mu_{eg} M \lambda_r^{-1} v_r$; one gauss = 1.755×10^7 lines·sec⁻¹; e.g., *earth's value equals 0.59 gauss, sun's equals 53.0, and 78 Virginus' equals 2050. μ_{eg} is equal to approximately $(\mu_e \mu_g \pi^{-4})^{1/2}$.

(4) Equal also to μ_{eg} x Angular Momentum. Bohr magneton = 1.63×10^{-13} cm³ sec⁻¹; e.g., **earth's value equals 1.71×10^{46} magnetons, sun's equals 2.59×10^{54} , 78 Virginus' equals 6.07×10^{56} .

Some CGS Relationships in the Planetary System

Planet	Mass M gm	Orbital Circumference λ_b cm	Revolutions per Second ν_b sec ⁻¹	Orbital Velocity (Avg.) $\lambda \nu$ cm sec ⁻¹	Areal Velocity (Constant) $\lambda_g^2 \nu_g$ cm ² sec ⁻¹	Harmonic** Relat: on (Sun) $\lambda^3 \nu^2$ cm ³ sec ⁻²	Linear Momentum $M \lambda \nu$ gm cm sec ⁻¹	Angular Momentum $M \lambda_g^2 \nu_g$ gm cm ² sec ⁻¹	Energy ($M_p M_g G r^{-1}$) or $M \lambda^2 \nu^2$ gm cm ² sec ⁻²
Mercury	3.35×10^{26}	3.64×10^{13}	1.3×10^{-7}	4.8×10^6	1.75×10^{20}	1.33×10^{25}	1.61×10^{33}	5.84×10^{45}	7.7×10^{39}
Mars	6.46×10^{26}	1.43×10^{14}	1.69×10^{-8}	2.42×10^6	3.46×10^{20}	1.34×10^{26}	1.55×10^{33}	2.24×10^{47}	3.78×10^{39}
Venus	4.9×10^{27}	6.8×10^{13}	5.22×10^{-8}	3.54×10^6	2.41×10^{20}	1.35×10^{26}	1.73×10^{34}	1.17×10^{48}	5.13×10^{40}
Earth	5.98×10^{27}	9.36×10^{13}	3.18×10^{-8}	2.98×10^6	2.78×10^{20}	1.33×10^{26}	1.78×10^{34}	1.67×10^{48}	5.32×10^{40}
Uranus	8.73×10^{28}	1.79×10^{15}	3.82×10^{-10}	6.84×10^5	1.23×10^{21}	1.34×10^{26}	5.95×10^{34}	1.08×10^{50}	4.07×10^{40}
Neptune	1.03×10^{29}	2.83×10^{15}	1.93×10^{-10}	5.45×10^5	1.54×10^{21}	1.34×10^{26}	5.61×10^{34}	1.55×10^{50}	3.06×10^{40}
Saturn	5.68×10^{29}	9×10^{14}	1.06×10^{-9}	5.55×10^5	8.6×10^{20}	1.31×10^{26}	5.42×10^{35}	4.88×10^{50}	5.17×10^{41}
Jupiter	1.9×10^{30}	4.9×10^{14}	2.58×10^{-9}	1.31×10^6	6.42×10^{20}	1.34×10^{26}	2.49×10^{36}	1.22×10^{51}	3.27×10^{42}
(Sun)	(1.97×10^{33})	---	---	---	---	---	---	---	---

**Note that $1.32 \times 10^{26} \text{ cm}^3 \text{ sec}^{-2} / 1.97 \times 10^{33} \text{ gm} = G = 6.67 \times 10^{-8} \text{ cm}^3 \text{ gm}^{-1} \text{ sec}^{-2}$.

*Note near equalities of linear momenta and energies.

