THE GRAVITATIONAL WAVE

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The Chairman, Michael Ash, M.A., M.R.C.S., L.R.C.P., introduced the speaker in the following words: "Father Andrew Glazewski combines theoretical knowledge with practical and experimental ability. By combining these two entirely different approaches to the subject of Radiesthesia, he has succeeded in producing an instrumental detector of the Radiesthetic Stimulus, that goes far to satisfy the requirements of doctors such as myself, who have to use such instruments in practice. Therefore it gives me great pleasure to introduce Father Andrew Glazewski."

Introduction

The present lecture is only a very general outline of the hypothesis. No extended and rigorous proof can be given for the hundreds of problems which accumulate in such a short time as a lecture lasting 45 minutes. Therefore we are only giving here the mere skeleton; the extended argument will be given at a later date in a single volume.

In spite of the short time available, we are forced to put forward all the numerous problems involved, as otherwise the general picture will not appear. A sort of bridging is made between several branches of science—physics, astronomy, biology, medicine, radiesthesia, &c. The problem of gravity is approached not in the usual way, as is the practice in nearly all hypotheses. We are not trying to explain the origin and motions of our solar system. No! What is intended is to find the precise nature of gravity, acting alike in atoms as in stars. It is believed that once the exact nature of this phenomenon is discovered, other things will be more easily explained.

Finally it is necessary to emphasise here that the present lecture is a repetition in a shorter and a rather more technical form of what was read on December 1st, 1949, to the Psychosomatic Research Association in London. In the present lecture every effort will be made to present things in a simple way. All heavy stuff will be eliminated in order to give the general picture as clearly as possible.

Before the subject itself is approached, three assumptions must be mentioned, on which the rest is constructed.

1. *The nature of electricity.**—It is assumed that electricity, as it appears to an observer, consists of a sudden drop or change of gravitational potential at a locus or area of space (mathematically in the change of the value of tensor) in relation to the

* For the justification of this assumption see notes (4), (6) and (19) in Part I.

his paper. In short, one can conclude generally from his sections 5, 1 and 5, 2, that ultimately we have to reduce gravity to electromagnetic forces, instead of saying that the latter (as it appears from the analysis of the formula given above) are the result of the mechanical motion of mass *even in atomic size.* (In the macrophysical size Blackett in sec. 5, 3 definitely defends the thesis that a massive rotating body produces a magnetic field, but in the atomic size (sec. 5, 1 and 5, 2) he seems to favour the opposite conclusion (4). In other words, from the strict analysis of the Schuster's formula which holds throughout the physical world, it follows clearly that we should reduce gravitational and electromagnetic phenomena to mass in motion, when not only the orbital and spin motions have to be reckoned with, but principally the sum of the motions of all the elements of the respective mass $\sum_{i}^{n} \triangle m$ — where $\triangle m$ stands for the element of mass—must be taken seriously into consideration. Putting thus the problem with the assumptions given in the introduction as the background, all the main difficulties should vanish (5).

We have to recall here once again the assumption concerning the nature of electricity, whereby this consists of a slow or sudden change of the gravity potential in a particular locus—the change of the value of a tensor—in relation to the surrounding space where the potential is comparatively uniformly distributed (6). Such change is noticed as electricity, by anyone standing outside this closed physical sytem, and therefore standing in a relatively uniformly distributed potential pertaining to his own space.

Let us now begin with an analysis of Schuster's formula. We can write it thus:

$$G = c^2 \left(\frac{P}{U}\right)^2 \beta \ldots\ldots\ldots\ldots (1)$$

Before we consider this formula closely, it is necessary to recall that in physics we are dealing with two kinds of mass (7), without distinguishing between gravitational and inertial mass. One may be called the weight mass of the body which comprises these two. The other is the mass due to electromagnetic forces generally, which according to the theory of relativity grows with velocity, becoming infinite at the absolute speed of light (8).

