

To
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My dear Sir,

In the attached letter, you had been acquainted with my purpose. Let me go to the subject, straight.

The difficulties of luminiferous ether are about its rigidity, density and whether it is at rest or in motion. We may assume it to be somewhat gaseous, but since it is a continuous substance, there is nothing like intermolecular space, everything is stuffed with substance, - thus accounting for its rigidity and density. It is considered to be rigid because of its enormous resistance offered, - the example I will soon give.

When photons travel along they are considered as light waves. $E = h\nu$ is latent in the wave energy. The energy-density of $h\nu$ is equivalent to mass. This E in waves has been transformed into E_{kin} giving the motion of waves. This E_{kin} overcomes the resistance of ether, $-R$ and gives the velocity of C . $\therefore E_{kin} \equiv RC$. Again $E \equiv mc^2$.

$$\therefore RC = mc^2 \quad \text{or} \quad R = mc$$

$\therefore m = \frac{R}{c}$. That, R is given by the resistance of ether divided by the velocity is clearly explained. Therefore we see that the velocity of electrons makes those bodies less immune from the resistance of ether, thus giving the mass. From here it is clear, that the mass of a photon varies inversely as its velocity: -

$$m \propto \frac{1}{c}$$

According to Stoke's theorem; - $F = 6\pi\eta rV$.

Here again, $RV \equiv F$. As V increases, F increases more, being multiplied by those constants, - thus, R also increases more and so does the ratio $\frac{R}{c}$.

NOW it can be clearly stated that $m \propto \frac{1}{c}$. This increase of mass with velocity may be interpreted by Einstein's $m = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}}$.

The two formulae may be coincided, this way: - If $m \propto \frac{1}{c}$ and R is the proportionality constant, then $m = R \cdot \frac{1}{c}$ must be equal to $\frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}} \times \frac{1}{c}$.

Then R must be equal to $\frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}} \bigg/ \frac{v}{\sqrt{1-(\frac{m_0}{m})^2}}$

But $R = mc$

Again $mc \neq \frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}} \bigg/ \sqrt{1-(\frac{m_0}{m})^2}$

∴ The formulae cannot be concided.

My formula shall act only with electrons and photons etc. indeed perceptible masses do not undergo the resistance or friction of ether.*

By now we may assume that ether is a dense substance but mobile like a gas. As in Hydrostatics, we may consider this as consisting of a number of layers each one rigid, dense, — like a very thin stretched membrane, along which longitudinal and transverse vibrations are propagated with their velocities.

It is supposed to permeate all vacuum and intermolecular, interatomic and void space within atom (let us from now denominate these as S_1, S_2, S_3).

This is the idea of extension and impenetrability (we will consider this later anyhow.) of ether.

Now let us interpret the origination of γ -rays, this way. They are known to be short wave electromagnetic radiations, — not corpuscular at all.

As the vibrations of light electrons are alluded to the origination of light, so the electromagnetic shock given to the ether may cause short waves of high frequency — the γ -rays. As waves are caused in the sea by the explosion of a mine so the explosion of a radio-active atom may cause such waves. The more violent is the explosion, the greater the resistance of ether and the more intense is the wave. So the explosion of an atomic bomb causes very intense γ -rays. Now we have proved the extension and persistence of ether and can speak of its existence as a material substance. Armed with this let me now explain a puzzling problem.

According to Goudsmit and Uhlenbeck the electron inside the atom is rotating with such velocity that its mechanical moment $S_6 = s \cdot \frac{h}{2\pi}$
 $= \frac{1}{2} \cdot \frac{h}{2\pi}$, when s is the spin

quantum. This enables us to calculate ω .

$\frac{a\omega}{c} = \left(\frac{1}{2}\right)^2 \times \frac{1}{\alpha}$, Where α is Sommerfeld's fine structure constant. Then the linear velocity of a peripheral point of the electron becomes $308c$, — a fact which has remained incomprehensible to a degree. To explain, — this would happen when free from all constraint but actually the resistance of ether decreases down the angular momentum. And the layers are knocked back rebounded again and on the whole the rotational momentum has to baffle much pressure against it.