Planet	Mass M gm	Distance to Sun (Avg.) λ_g cm	Angular Velocity (Radians per Second) ν_g sec ⁻¹	Orbital Velocity (Avg.) $\lambda \nu$ cm sec ⁻¹	Areal Velocity (Constant) $\lambda_g^2 \nu_g$ cm ² sec ⁻¹	Harmonic Relation (Sun) $\lambda^2 \nu$ cm ³ sec ⁻²	Linear Momentum $M \lambda \nu$ gm cm sec ⁻¹	Angular Momentum $M \lambda_g^2 \nu_g$ gm cm ² sec ⁻¹	Energy ($M_p M_g G^{-1}$) $M \lambda^2 \nu^2$ gm cm ² sec ⁻²
Mercury	3.35×10^{26}	5.8×10^{12}	8.26×10^{-7}	4.8×10^6	2.78×10^{19}	1.33×10^{26}	1.61×10^{33}	9.3×10^{45}	7.7×10^{39}
Venus	4.9×10^{27}	1.08×10^{13}	3.28×10^{-7}	3.54×10^6	3.82×10^{19}	1.35×10^{26}	1.73×10^{34}	1.87×10^{47}	6.13×10^{40}
Earth	5.98×10^{27}	1.49×10^{13}	2.0×10^{-7}	2.98×10^6	4.45×10^{19}	1.33×10^{26}	1.78×10^{34}	2.66×10^{47}	5.32×10^{40}
Mars	6.46×10^{26}	2.28×10^{13}	1.06×10^{-7}	2.42×10^6	5.52×10^{19}	1.34×10^{26}	1.56×10^{33}	3.57×10^{47}	3.78×10^{39}
Jupiter	1.9×10^{30}	7.8×10^{13}	1.68×10^{-8}	1.31×10^6	1.02×10^{20}	1.34×10^{26}	2.49×10^{36}	1.94×10^{50}	3.27×10^{42}
Saturn	5.68×10^{29}	1.43×10^{14}	6.7×10^{-9}	5.55×10^5	1.37×10^{20}	1.31×10^{26}	5.42×10^{35}	7.78×10^{49}	5.17×10^{41}
Uranus	8.73×10^{28}	2.84×10^{14}	2.4×10^{-9}	6.84×10^5	1.97×10^{20}	1.34×10^{26}	5.95×10^{34}	1.72×10^{49}	4.07×10^{40}
Neptune	1.03×10^{29}	4.5×10^{14}	1.21×10^{-9}	5.45×10^5	2.46×10^{20}	1.34×10^{26}	5.61×10^{34}	2.53×10^{49}	3.06×10^{40}
(Sun)	(1.97×10^{33})	---	---	---	---	---	---	---	---

Planet	Mass M gm	Axial Rotation (Radians per second) ν sec ⁻¹	Calculated (Orb. Velocity - Axial Rotation) λ_c cm	Associated "wave-length" Approximating the Calculated λ λ_a cm	Radius of Body λ_r cm
Mercury	3.35×10^{26}	8.28×10^{-7}	5.8×10^{12}	(Dist. to Sun) 5.8×10^{12}	2.42×10^8
Venus	4.9×10^{27}	2.43×10^{-6}	1.46×10^{12}	--	6.1×10^8
Earth	5.98×10^{27}	7.29×10^{-5}	4.09×10^{10}	(Dist. to Moon) 3.84×10^{10}	6.36×10^8
Mars	6.46×10^{26}	7.3×10^{-5}	3.31×10^{10}	--	3.4×10^8
Jupiter	1.9×10^{30}	1.75×10^{-4}	7.49×10^9	(Radius of Jupiter) 7.0×10^9	7.0×10^9
Saturn	5.68×10^{29}	1.7×10^{-4}	5.62×10^9	(Radius of Saturn) 5.8×10^9	5.8×10^9
Uranus	8.73×10^{28}	1.63×10^{-4}	4.19×10^9	(Diameter of Uranus) 5.1×10^9	2.55×10^9
Neptune	1.03×10^{29}	1.1×10^{-4}	4.95×10^9	(Diameter of Neptune) 5.3×10^9	2.66×10^9
Sun	(1.97×10^{33})	(2.95×10^{-6})	(6.8×10^{11})	---	6.95×10^{10}

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Table 6

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Some CGS Relationships in the Satellite Systems