In formula (1) we can immediately see the components to which the gravitational constant G is due. First the constant c, the ratio of electrostatic to electromagnetic units. Here it is squared. It is one of the components, but by no means the only one. (A very clear mental distinction must be preserved between electromagnetic forces, electrostatics and magnetostatics. This is not always done in arguments and books). Hence gravity is not due to electromagnetic forces only. The second factor is the magnetic field moment P, reckoned along the field lines, to which

the relative mass (the one which grows with velocity) is due. The third element from which the constant G results is the mechanical angular momentum U. It is concerned with the mechanical motion of the weight mass. As U is the denominator here, it follows that it must be the main factor of the proportionality given in this equation (9). The ratio then P : U boils down to the ratio of two kinds of mass and their respective motions, mechanical motions of course. We shall see later on that from the analysis of the fundamental equation of wave mechanics $h/\lambda=mv$, the factor c or c^2 is also connected with the mechanical momentum, i.e., mass times velocity. Therefore a little consideration shows that whether we take P, U or c, in each of these components the motion of the mass, the mechanical motion, is essential, and G is connected only with this motion. We have to remember that G stands for the *gravitational constant.*

Hence, from the analysis—even as short a one as this—of formula (1) we have to conclude that G is the function of the mechanical motion of the two kinds of mass, the electromagnetic component of the mass and the weight mass, where the electric, magnetic and electromagnetic phenomena are the result of the motion of these masses. The general application of the Lorentz transformation formula to all mass in motion shows this clearly (see below). As G is a tensor, being reckoned from the Einstein computation (see below), it can be easily shown that the stress-strain relation is of vital importance (please recall the second assumption in the introduction concerning the concept of space). In the light of the tensorial concept of G, space, whatever size we take, atomic or astronomic, *is not an isotropic but an anisotropic medium,* in which the gravitational forces are differently distributed along different co-ordinates. Actually, astronomic space as an anisotropic medium *can be compared to a crystalline lattice* (of an astronomic size), where this lattice is anisotropic just because the gravity fields of the space between the molecules are differently distributed. The above statement is essential for the understanding of the nature of gravity and further development of the theory.

We arrive here at an entirely different concept of interstellar as well as of inter-atomic and inter-molecular space, from that hitherto held in physics, especially as regards astronomical space. Let us formulate : *Space is an anisotropic medium, thanks to the gravitational forces acting in it and to their interference pattern. Hence it is unevenly distributed.* (According to Relativity the mass of the far distant stars contributes more to the potential of gravity at a particular locus than does that of a comparatively non-distant star (unless it is very near), thanks to their great mass. It should be remembered that space tends still to isotropicity, and therefore the gravitational field introduces in it a stress-strain relation (10).

Concerning the factor G, it must be emphasised as strongly as possible that it is not a scalar, as in the Newtonian formula. Einstein posed very correctly that the gravitational potential is a tensor and not a scalar (11) in his *Meaning of Relativity*. Actually G is not only a symmetrical tensor, on the contrary it is often an antiself conjugate one, i.e., a skew, as well. But whatever is said about it, it is evident that when G is conceived as a tensor, an entirely new light is thrown on the very concept of gravity.

It has been found lately by the writer that the matrix calculus connected with the concept of tensors reveals a harmonic law, and shows therefore that gravity must be a harmonic phenomenon where periodic motions are involved (12). We shall refer presently to how Kepler in his work called *Harmonice Mundi* solved his known third law by harmonic computation only.

The theorem of equal areas, and mainly his third law (the squares of the periodic times taken to describe their orbits by two planets are proportional to the cubes of the major semi-axes of their orbits) was computed by Kepler on March 8th, 1618, by a *harmonic analysis*. He first formulated his law thus: " . . . the second *octaves* of the orbital velocities of two planets are proportional to the third *octaves* of their great axes " (13). As in harmonic calculus the number of the octaves corresponds to indices (powers), therefore he subsequently formulated his law in terms of squares and cubes. By this harmonic computation he arrived at the idea of the harmony of spheres and a sort of counterpoint (musical) played by the motion of the planets. The tables made by him are most astonishing. (See Tables I, II, III). On the same base H. Kayser made by harmonic analysis a logarithmic table, in which ratios transposed to musical notes reveal a musical scale produced by the revolving planets (see Tables IV and V; all these Tables are after H. Kayser: see *Der Hörende Mensch*, pages 178-193). For more details the reader is referred to the above work of Kayser. All that can be said here is, that these tables are calculated on the ratios of mutual motions in logarithms, and which ratios can be represented by musical notes.

Any modern physicist taking in his hands the *Harmonice Mundi* of Kepler would realise, to his astonishment, that it is a book of harmonics. The word " harmonics " should not be confused with the concept of harmony in music. It means here the phenomenon of harmonics of a wave, or integral multiples of a wave vibration. The result achieved by Kepler in solving one of the fundamental laws of gravity only by harmonical relations, is a strong argument for a wave solution of gravity. Unfortunately the harmonical computations have been for a long time left undeveloped and nearly forgotten. Only the very latest developments of mathematics (mathematics of groups) is reacting to this sort of computation. May we recall that tensor matrices are related

to the algebra of groups of linear equations. Harmonical computations are only a different type of the same calculus (14).