Mathematically,

If the force \vec{a}_i on a point P on the spherical surface of the electron and if P_i are its various components, the turning moment or the torque of a force is given by, $\beta_{ik} = \Gamma_{ik} \zeta_i$.

that is, when \vec{OP} is a vector,
 $OP = x$.
 $x = \sum_i P_i (\xi'_0 + \eta'_i) = \sum_i P_i (\xi'_0 + \eta'_i)$
 when $\xi'_0 + \eta'_i$ is one of the Cartesian or curvilinear (Gaussian) coordinates system or Minkowsky-Brahmachary system.

The turning moment of a system of forces is given by simple additions.

The fundamental law of motion is $\frac{\partial g_i}{\partial t} = \pi_i$ and $G_i = m u_i$, where G_i denotes the components of the impulse of a mass point and π_i those of the force. [say, $Ft = x \cdot x = \sum_i G_i (\eta'_0 + \xi'_i)$, which transforms into $\sum_i G_i (\eta''_0 + \xi''_i)$ and $f_t = y = \sum_i \pi_i (\eta''_0 + \xi''_i) = \sum_i \pi_i (\eta''_0 + \xi''_i)$.]

In addition to this law the following holds good: $\frac{\partial L_{ik}}{\partial t} = \beta_{ik}$. The torque of a rigid body is controlled by this. L_{ik}, β_{ik} are tensors of the second order. Let us contract.

$L_{ik} = L_i^k = L_{ik}^{\alpha\beta} = \sum_{\alpha\beta} C_{(\alpha\beta)}^{(ik)} = \sum_{\alpha\beta} C_{\alpha\beta}$, — a scalar,
 and

$\beta_{ik} = \beta_i^k = \sum_{\alpha\beta} \beta_{\alpha\beta}^{ik} = \sum_{\alpha\beta} C'_{(\alpha\beta)}^{(ik)} = \sum_{\alpha\beta} C'_{\alpha\beta}$, — a scalar.

Now the formula is changed into a simpler one.

* Explained later

— $\frac{\partial C}{\partial t} = \partial C'$. This holds good only when free from all restraints. $\partial C'$ is acted upon against R , the force of ethereal resistance.

With the same argument I can interpret Doppler's effect, — the red-shift of a moving nebula. Suppose a gaseous mass travels along at a great velocity. It strikes the layers of ether and something like inelastic collisions happen and this vibration is propagated from layer to layer and at the motion of any perceptible mass, such longitudinal undulations go on spreading towards the opposite of the direction of motion of the body, — something like the waves created by the ploughing of a steamer.* But the atoms within the mass, suffer from an impact against ether in S_2, S_3 (page 2.).

Suppose an atom, travelling with a velocity v , moves away from a world-point W , in a time-period t . Then push will be acted upon by the resistance of the ether, which will act as a pressure P . This will be, however, much greater in an individual atom than on those in the mass. This P acts upon the extranuclear electrons, — reducing their frequency of vibrations. As v decreases, λ increases.

$$\therefore \lambda \propto P \quad \lambda = K.P \quad R, \propto \lambda, \quad R = m.\lambda$$

$$\therefore R = m.K.P = \pi.P \quad \therefore R \propto P, \text{ when the } R \text{ is the}$$

amount of redness. Again $R \propto \frac{1}{t}$. The greater the time, the greater is the distance and larger becomes the velocity and more of R .

$$\text{Then } R \propto \frac{P}{t} \quad \text{Again } P \propto v, \quad P = \mu.v.$$

$$R \propto \frac{\mu.v}{t} \quad \therefore R = v \cdot \frac{\mu.v}{t} \quad \text{let } \mu v = r.$$

$$\text{Then } R = \frac{r.v}{t}.$$

* The push of the ether head-wind cannot be measured — by the Michelson-Morley experiment — but the verification of these waves, I know of and shall explain

Now let us consider another ³ problem not thought of before. It depends upon the idea of expansion of the universe, more or less globular in form. All the nebulae are diverging away not relative to any particular centre. But of course the sphere must have a centre, — say a world-point w . As the time-period t increases, the spheres become larger in volume. The volume is a function of time.