Satellite or Planet	Mass M g	Distance to Central Body (Avg.) λ cm	Angular Velocity (Radians Per Second) $\dot{\lambda}$ sec^{-1}	Orbital Velocity (Avg.) $\dot{\lambda}$ $cm\ sec^{-1}$	Areal Velocity (Constant) $\dot{\lambda}^2 \dot{\lambda}$ $cm^2\ sec^{-1}$	Harmonic Relation (Central Body) $\dot{\lambda}^3 \dot{\lambda}^2$ $cm^3\ sec^{-2}$
Jupiter V	-----	1.8×10^{10}	1.46×10^{-4}	2.63×10^6	4.74×10^{16}	1.24×10^{23}
Io	7.3×10^{25}	4.2×10^{10}	4.2×10^{-5}	1.76×10^6	7.4×10^{16}	1.23×10^{23}
Europa	4.7×10^{25}	6.68×10^{10}	2.05×10^{-5}	1.37×10^6	9.15×10^{16}	1.26×10^{23}
Ganymede	1.55×10^{26}	1.07×10^{11}	1.01×10^{-5}	1.08×10^6	1.16×10^{17}	1.26×10^{23}
Callisto	9.72×10^{25}	1.88×10^{11}	4.36×10^{-6}	8.24×10^5	1.55×10^{17}	1.28×10^{23}
Jupiter VI	-----	1.18×10^{12}	2.73×10^{-7}	3.23×10^5	3.81×10^{17}	1.23×10^{23}
Jupiter X	-----	1.18×10^{12}	2.8×10^{-7}	3.3×10^5	3.9×10^{17}	1.28×10^{23}
Jupiter VII	-----	1.21×10^{12}	2.63×10^{-7}	3.18×10^5	3.85×10^{17}	1.23×10^{23}
Jupiter XI*	-----	2.25×10^{12}	1.05×10^{-7}	2.36×10^5	5.31×10^{17}	1.25×10^{23}
Jupiter VIII*	-----	2.35×10^{12}	9.84×10^{-8}	2.31×10^5	5.43×10^{17}	1.25×10^{23}
Jupiter IX*	-----	2.38×10^{12}	9.6×10^{-8}	2.28×10^5	5.44×10^{17}	1.26×10^{23}
(Jupiter)	(1.9×10^{30})	-----	-----	-----	-----	-----
Mimas	3.8×10^{22}	1.86×10^{10}	7.75×10^{-5}	1.44×10^6	2.68×10^{16}	3.86×10^{22}
Enceladus	8.62×10^{22}	2.38×10^{10}	5.6×10^{-5}	1.33×10^6	3.17×10^{16}	4.21×10^{22}
Tethys	6.48×10^{23}	2.95×10^{10}	3.88×10^{-5}	1.14×10^6	3.37×10^{16}	3.85×10^{22}
Dione	1.03×10^{24}	3.78×10^{10}	2.65×10^{-5}	1.0×10^6	3.78×10^{16}	3.78×10^{22}
Rhea	2.21×10^{24}	5.28×10^{10}	1.62×10^{-5}	8.54×10^5	4.51×10^{16}	3.85×10^{22}
Titan	1.41×10^{26}	1.22×10^{11}	4.56×10^{-6}	5.64×10^5	6.88×10^{16}	3.88×10^{22}
Hyperion	4.4×10^{22}	1.48×10^{11}	3.42×10^{-6}	5.06×10^5	7.5×10^{16}	3.8×10^{22}
Iapetus	1.4×10^{24}	3.56×10^{11}	9.2×10^{-7}	3.28×10^5	1.17×10^{17}	3.83×10^{22}
Phoebe	-----	1.3×10^{12}	1.33×10^{-7}	1.73×10^5	2.25×10^{17}	3.89×10^{22}
(Saturn)	(5.68×10^{29})	-----	-----	-----	-----	-----
Ariel	-----	1.92×10^{10}	2.91×10^{-5}	5.6×10^5	1.07×10^{16}	6.01×10^{21}
Umbriel	-----	2.67×10^{10}	1.75×10^{-5}	4.67×10^5	1.25×10^{16}	5.85×10^{21}
Titania	-----	4.39×10^{10}	8.36×10^{-6}	3.67×10^5	1.61×10^{16}	5.9×10^{21}
Oberon	-----	5.87×10^{10}	5.38×10^{-6}	3.16×10^5	1.86×10^{16}	5.36×10^{21}
(Uranus)	(8.73×10^{28})	-----	-----	-----	-----	-----
Triton	1.32×10^{26}	3.54×10^{10}	1.24×10^{-5}	4.4×10^5	1.56×10^{16}	6.85×10^{21}
(Neptune)	(1.03×10^{29})	-----	-----	-----	-----	-----
Moon	7.36×10^{25}	3.84×10^{10}	2.66×10^{-6}	1.02×10^5	3.93×10^{15}	4.02×10^{20}
(Earth)	(5.98×10^{27})	-----	-----	-----	-----	-----
Phobos	-----	9.35×10^8	2.28×10^{-4}	2.13×10^5	1.99×10^{14}	4.23×10^{19}
Deimos	-----	2.35×10^9	5.83×10^{-5}	1.37×10^5	3.22×10^{14}	4.23×10^{19}
(Mars)	(6.46×10^{26})	-----	-----	-----	-----	-----

** Note that $\lambda^3 \dot{\lambda}^2$: mass of planet = $6.67 \times 10^{-8} \text{ cm}^3 \text{ gm}^{-1} \text{ sec}^{-2} = G$.