Kayser made another most interesting reckoning on a harmonic base for an angular deflection for each particular ratio (tone) which, transposed into musical notation as a convenient way of an evaluation of these ratios, gave him the results demonstrated in Table VI. He showed also that the same can be done for the periodic table of elements, where each element has its own angle relative to others. (For details refer to H. Kayser, *Der Hörende Mensch*, 141 and in particular, 145). This recalls the experiments with ionisation tubes on the fundamental ray, made by Mr. J. Cecil Maby and published a year ago in *Radio-Perception* (15). The astonishing fact is, that Kayser's computation is in accordance with Maby's experiments (15). For it shows that the fundamental ray corresponds to the angular deflection of Kayser's harmonic calculus. (See Table VI).

So far it has been shown in an extremely abbreviated way through the analysis of formula (1) and through Kepler's results that :

(*a*) gravity should be strictly connected with the mass in motion, i.e., with the mechanical momentum (mv),

(*b*) it should be a harmonic phenomenon, as the tensor analysis tells us, and as Kepler has shown.

In connection with the point (*b*) it should be recalled that the gravitational constant G is a tensor, and that as stated above, tensor's matrices, anyhow in many instances, follow a harmonic law. It was then concluded that gravity must be a harmonic phenomenon. The works of Kepler confirmed this supposition in a striking manner.

From the analysis of formula (1) and the results given by Kepler it appeared that this harmonic phenomenon must be of a mechanical nature. This fitted well with the known fact, that behind all the mechanical side of physics, as Eddington rightly pointed out, there is one *and only one* law and *this is gravity*. The c.g.s. dimensional measurements are based on this law (17). Please remember that inertia and gravity according to the relativity theory (equivalence principle), are identical phenomena. This is the corner stone of relativity. Hence inertial vibration must have a gravitational origin and nature. It should also be accompanied by electromagnetic phenomena, thanks to the Lorentz transformation, that is, to the change of the electromagnetic mass with velocity. When this is variable, the electromagnetic component should vary accordingly. Further, the above harmonical consideration demanded a wave solution of gravitational phenomena, as the very concept of harmonics is connected essentially with wave motion.

Before we proceed further it would be useful to mention here that every wave is fundamentally a rotative motion. If the rotation is at right angles to the direction of motion, such wave is called a transverse wave, as for instance light is (according to the second theory of Fresnel and others), but when the rotation is parallel to the direction of motion of the wave, it is called a longitudinal wave. These definitions should be remembered (18).

Observing the motions of heavenly bodies, there is one striking fact to be noticed. These motions are *always periodic* and have *a mechanical nature*. Newton rightly called it "mechanics of heaven." It can be conceived as an inertial motion (vibration) on an astronomic scale. Exactly the same periodicity of mechanical and inertial motion appears in the world of atoms and molecules. Actually, we know *that every body freely suspended in space is from necessity subject to these periodic motions*. Hence follows the theorem of mutual co-dependence of motions of a mechanical nature, of bodies freely suspended in space. It is a mechanical and gravitational theorem. Atoms as well as stars can be considered as such bodies.

But all periodic motions are definitely of an undular nature. If we produce an inertial and mechanical periodic motion in our common life, then a mechanical wave is an effect of it and we call it *sound*. It is a longitudinal wave as we know.

This immediately led the writer to the conclusion that gravity must definitely be due to a wave, and a wave of mechanical and inertial character. Such observation fitted well with the former theoretical consideration. Here the factual observation was in perfect agreement with the theoretical conclusions drawn from the former analysis. It was noticed further that such concepts as inertia, mass, weight, acceleration, force, work, power, friction, elasticity, resistance, and, in general, all concepts of mechanics, were formally based on the principles of gravity and *vice versa*.

All considerations of gravity were forcibly reduced to a mechanical basis. The only and indispensable condition for a conception of gravity in its full significance was to regard it not only as a phenomenon connected with the astronomical bodies producing the so-called "pull" of the sun, earth, &c., but also to connect it automatically with inter-atomic and inter-molecular forces, where the electric fields, as we assumed in our introduction, are due to the change of the gravitational potential at the locus owing to the change in direction of motion of the mass (equivalence principle, see note 19).