$\frac{4}{3} \pi r^3 = F(t)$. So a system of unicentric spherical formation gradually issues out. Each sphere is larger than the one before.

v_2 at $t_1 < v_2$ at $t_2 < v_3$ at $t_3 < \dots < v_n$ at t_n , where $\lim_{m \rightarrow \infty} t_n$, when $m > 0$. Anyhow, but where the globe of space-time expands into? Outside universe there is no space. Then where the material structure metrical structure of the universe expands into? This is again an unsolved problem. Now I ask where does it exist? In something nothingness, which is neither space nor time. But if this metrical structure of the universe can exist in this which is not 'Raum und Zeit', we unconsciously assert it to space-like property of capacity. Then this shall be acted upon by Riemann's n -dimensional geometry. This nothingness must be at least 5-dimensional to receive a 5-dimensional metrical structure (including Kaluza's projection). Then this nothingness is analogous with space, having the most important property of capacity in common. I came to this conclusion after a talk with Mr. S.N. Bose (you remember his light quantum statistics in Zeitschrift für Physik, 1924) at Dacca.

Now suppose, relative to the world-point w , another world-point w' , in the surface of the sphere, moves along with the expansion of the universe, say at a velocity of 10,000,000 miles a second.

Then $w - w' = r$ is the radius of the universe. Volume is given by,

$$V = \frac{4}{3} \pi (rt_0)^3, \frac{4}{3} \pi (rt_1)^3 \text{ etc.}$$

$$\text{Then } V_{t_2} - V_{t_0} = \frac{4}{3} \pi \{ (rt_2)^3 - (rt_0)^3 \}.$$

But the second term in the bracket on the r.h. side increases with time and soon becomes very enormous. The volume and consequently the radius is a function of time. Let L be the length of the radius.

observed in 1924

L = f(Et), when \dot{E} is the expansion constant of the universe. Let the limit of integration be 10^{∞} . 56 539-6

Let the lower limit a be a fixed quantity, - at the present moment. We can form the integral: -

$$\int_0^{\infty} f(Et) dV \rightarrow \int_0^x f(x) dV \rightarrow \int_0^x f(v) dv = \psi(x)$$

Now if we suppose the universal space to be filled with ether, that will also expand in the same way, - that no vacuum remains. Then its density ρ will become smaller and smaller with time.

$\rho \rightarrow 0$ as $t \rightarrow \infty$. There are some ideas of the eternal expansion of the cosmos. Then soon the ether will vanish into nothingness. This is a proof, if ether is a material substance, of the limitation of the cosmic expansion. But still with time, the density of ether is not appreciably changing, the radiations of γ -rays do not lose their intensity, (!) - so I am of the mind of its direct creation of ether out of something. What can it be? I think of transmutations of radiation and matter. There are millions of metagalaxies of radiating masses, losing material substances in radiation. These may again in an unlocalized form change into ether. It seems that with radiation a 'flotsam' of photons and minute particles escape in space-ether. It is probable to assume that some of these mix up with space-ether, giving volume to ether. Then we can propose the following order of transmutation: -

Matter \rightarrow radiation \rightarrow matter \rightarrow Ether \rightarrow matter.
 1. 2. 3. 4.

If 3 is correct, then 4 must be correct also.

I think to that some energy-tensor-density $T_i^k \equiv$ mass, induced within an unit amount of ether will create a mass. We will however come back to it later.

Let U be a radiator.

$U \rightarrow u_2 +$ radiation. Let $U - u_2 = \bar{U}$.

This \bar{U} is mixed up with space ether.

Let \bar{U} consist of $(h\nu)R$, where R is a very large integral multiple.

$$\bar{U} = E \cdot R. \quad \frac{E \cdot R}{c^2} = m \cdot R = M. \text{ This energy}$$

7.
 may be converted into mass and pick up electric charges. Anyhow before the energy had been finally condensed into mass, some spontaneous action may change it into ether. Or as B is correct, we can use the following notation: — Energy \rightarrow mass \rightarrow ether.

Then the inertial energy of ether is the final cosmic energy. Let us denote it by $\text{curl } E$.

$$\frac{\partial E_i}{\partial x_j} + \frac{\partial E_j}{\partial x_i} \equiv E \text{ and } \phi.$$

E = electromagnetism and ϕ is gravitational energy. All forces had been reduced to these two types. It has been proposed to bring about the union of the two by Kaluza's suggestions of the adoption of a five dimensional continuum, leaving the idea of gauging free to bring about the union of quantum theory with these branches of physics. So we may give these the same origin.