* Have retrograde orbits.

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Table 1

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Practical Units of Electricity and Magnetism

Summary of Present Terminology and CGS Dimensions

Symbol	Property or Action	Electrical	Electromagnetic	Electrostatic	Magnetostatic
Q	Charge	Coulomb = 6.2×10^{18} electrons	Abcoulomb = 10^1 coulombs = $\sqrt{\frac{gm}{\mu}}$	*Statcoulomb = 3.33×10^{-10} coulombs = $\sqrt{\frac{gm}{\epsilon}}$	
I	Current, magnetomotive force	*Amp = $\frac{\text{coulomb}}{\text{sec}}$	Abamp = 10^1 amps = $\sqrt{\frac{gm}{\mu}} \cdot \frac{1}{\text{sec}}$	Statamp = 3.33×10^{-10} amp = $\sqrt{\frac{gm}{\epsilon}} \cdot \frac{1}{\text{sec}}$	
H	Magnetic field intensity	$\frac{\text{Amp}}{\text{cm}}$ = 10^{-1} oersted	*Oersted = $\sqrt{\frac{gm}{\mu}} \cdot \frac{1}{\text{sec}}$	$\frac{\text{Statamp}}{\text{cm}}$ = 3.33×10^{-11} oersted = $\sqrt{\frac{gm}{\epsilon}} \cdot \frac{1}{\text{sec}}$	Oersted = $\frac{\text{dyne}}{\text{unit pole}}$
V	Voltage, electrical potential, electromotive force	*Volt = $\frac{\text{joule}}{\text{coulomb}}$	Abvolt = 10^{-8} volts = $\sqrt{\frac{\mu gm}{\epsilon^2}}$	Statvolt = 3×10^2 volts = $\sqrt{\frac{gm}{\epsilon}} \cdot \frac{1}{\text{sec}}$	
A	Electrical field intensity, dielectric strength	$\frac{\text{Volt}}{\text{cm}}$	$\frac{\text{Abvolt}}{\text{cm}}$ = $10^{-8} \frac{\text{volt}}{\text{cm}}$ = $\sqrt{\frac{\mu gm}{\epsilon^2}}$	$\frac{\text{Statvolt}}{\text{cm}}$ = $\frac{3 \times 10^2 \text{ volts}}{\text{cm}}$ = $\sqrt{\frac{gm}{\epsilon}} \cdot \frac{1}{\text{sec}}$	
m	Magnetic pole, magnetic force	Weber = 10^8 maxwells	Maxwell = $\sqrt{\frac{\mu gm}{\epsilon^2}}$	Statvolt · sec = 3×10^{10} maxwells = $\sqrt{\frac{gm}{\epsilon}}$	*Unit pole = maxwell
M	Magnetic moment	Weber · cm = 10^8 emu	Unit mag. moment = $\sqrt{\frac{\mu gm}{\epsilon^2}}$	Statvolt · sec · cm = 3×10^{10} emu = $\sqrt{\frac{gm}{\epsilon}}$	Unit mag. moment = maxwell · cm
B	Intensity of magnetization, magnetic induction(1)	$\frac{\text{Weber}}{\text{cm}^2}$ = 10^8 gauss	*Gauss = $\frac{\mu gm}{\text{cm sec}}$	$\frac{\text{Statvolt} \cdot \text{sec}}{\text{cm}^2}$ = 3×10^{10} gauss = $\frac{gm \text{ sec}}{\epsilon \text{ cm}^3}$	
R	Resistance	*Ohm = $\frac{\text{volt}}{\text{amp}}$	Abohm = 10^{-9} ohm = $\frac{\mu \text{ cm}}{\text{sec}}$	Statohm = 9×10^{11} ohms = $\frac{\text{sec}}{\epsilon \text{ cm}}$	
R _l	Resistivity, electrical volume resistance	Ohm · cm	Abohm · cm = 10^{-9} ohm · cm = $\frac{\mu \text{ cm}^2}{\text{sec}}$	Statohm · cm = 9×10^{11} ohm · cm = $\frac{\text{sec}}{\epsilon}$	
L	Electrical inductance, magnetic permeance(2)	Henry = $\frac{\text{volt} \cdot \text{sec}}{\text{amp}}$	Abhenry = 10^{-9} henry = $\mu \text{ cm}$	Stathenry = 9×10^{11} henry = $\frac{\text{sec}^2}{\epsilon \text{ cm}}$	
C	Capacitance, electrical capacity	Parad = $\frac{\text{coulomb}}{\text{volt}}$	Abfarad = 10^9 farad = $\frac{\text{sec}^2}{\mu \text{ cm}}$	Statfarad = 1.11×10^{-12} farad = $\epsilon \text{ cm}$	
ε	Dielectric constant, electrical inductivity		$\epsilon = \frac{1}{\mu c^2}$	*ε = 1.0	
μ	Magnetic permeability, electrical susceptibility		*μ = 1.0	(μ = $\frac{1}{\epsilon c^2}$)	*μ = 1.0
F	Force	$\frac{\text{Joule}}{\text{cm}}$ = 10^7 dynes = $10^7 \frac{gm}{\text{sec}^2}$	Dyne = $1.0 \frac{gm}{\text{sec}^2}$	*Dyne = $1.0 \frac{gm}{\text{sec}^2}$	*Dyne = $1.0 \frac{gm}{\text{sec}^2}$
E	Energy	Joule = 10^7 ergs = $10^7 \frac{gm \text{ cm}^2}{\text{sec}^2}$	Erg = $1.0 \frac{gm \text{ cm}^2}{\text{sec}^2}$	Erg = $1.0 \frac{gm \text{ cm}^2}{\text{sec}^2}$	Erg = $1.0 \frac{gm \text{ cm}^2}{\text{sec}^2}$
P	Power	Watt = $\frac{\text{Joule}}{\text{sec}}$ = $10^7 \frac{gm \text{ cm}^2}{\text{sec}^3}$	Abwatt = $\frac{\text{erg}}{\text{sec}}$ = $1.0 \frac{gm \text{ cm}^2}{\text{sec}^3}$	Statwatt = $\frac{\text{erg}}{\text{sec}}$ = $\frac{1.0 \text{ gm cm}^2}{\text{sec}^3}$	
r	Separation, radius, length	r = 1.0 cm	r = 1.0 cm	*r = 1.0 cm	*r = 1.0 cm
t	Time	t = 1.0 sec	t = 1.0 sec	t = 1.0 sec	t = 1.0 sec