On the other hand, if one could succeed in suspending gravity, it would entail the suspension of resistance, inertia, cohesion, periodic motion, space, time, electromagnetic forces, friction, weight, acceleration, &c. The most fundamental laws of nature and physics would no longer hold, for instance, the principles

of least action and resistance, the laws of thermodynamics; even entropy would vanish, because the time factor would no longer work. Analysis shows that time and its existence is the function of periodic motion, and when this is cancelled time ceases to exist, and so does its reciprocal, space. An entirely new world appears with the abolition of gravity. It shows how fundamental this law is. It is the root of our whole concept of the physical world.

As all the foundations for gravity are to be found in mechanics and mechanical motions, it is evident that gravity and periodic mechanical motions *are fundamentally linked together*.

In order to verify this conclusion it is advisable to check it from the different angles provided by other branches of physics. This we do in the following pages.

II

Gravity In Micro-Physics

These and other similar considerations which we pass over in silence, in the light of Blackett's first seven formulæ, forced me to look for a further close relationship between micro- and macro-physics. My reasoning was in short approximately as follows: if formula (1) was to hold good in atomic physics, as Blackett showed in his formulæ (2-7), then one would expect that, *vice versa*, some of the fundamental equations of micro-physics, for instance that of wave mechanics, would apply also to macro-physics.

If the analysis of formula (1) were right, then the meaning of G as the function of mass of any size in motion would lead naturally to the concept of the De Broglie mass wave, which is known to be a function of the mass in motion (of every size theoretically) as well. In other words mechanical momentum, that is the expression "mv" would be fundamental alike in the derivation of the nature of gravity, as in the wave-mechanical concept of the De Broglie mass wave. (We shall call it from now onwards, shortly: the "mass wave").

It was also quite natural to conclude that such a common thing in our daily life as sound, where the inertial vibration and mechanical momentum, mv, were essential, should also be a gravitational phenomenon. But before we approach the problem of sound, let us first analyse the wave-mechanical side.

The most fundamental equation of this theory runs thus:

$$\frac{h}{\lambda} = mv \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where h stands for Planck's constant, λ for the wave-length, m for the mass, and v for the mechanical velocity of this mass.

In order to analyse this formula to advantage, it is necessary to recall in most general terms how De Broglie arrived at this equation. He took the known Hamiltonian analogy, and compared the most fundamental law in mechanics (we must remember that behind all the mechanical side of physics stands the law of gravity), the principle of least action first developed by Maupertuis, with one of the fundamental laws of geometrical optics, known under the name of Fermat's principle.

The principle of least action of Maupertuis states, that the path described by a massive particle between two points A_1 and A_2 under the influence of force, " is such that a line integral of the mechanical velocity v has an extreme value." It can be written thus:

$$\int_{A_1}^{A_2} v\,ds = \text{extremum} \quad \ldots\ldots\ldots\ldots \quad (3)$$

where ds stands for an element of path.

From this principle *all the fundamental equations of mechanics* can be deduced, as was shown a long time ago by Euler. This principle holds also in gravity as the relativity theory has shown (1). A simple example is that of the orbits of the planets.

Fermat's principle is analogical and states " that the ray of light in passing from the point A_1 to a point A_2 will describe a path for which *the time of transit* has an extreme value. If u denotes the velocity of light and ds an element of path," then it can be expressed thus:

$$\int_{A_1}^{A_2} \frac{ds}{u} = \text{extremum} \quad \ldots\ldots\ldots\ldots \quad (4)$$

Comparing these two equations it can be seen immediately that v and u (the velocity of the massive particle and the velocity of light) are inversely proportional, and that in equation (3) the extreme value is applied to the distance (space), whereas in the equation (4) the extreme is attributed to time. Time and space are inversely proportional. This is evident also from such a simple equation as $v = s/t$, where v means the velocity of the particle, s distance and t the time taken by the particle when covering the distance s. We can see here that $s = 1/t$. This inverse proportionality of time and space (distance) is fundamental to the conception and explanation of time and space.

Further, as Fermat's principle is connected with light, which is as we know a transverse wave, then equation (4) expresses the transverse wave, whereas equation (3), as is apparent, is linked with *the longitudinal component of the vibration.* Both these waves are inversely proportional, as the equation linking them

shows. (Ratio of λ to mv see below). Also the extreme of time is linked with the transverse wave, and the extreme of distance (space) with the longitudinal one. It is also easily conceived that generally these two vibrations, transverse and longitudinal, are at right angles to each other, and that the kinetic energy side should be connected with equation (3) and the potential with equation (4). A further analysis of the energy side must be dropped here as not essential to the general picture.