Where K_ν is the intensity of radiation of frequency ν , $K_\nu = \frac{\nu^2}{c^2} U$. Let K_ν be measured by some bolometric unit.

$$K_\nu^2 = \frac{\nu^2}{c^2} U_1. \text{ Also } \bar{U} = \frac{K_\nu - K_\nu^2}{\frac{\nu^2}{c^2}}.$$

$K_\nu - K_\nu^2 / \frac{\nu^2}{c^2}$ can be known if U and U_1 are known. Then $(h\nu)R$ is known also.

$\frac{1}{c^2} \times \frac{\partial (h\nu \cdot R)}{\partial t}$ is the rate of conversion of radiation into mass. In the process ether will be formed, the quantity shall depend upon the volumes of such radiating masses. Integrating through the 3 dimensions of space; —

$$\iiint_{t_1}^T \left(\frac{\partial \xi}{\partial t} / \frac{\nu^2}{c^2} \right) V dV, \text{ where } \xi = (h\nu)R.$$

V is the volume of all radiating masses. If it was known, we could integrate out,

$$\iiint_{t_1}^T \left(\frac{\partial \xi}{\partial t} / \frac{\nu^2}{c^2} \times V \right) dx dy dz, \text{ when } t_1 \text{ is the present time, } x=0 \text{ and } T \text{ lies above it in the future cone. } t \neq x=0$$

We know however something⁸ of the greatness of v . \therefore our result will be great also.

Now we consider ether as a fundamental material substance dense and rigid but still continuous and mobile. Each layer is somewhat like a solid elastic.

As any perceptible mass rushes along this ethereal ocean, the impact makes the layers vibrate. They give way and the vibrations are propagated along as longitudinal waves. Inelastic collisions happen, - so the friction is not undergone and bodies are not much hampered in their cosmic travels. Then about this longitudinal waves, - the asterisk on page

4. Attracted by the stupendous energy of that burning mass, the sun, the comet revolves round the sun in an elliptical orbit. Now the gas is

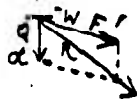


much more mobile and consequently, should be more powerfully attracted than the comet head, - the solid nucleus. The gravitational energy of the sun and mostly the moon causes a portion of the water to heave up and form the tide in our ocean. Like this a powerful tide, represented by a column of the gaseous tail pointing towards the sun, should have happened in the tail of a comet as it sweeps past the perihelion of its orbit. But this is not the case. Let TF represent this force.

The pointing of the tail towards \overrightarrow{QP} is ascribed to "die prinzip der light-quanten." Let QP represent this force. Those ethereal waves propagate along \overrightarrow{WF} . The greater the motion of the comet, the more powerful will be the force of WF' which shall tend to turn the tail towards WF' . So these 3 forces will act.



Assuming, $QP > TF$, the forces do not neutralize but another force \overrightarrow{R} $\leftarrow QP$ acts towards QP.



The resultant of $\alpha\alpha$, WF' is R, a little one the east to QP. And we see that the

tail is not pointing to QP exactly but towards a little east. Assuming TF to be $> QP$, R will point to QP, - an abnormal direction. Then we will assume, - the atoms



of the tail of a comet are electrified, - that is ionized. cations and anions attract each other and this affinity makes the tail rigid as a whole, that is do not yield to other forces. Let this

force of rigidity act as qy . Then the R of qB, qY point towards qB , which is all right.

NOW this ether is co-ordinated with space. The three dimensions of space are co-ordinated with the other three dimensions of ether. So universe is a 7-dimensional ab-finite space, - 6 of space-ether one of-time, with Kaluza's projection.

So Minkowsky's,

$$ds^2 = dx_1^2 + dx_2^2 + dx_3^2 - dt^2, \text{ shall be changed into}$$

$$d\sigma^2 = (dx_1^2 + dx_0^{\prime 2}) + (dx_2^2 + dx_0^{\prime\prime 2}) + (dx_3^2 + dx_0^{\prime\prime\prime 2}) - dt^2, *$$

$$= \Sigma_1^2 + \Sigma_2^2 + \Sigma_3^2 - dt^2.$$

But now we understand that $\Sigma_1^2, \Sigma_2^2 + \Sigma_3^2$ are respectively $\equiv dx_1^2, dx_2^2 + dx_3^2$.