(1) Also electrical mass resistivity

(2) Also electromagnetic self-inductance

*Primary units in equations $V = RI$, $B = \mu H$, $P = \frac{Q_1 Q_2}{\epsilon r^2}$, $F = \frac{m_1 m_2}{\mu r^2}$ A. T. J. 1955
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Table 2
Practical Units of Electricity and Magnetism

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Symbol	Property or Action	Electrical	Electromagnetic	Electrostatic	Magnetostatic
Q	Charge	Coulomb = 5.698×10^{-9} gm	Abcoulomb = 5.698×10^{-8} gm	*Statcoulomb = 1.9×10^{-18} gm	
I	Current, magnetomotive force	*Amp = 5.698×10^{-9} $\frac{\text{gm}}{\text{sec}}$	Abamp = 5.698×10^{-8} $\frac{\text{gm}}{\text{sec}}$	Statamp = 1.9×10^{-18} $\frac{\text{gm}}{\text{sec}}$	
H	Magnetic field intensity	$\frac{\text{Amp}}{\text{cm}} = 5.698 \times 10^{-9}$ $\frac{\text{gm}}{\text{cm sec}}$	*Oersted = 5.698×10^{-8} $\frac{\text{gm}}{\text{cm sec}}$	$\frac{\text{Statamp}}{\text{cm}} = 1.9 \times 10^{-18}$ $\frac{\text{gm}}{\text{cm sec}}$	Oersted = 5.698×10^{-8} $\frac{\text{gm}}{\text{cm sec}}$
V	Voltage, electrical potential, electromotive force	*Volt = 1.755×10^{15} $\frac{\text{cm}^2}{\text{sec}^2}$	Abvolt = 1.755×10^7 $\frac{\text{cm}^2}{\text{sec}^2}$	Statvolt = 5.263×10^{17} $\frac{\text{cm}^2}{\text{sec}^2}$	
A	Electrical field intensity, ⁽¹⁾ dielectric strength	$\frac{\text{Volt}}{\text{cm}} = 1.755 \times 10^{15}$ $\frac{\text{cm}}{\text{sec}^2}$	$\frac{\text{Abvolt}}{\text{cm}} = 1.755 \times 10^7$ $\frac{\text{cm}}{\text{sec}^2}$	$\frac{\text{Statvolt}}{\text{cm}} = 5.263 \times 10^{17}$ $\frac{\text{cm}}{\text{sec}^2}$	
m	Magnetic pole, magnetic flux	Weber = 1.755×10^{15} $\frac{\text{cm}^2}{\text{sec}}$	Maxwell = 1.755×10^7 $\frac{\text{cm}^2}{\text{sec}}$	Statvolt-sec = 5.263×10^{17} $\frac{\text{cm}^2}{\text{sec}}$	*Unit pole = 1.755×10^7 $\frac{\text{cm}^2}{\text{sec}}$
M	Magnetic moment	Weber-cm = 1.755×10^{15} $\frac{\text{cm}^3}{\text{sec}}$	Unit Mag. Moment = 1.755×10^7 $\frac{\text{cm}^3}{\text{sec}}$	Statvolt-sec-cm = 5.263×10^{17} $\frac{\text{cm}^3}{\text{sec}}$	Unit mag. moment = 1.755×10^7 $\frac{\text{cm}^3}{\text{sec}}$
B	Intensity of magnetization, magnetic inductance	$\frac{\text{Weber}}{\text{cm}^2} = \frac{1.755 \times 10^{15}}{\text{sec}}$	*Gauss = 1.755×10^7 $\frac{\text{lines}}{\text{sec}}$	$\frac{\text{Statvolt-sec}}{\text{cm}^2} = \frac{5.263 \times 10^{17}}{\text{sec}}$	