For universe is a spherical globe of space with the ethereal fluid in it. Imagine a globe of water. globe in the space, in it is co-ordinated the dimensions of the watery globe. Its dimensions fall in those of space. We cannot consider the dimensions of space different from those of the water. So Minkowsky-Brahmachary's geometry is only to show that space and ether are ~~not~~ co-ordinated.

Is ether at rest or in motion? It is at both, because the idea of motion is entirely relative. Because of the expansion of space, the ether is moving relatively to the universal centre. But to every other object it ~~not~~ is apparently at rest, because it moves with the same velocity and towards the same direction.

Has ether got any mass or weight? It is the propagator of gravitational waves. It is supposed to be the carrier of longitudinal waves, - with velocity $\sqrt{\mu/\rho}$, while the transverse light waves have a velocity of $\sqrt{\mu/\rho}$. Formerly gravitational action was thought to be instantaneous. But as they are propagated as transmission signals, they are thought to have a velocity of c or $\sqrt{\mu/\rho}$. But then I can show that the velocity of

* This Minkowsky-Brahmachary's co-ordinate system of asterisk in page 3.

gravitational waves is ^{10.} at least $2c$.

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Let $v = \frac{\sqrt{\lambda + 2\mu}}{\rho} = \sqrt{\frac{\lambda}{\rho} + \frac{\mu}{\rho} + \frac{\mu}{\rho}}$ whereas c is

only $\sqrt{\mu/\rho}$. Then we will assume that the group velocity is equal to the velocity of light but somewhat as in De Broglie's pilot waves the individual undulations may be speedier than light.

Now since ether, the fundamental substance, is materially, existing, it must have some inertial mass equal to the gravitational mass.

$m_0 = M$ — Equivalence hypothesis.

If there exists a special gravitational field for ether to be affected upon, — ether shall have weight.

Now there are many ideas of a nucleus of the universe. As the universe is so rapidly expanding, the moving etherial ocean trembles and vibrates so that universe looks like a trembling, expanding soap bubble. It would

have faint form and burst unless some electric charge in a specially solidified etherial centre with its specially propagated gravitational waves, had been acting upon the universe with an attractive force. Let a tensor a_{ik} represent the vibrations of

ether. ~~Let it be resolved~~ Let it be resolved into three independent variables, — longitudinal-longitudinal, longitudinal-transverse, transverse-transverse, because of the splitting up of

constant symmetrical tensor a , $\begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix}$ of the into three summands: —

$$\begin{vmatrix} a_{11} & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{vmatrix} + \begin{vmatrix} 0 & a_{12} & a_{13} \\ a_{21} & 0 & 0 \\ a_{31} & 0 & 0 \end{vmatrix} + \begin{vmatrix} 0 & 0 & 0 \\ 0 & a_{22} & a_{23} \\ 0 & a_{32} & a_{33} \end{vmatrix}$$

(1 = l.l, 2 = l.t, 3 = t.t)

The first sort of wave is specially meant to give ether a gravitational mass, the second one, the general gravitational waves and the third one for light waves. The second class also consists of electric and magnetic waves (explained in the ...)

After the above assumption: — 56 539 —
 suppose the universe to consist of a number of points of space ether, each having the mass unity. As it moves along with the expansion of ethereal universe in presence of the gravitational field, ϕ — the potential at the centre of the universe, each geodesic, representing the motion of the point tends to become a curved trajectory. Thus the whole surface becomes a curved one and we see that the curvature of outer space is dependent upon its large surface.

NOW $C \propto M, V$. $C \propto M$; $C = \phi M$; $M = \frac{C}{\phi}$

AS $M \rightarrow \infty$, $C = \phi M \rightarrow \phi(\infty)$, indeterminate... (i)

The velocity of any such point-mass is greater than the velocity of light in vacuo, — being about 10,000,000 miles/sec. so with velocity (let it B) increasing, mass becomes greater.

AS $M \rightarrow \infty$, $V \rightarrow 0$. $MV \propto C$; $MV = k \cdot C$

$MV \propto M$
 $\propto \frac{C}{\phi}$ $\therefore MV = k \cdot C / \phi$ $\therefore C = \frac{MV\phi}{k} = \frac{\infty \cdot 0 \cdot \phi}{k}$,
 which is again indeterminate... (ii)

AS the velocity becomes B, the ethereal point-mass increases in magnitude.

$M = \frac{m_0}{\sqrt{1 - \left(\frac{10,000,000}{186,000}\right)^2}} = \frac{1}{\sqrt{1 - \frac{5000}{93}}}$ [$m_0 = 1$, already taken.]
 $=$ approximately $\frac{1}{\sqrt{1 - \left(\frac{5000}{93}\right)^2}} = \frac{1}{\sqrt{1 - 2500}}$

$\therefore M \sqrt{1 - 2500} = 1$ OR $M^2 (1 - 2500) = 1$

$M^2 = \frac{1}{-2499}$ (iii) So mass seems to be a small negative fraction. M, however becomes imaginary.

For physical purposes however I think that the mass will be a larger negative fraction. As a mathematical inference, it is, I think only to show us our conclusion about something else. let us find it out.

Before, Let us see about the volume.

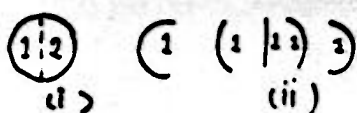
The volume is given by this ratio: $1:\sqrt{1-\beta^2}$
 $1 : \sqrt{1 - \frac{u^2}{c^2}}$ or $1 : \sqrt{1 - (\frac{5000}{100})^2}$ or finally $1:\sqrt{-2499}$
 or $12 : (\sqrt{-2499})^2$ or $1 : -2499$. This way will try to interpret, — the volume decreases towards the direction of motion, negatively, — that is, increases.

When mass is negative,

$$c = \phi M = \phi(-x) = -\pi \text{ say.}$$

That is the idea of universe having a negative curvature. The result of (iii) is only to show us this.

As I am interpreting the negative mass, volume this way, it will not be adequate to say usually that here negative curvature will be one to contain more volume, in a given radius or that $\frac{\text{circum.}}{\text{diamet.}} > \pi$. I only can mean it this way: — the curvature in the opposite direction, — it concave changing into imaginary convex. The figure explains.



It will change as in (ii). But there are conditions of curvature which had been indeterminate. For these

1 will not change completely, — nor 2. Then the resultant sphere becomes like this: — (iii). Then the universe tends to become ellipsooidal in form.

Considering the negative curvature, usually,

$\frac{\text{circum.}}{\text{diam.}} > \pi$, Ludolph's number. That is the length of the periphery increases more than the

considered diameter. Then the periphery becomes an ellipse and the considered diameter, — the minor axis.

My conclusions only say that universe is not spherical but it may be ellipsooidal, parabolic or hyperbolic.

If space is closed it will be ellipsooidal. In (Nature) of 1939, two physicists wrote that universe is negatively curved. But they considered it to be parabolic or hyperbolic.

Ether and heat.

The vibrations of a number of molecules in a hot body ought to be stopped because of the resistance of ether. In these vibrations, mostly, inelastic collisions occur between the vibrating mass and rigid layers of ether round it, — like the impact

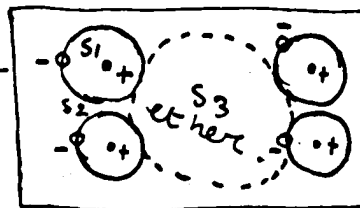
between two molecules as in the kinetic theory of gases. In extreme cases of heated vibrations, as in stellar temperatures some ethereal waves may be caused as hoped for. These will be the extreme short wave radiations. Then I think this is the origin of cosmic rays. It has been found out that a small amount of cosmic rays come from sun (Nature, - Jan. - June 1930). Mostly they then come from the extremely heated stars from all quarters of the universe.

Now can we assume that ether, while ^{it is} letting heat in general to pass away, shall absorb a little? There is no way of proving it wrong. A bit of the radiation from the sun may be absorbed in space-ether. Thus a lot of heat is absorbed by the whole of the ethereal ocean and an equilibrium is restored. Then if a large sheet of ether is heated, we can't conceive it, for the entropy of the universe has increased and a new equilibrium must be restored. Let such radiational energy absorbed by ether be denoted by R . We shall see its significance later.