R	Resistance ⁽²⁾	*Ohm = 3.08×10^{23} $\frac{\text{cm}^2}{\text{gm sec}}$	Abohm = 3.08×10^{14} $\frac{\text{cm}^2}{\text{gm sec}}$	Stathm = 2.77×10^{35} $\frac{\text{cm}^2}{\text{gm sec}}$	
R _l	Resistivity, ⁽³⁾ electrical volume resistance	Ohm-cm = 3.08×10^{23} $\frac{\text{cm}^3}{\text{gm sec}}$	Abohm-cm = 3.08×10^{14} $\frac{\text{cm}^3}{\text{gm sec}}$	Stathm-cm = 2.77×10^{35} $\frac{\text{cm}^3}{\text{gm sec}}$	
L	Electrical inductance, ⁽⁴⁾ magnetic permeance	Henry = 3.08×10^{23} $\frac{\text{cm}^2}{\text{gm}}$	Abhenry = 3.08×10^{14} $\frac{\text{cm}^2}{\text{gm}}$	Stathenry = 2.77×10^{35} $\frac{\text{cm}^2}{\text{gm}}$	
C	Capacitance, electrical capacity	Farad = 3.247×10^{-24} $\frac{\text{gm sec}^2}{\text{cm}^2}$	Abfarad = 3.247×10^{-15} $\frac{\text{gm sec}^2}{\text{cm}^2}$	Statfarad = 3.6×10^{-36} $\frac{\text{gm sec}^2}{\text{cm}^2}$	
ϵ	Dielectric constant, ⁽⁵⁾ electrical inductivity	$\frac{\text{Farad}}{\text{cm}} = 3.247 \times 10^{-24}$ $\frac{\text{gm sec}^2}{\text{cm}^3}$	$\frac{\text{Abfarad}}{\text{cm}} = 3.247 \times 10^{-15}$ $\frac{\text{gm sec}^2}{\text{cm}^3}$	* ϵ (vacuum) = $\frac{1}{\mu c^2} = 3.6 \times 10^{-36}$ $\frac{\text{gm sec}^2}{\text{cm}^3}$	
μ	Magnetic permeability, ⁽⁶⁾ electrical susceptibility	$\frac{\text{Henry}}{\text{cm}} = 3.08 \times 10^{23}$ $\frac{\text{cm}}{\text{gm}}$	μ (vacuum) = $\frac{1}{\epsilon c^2} = 3.08 \times 10^{14}$ $\frac{\text{cm}}{\text{gm}}$	$\frac{\text{Stathenry}}{\text{cm}} = 2.77 \times 10^{35}$ $\frac{\text{cm}}{\text{gm}}$	* μ (vacuum) = 3.08×10^{14} $\frac{\text{cm}}{\text{gm}}$
F	Force	$\frac{\text{Joule}}{\text{cm}} = 1.0 \times 10^7$ $\frac{\text{gm cm}}{\text{sec}^2}$	Dyne = 1.0 $\frac{\text{gm cm}}{\text{sec}^2}$	*Dyne = 1.0 $\frac{\text{gm cm}}{\text{sec}^2}$	*Dyne = 1.0 $\frac{\text{gm cm}}{\text{sec}^2}$
E	Energy	Joule = 1.0×10^7 $\frac{\text{gm cm}^2}{\text{sec}^2}$	Erg = 1.0 $\frac{\text{gm cm}^2}{\text{sec}^2}$	Erg = 1.0 $\frac{\text{gm cm}^2}{\text{sec}^2}$	Erg = 1.0 $\frac{\text{gm cm}^2}{\text{sec}^2}$
P	Power	Watt = 1.0×10^7 $\frac{\text{gm cm}^2}{\text{sec}^3}$	Abwatt = 1.0 $\frac{\text{gm cm}^2}{\text{sec}^3}$	Statwatt = 1.0 $\frac{\text{gm cm}^2}{\text{sec}^3}$	
r	Separation, radius, length	r = 1.0 cm	r = 1.0 cm	*r = 1.0 cm	*r = 1.0 cm
t	Time	t = 1.0 sec	t = 1.0 sec	t = 1.0 sec	t = 1.0 sec