Then as ~~it~~ heat is induced the inertial energy is greater also.

$E_0 \propto R$. Let us consider what will happen with increasing E_0 . In common atomic matter, this will induce a motion in the molecules and atoms and thus will show its presence. But ether is continuous so the only natural phenomenon will be to expand.

Let us consider expansion of substances. A solid is heated. The ether in S_1, S_2, S_3 are heated. A lot passes away. A little is absorbed. molecular motion is induced. As S_1 increases in area it offers pressure on the electron. The Bohr-quantized circle would have been greater in area but for the strong affinity of electron-proton. The pressure of S_3 is greater and the molecular affinity is acted upon by this pressure. S_3 becomes larger. As cohesion in gas is ~~at~~ least, expansion of S_2 is greatest.



The broken circle shall be considered to be S_3 .

Let the vol. of 1 c.c of air be V_A .

Let V_B the volume of S_3 . Let each molecule be V_C with radius 2.5 \AA Angstrom units. $V_C \sim 2.5 \text{ \AA} \cdot U$.

$$\begin{aligned}
 \text{Vol. of each molecule} &= \frac{4}{3} \pi (2.5)^3 \text{ in Angstrom units.} \\
 &= \frac{4}{3} (3.1419) (2.5)^3 \text{ in Angstrom units.} \\
 &= \frac{4}{3} \times \frac{31419}{10000} (5.2)^3 \text{ in } \text{Å} \cdot \text{U.} \\
 &= \frac{125676}{30000} \times \frac{125}{8} \text{ in } \text{Å} \cdot \text{U.} = V_{D_0} \text{ say.}
 \end{aligned}$$

$$V_{D_0} = x \text{ cubic } 10^{-8} \text{ cm.}$$

The volumes of all molecules in V_A is V_D .

$$V_D = V_{D_0} \times \text{Lochsmidt number.}$$

$$= V_{D_0} \times (3 \times 10^{19}) = \frac{125676}{30000} \times (3 \times 10^{19}) = \frac{125676 \times 10^{19}}{10000} \text{ in cubic } \text{Å} \cdot \text{U}$$

Then $V_A - V_D = V_K$, the volume of S_3 , constant.

\therefore Expansion is proportional to V_K .

$\therefore E \propto V_K$. This expansion-pressure is equal to BaV_K . $E = BaV_K$, where Ba is Brahmachary's constant, dependent upon the molecular structure of matter. Now V_K will denote S_1, S_2 or S_3 .

The origin of light-waves, we allude to the vibrations of electrons. As S_1 tries to increase in area but cannot, it offers a continuous pressure to the electron, wherever may it be upon the circle.

$3V = x \cdot BaV_K$ because $3V \propto BaV_K$ or $\propto E.P$, the expanding pressure. (Vib vibration in 3 degrees of freedom.) But as BaV_K increases V , decreases, that is increases ~~positively~~ negatively. x shall be negative. Really then $\lambda = x \cdot BaV_K$, when x is a positive constant. Larger the massive volume of a star, greater the V_K (all V_K 's of the mass) and consequently, the light emitted is redder. Now the burning gases give so many special colors, that we cannot verify this. However the largest stars are red ones.

The fundamental cosmical energy is curl E , the inertial energy of ether. And this is increasing because the R -energy absorbed (page 13.).

$\therefore \text{curl } E_{t_2} = \text{curl } E_{t_0} + R_0$, increases with time. We have seen before the possibilities of transformation of ether to matter and reverse. As the universe expands, the ether expands and finally all matter shall

be dissociated into ether. This will go on expanding before the ρ of ether becomes 0. That is the universe will not increase in volume for an infinite amount of time.

After the universe begins the expansion contraction, the entropy will again go on decreasing. Let $\text{curl } E_T$ be the final entropy maximum. Let $\text{curl } E_0$ be the minimum entropy.

$\text{curl } E_T - \text{curl } E_0 = \text{curl } E_{\text{max}} - \text{curl } E_{\text{min}} = \text{curl } E_m$ as energy shall create all the matter in the universe.

Let this be M . Then $MC^2 = \text{curl } E_m = \left(\frac{\partial E_i}{\partial x_k} + \frac{\partial E_k}{\partial x_i} \right)_m$.

A lot of the $\text{curl } E_m$ remains at the present time t , as free energy and the rest as mass.

What can the masses of electrons, protons be made of? Ether. Any etherial unit lodged with some energy unisor-density T_{ik} will form a mass. We will assume all energies to be transformable. The presence of T_{ik} shall be to condense a portion of ether and may be changed into electric energy. Thus making a proton or an electron. A lot of the mc^2 is from the inertial energy of the ether. Any portion of ether containing an energy-density T_{ik} shall be called a field and in this sense a matter shall be carried out from this field which is more fundamental. we are thus forming a new field Physics. Let us denote it by $F_{\xi\eta}$, ξ representing the energy nucleus and η the positional co-ordinate. The uncertainty of position of ξ can be represented usually by a series of non-commutable infinite matrices.

Say like,

ξ_{10}	ξ_{11}	ξ_{12}	...
ξ_{20}	ξ_{21}	ξ_{22}	...
ξ_{30}	ξ_{31}	ξ_{32}	...
...

Field shall be of two type. Primary and secondary. Magnetic field shall fall under $\pm \dots$ I will explain this later.

The T_{ik} of a photon is unity. An integral multiple of this T_{ik} say $K \cdot T_{ik}$ shall form an electron, while $R \cdot T_{ik}$ shall form a proton. $R > K$. For $R \cdot T_{ik} = K T_{ik} + t_{ik}$, for the greater mass. Probably the unit T_{ik} does not make any mass of ether but the larger units condense some ether so any mass becomes enormously dense. It is containing an enormous amount of energy inside. But the lot of T_{ik} as an extra-potential acts, and an electron should have been burst out. But $E - \text{grad } \phi = 0$.

ϕ acts as an electric pressure. Some of this T_{ik}

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changes into ϕ . We can assume then an electron to appear somewhat like this ~~sketch~~. At each point a force of energy is trying to burst out. Let there be n such forces. Now like electromagnetic waves let us consider electrical waves also. As an electron moves along space, all these N forces act upon layers of ether and waves arise and are propagated along. Throughout a cubical space this will happen and that space we will call the electric-field. All the principles of action at a distance I think should be alluded to the longitudinal-transverse vibrations of ether. As the amplitude decreases the intensity of the effect decreases also. When it becomes 0, the field vanishes. As the electric waves move along, they strike sheet after sheet of ether at $rt \angle s$ to the electric waves. These sheets will form another secondary cube, — the field of magnetism. So impacts at $rt \angle s$ to the magnetic field creates another electric field.

Now electricity itself is a wave. In the new nature of electron, it is not only accompanied by De-Broglie's waves but is itself a spreading wave. I think it is because of its dissociation into electric waves which spread along. $\therefore u(x, y, z, t)$ satisfies $\nabla^2 u = \frac{1}{v^2} \frac{\partial^2 u}{\partial t^2}$.

I think matter is like a bubble in ~~st~~ field, — the water. The bubble is a real singularity but it is so unsubstantial. The spreading of the electron wave is like the swelling of the bubble before bursting.

So I now consider ether to be a material substance having resistance, rigidity and extension.

AS ~~ether~~ gravitational and inertial mass are different aspects of the same thing, so matter and ether, both, substantial singularities of the universe, are different existence of the same object.

4th September,
1945.

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APPENDIX.

I think there is a flaw in the fundamental idea of Michelson-Morley experiment. It is to determine the velocity of earth relative to ~~the~~ ether at rest. But do you consider that with the expansion of the universe, the galaxy of our earth and Milky Way is running along at a terrific speed from the centre of the universe*. The ethereal ocean is also expanding. For every object, the ethereal layer around it shall seem to be at rest for both are

* see page 5.

travelling towards the same direction with the same velocity. when a log of wood drifts along the current, can you consider its motion relative to the water at rest!

The null result of Michelson-Morley experiment is very natural showing there is no absolute motion of the earth relatively to the ether, because both are moving in the same direction with the same velocity. There is a longitudinal motion of 19 m.p.h. relative to ether but a transverse motion of both a' of thousands of miles per sec. so a correction of even 1% should not do anything.

7th September '45.

— Master Ratan Lal Brahmachary.