Notes: (1) Dimensions of acceleration

(2) Reciprocal is conductance

(3) Reciprocal is conductivity

(4) Reciprocal is magnetic reluctance

(5) Note that inverse dimensions are the same as those for the Gravitational Constant

(6) Reciprocal is magnetic reluctivity

Note that all these units, within given systems, can be related by an equation, as follows:

$$Q = It = Hrt = VC = \frac{P}{A} = \frac{m}{R} = \frac{M}{R_1} = \frac{BCr^2}{t} = \frac{at}{L} = \sqrt{F \epsilon} r^2 = \frac{m^2}{\mu V r} = \frac{E}{V} = \frac{Pt}{V}$$

So that many interrelationships of properties and actions can be readily determined, e.g.:

$$I = \frac{Q}{t} = Hr = \frac{VC}{t}, \text{ etc; } H = \frac{Q}{rt} = \frac{I}{r} = \frac{VC}{rt}, \text{ etc; } V = \frac{Q}{C} = \frac{It}{C} = \frac{Hrt}{C}, \text{ etc; etc.}$$

$$\text{*Primary units in equations } V = RI, B = \mu H, P = \frac{QI}{\epsilon r^2}, P = \frac{mI}{\mu r^2}$$

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Table 3

Interrelationships of the Electrical, Electromagnetic, Electrostatic, and Magnetostatic Equations

(Symbols from Tables 1 and 2 are employed: l refers to dimension of length, whereas r refers to dimension of area or distance of separation.)

(1) $V = RI = Al$; $R = \frac{R_1 l}{r^2}$; $E = VI t + RI^2 t = QV$; $P = VI + \frac{E}{t} = RI^2$; $H = \frac{I l}{r^2}$	<u>Electrical</u>
(2) $H = \frac{I l}{r^2} = \frac{F}{m} = \frac{B}{\mu}$; $B = \mu H = \frac{M}{r^3}$; $E = m H r = M H = m I = L I^2$; $F = B I r = \frac{I^2 \mu l^2}{r^2}$; $Q = C R I$	<u>Electromagnetic</u>
(3) $F = \frac{Q_1 Q_2}{\epsilon r^2}$; $E = \frac{Q}{\epsilon} = \frac{Q^2}{\epsilon r} = C V^2$; $A = \frac{Q}{\epsilon r^2} = \frac{1}{\mu \epsilon r} = \frac{Q r}{\epsilon r^2} = \frac{1}{\epsilon L}$; $C = \frac{\epsilon r^2}{r} = Q$; $V = \frac{Q}{V} = A r$	<u>Electrostatic</u>
(4) $F = \frac{m_1 m_2}{\mu r^2} = m H$; $B = \mu H = \frac{E}{H r^3}$; $H = \frac{B}{\mu} = \frac{M}{r^3 \mu}$; $M = m l = B l^3$	<u>Magnetostatic</u>

The above expressions can be variously related to R_1 , ϵ , and μ , as follows:

- (5) $R_1 = \frac{Q}{\epsilon r H} = \frac{\mu r^2}{t} = \frac{m^2}{\mu H Q r} = \frac{R r^2}{l} = \frac{V r^2}{I l} = \frac{V}{H} = \frac{P}{H I} = \frac{E}{H I t} = \frac{L r^2}{I t} = \frac{(R I + V)}{H} = \frac{A r^2}{I} = \frac{Q}{H C} = \frac{F r}{H Q} = \frac{m r}{I t} = \frac{M}{Q} = \frac{B r^3}{Q}$
- (6) $\epsilon = \frac{Q}{R_1 r H} = \frac{Q t}{\mu H r^3} = \frac{Q^2 \mu}{m^2} = \frac{Q l}{H R r^3} = \frac{Q I l}{H V r^3} = \frac{Q}{V r} = \frac{I^2 t}{P r} = \frac{Q^2}{E r} = \frac{Q l t}{H L r^3} = \frac{Q}{r(R I + V)} = \frac{Q I}{H A r^3} = \frac{C}{r} = \frac{Q^2}{F r^2} = \frac{Q^2}{H m r^2} = \frac{Q^2}{H M r} = \frac{Q^2}{H B r^4}$
- (7) $\mu = \frac{R_1 t}{r^2} = \frac{Q t}{\epsilon H r^3} = \frac{m}{I r} = \frac{R t}{l} = \frac{V t}{I l} = \frac{V t}{H r^2} = \frac{P t}{H I r^2} = \frac{E}{H I r^2} = \frac{L}{l} = \frac{t(R I + V)}{H r^2} = \frac{A t}{I} = \frac{Q t}{H C r^2} = \frac{F t}{H Q r} = \frac{M}{I r^2} = \frac{B r t}{Q}$

The relationship of R_1 , ϵ , and μ is found to be:

- (8) $R_1 = \frac{t}{\epsilon} = \frac{\mu r^2}{t}$; $\epsilon = \frac{t}{R_1} = \frac{t^2}{\mu r^2}$; $\mu = \frac{R_1 t}{r^2} = \frac{t^2}{\epsilon r^2}$, or
- (9) $R_1 = \frac{1}{\epsilon V} = \mu \lambda^2 V$; $\epsilon = \frac{1}{R_1 V} = \frac{1}{\mu \lambda^2 V^2}$; $\mu = \frac{R_1}{\lambda^2 V} = \frac{1}{\epsilon \lambda^2 V^2}$, or fundamentally,
- (10) $R_1 = \frac{1}{\epsilon B} = \mu m$; $\epsilon = \frac{1}{R_1 B} = \frac{1}{\mu V}$; $\mu = \frac{R_1}{m} = \frac{1}{\epsilon V}$

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Sept. '55

Status of Other Investigations

Substantative material presently in preparation will be reported soon in memo form to expand on the above discussion, to record the status of the other fundamental aspects of the proposed theory, and to introduce the basis for practical studies which were the original intention of the investigation.

The writer feels that sufficient data has now been compiled and correlated⁽¹⁾ so that the fundamental relationships of medial or materials properties may be extensively interpreted in terms of the M, λ, ν, ν_m , and the equivalent temperatures of the constituent particles. Whereas the ordinary mechanical properties were readily shown to be related functions of M, λ, ν , and $^{\circ}A$ through extreme ranges of "temperature" or energy levels, the associated aspects of electronic or magnetic properties, (e.g. permeability, resistivity, and their temperature coefficients) have eluded philosophical clarity in relation to the other properties. It appears that introduction of the ν_m expression into the composite theory will permit the understanding and correlation of mechanical and electronic properties. If the result is successful, it may then be possible with the use of appropriate constants to completely describe the physical picture of a medium or material at given energy or "temperature" levels on the basis of one mechanical (e.g. specific heat) and one electromagnetic (e.g. resistivity) measurement. A more optimistic result, and the eventual aim of such a study, would be that predictions of the physical properties of new substances, mixtures, or alloys could be quantitatively made. A further creative aim of the fundamental and practical study is to provide a reasonable theoretical basis for the understanding of the solid, liquid, and gas states, or surfaces and interfaces, in relation to the simultaneous effects of chemical, thermal, and irradiation exposure.

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⁽¹⁾ In terms of dimensional aspects of the laws implied by DeBroglie, Boltzman, Maxwell, and others, to describe the sub-relativistic condition of matter.