De Broglie showed that there is reasonable ground for comparing these two equations in the way given in formula (2). Now as the left hand side of equation (2) can be replaced by the expression $h\nu/c$ where ν is the frequency, it is evident that the λ of the denominator of this side of the equation corresponds to the meaning of c, that is to the electromagnetic component of the wave, as c is the ratio of the electrostatic to the electromagnetic units. This left side of the equation represents also Fermat's Principle connected with the electromagnetic waves. Hence calculating λ in the usual manner thus:

$$\lambda = \frac{h}{mv} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

only the wavelength of the electromagnetic component has been calculated. This calculus made by De Broglie was subsequently experimentally proved by Germer and Davisson, G. P. Thomson, Kikuchi and others. But what these latter proved experimentally was only the electromagnetic component but not the actual mass-wave (see below).

For the writer, to whom the analysis of formula (1) showed that gravity was connected with mechanical motion, the wavelength of the mv expression was the most interesting. Here, and only here, the gravitational side was involved. In other words the mv component and its wavelength was the most important in this case. Unfortunately up till now almost nothing has been done about it in wave-mechanic computations.

Actually, in equation (2), if we attribute to the left-hand side a periodic motion of electromagnetic nature (a transverse wave), we are forced to attribute to the right-hand side also a periodic motion, but this time of a longitudinal character and of mechanical nature.

It is well known that the mv component of equation (2) represents the group velocity, which is different, of course, from the velocity of light, which is here the fundamental wave of Fermat's principle. Therefore the wavelength of this group velocity cannot be identical with the wavelength of the electromagnetic component of light, as given in equation (5). The λ there corresponds to the electromagnetic component. We must therefore attribute to the mv part of equation (2) a different wavelength owing to the different velocity.

This component of the wave will naturally appear on Poynting's vector, and will be the cause of the mechanical pressure produced by light, predicted by Maxwell and demonstrated by Lebedew and Hull in the year of 1900. This particular wavelength is mathematically the result of the multiplication of the electric and magnetic vector's ratio of light *by a tensor*, and not by a scalar (2). This can be seen from formula (1) where $c = \beta . U/P . G^i$ and where G is a tensor!

We can see also from the equation (2) that the mv component is inversely proportional to λ of the left hand side of the equation. It means that the hidden λ of the mv part, that is of the longitudinal mechanical vibration, is inversely proportional to the wavelength of the transverse electromagnetic wave. If one is short the other is long and *vice versa*. The same applies to the velocity and frequency. If then one tends to the limit of c, the other then tends to the limit of 1/c. The first corresponds to the ratio of electrostatic to electromagnetic units, and the other inversely, is the ratio of the electromagnetic to the electrostatic units. But nevertheless both are essentially linked together and are inseparable. It will be shown presently (and later on when we talk about sound) that this longitudinal wave is essentially connected with Coulomb's law, i.e., with electrostatics and magnetostatics.

The quantum theory of fields of Heisenberg and Pauli, developed afterwards by Solomon and Rosenfeld, showed the existence of such a longitudinal wave (an entirely different reasoning being used than in the present paper) which is due to the electrostatic component of light. It produces the so-called longitudinal photon, which is different from the transverse one, where this latter is the result of the electromagnetic component of the light wave. It is a great pity that this longitudinal wave connected with Coulomb's law is always eliminated in quantum and wave-mechanic computations; nobody seems to know what to do with it. I believe that the reason for it is that the electrostatic field is still considered as a purely static one. Therefore the wave is considered to be fictitious. But an electrostatic field is only statistically static, and a pure static field actually does not exist at all, as every mass in the world is in motion relative to other masses and vibrates of itself, e.g., by thermal agitation. (See also Note 4 in Part III).

It must be emphasised that, as has long been known, the energy side of the mass wave is connected with the mechanical velocity of the particle in motion, that is, with the group velocity. Therefore it is connected with the expression mv, which expression stands for the longitudinal wave. Actually it can be shown that the expression for atomic energy $E = mc^2$, where E stands for energy, m for mass and c for the velocity of light, is the function of the longitudinal wave, that is the mv factor of equation

(2). We proceed thus : $h\nu = mc^2$, where ν stands for frequency. This equation holds also for the mass wave, e.g., electron wave.

Now $u = \lambda\nu$ where u is the velocity of the wave and holds for all waves. By combination of these two equations we get

$$\frac{hu}{\lambda} = mc^2. \quad \text{But as} \frac{h}{mv} = \lambda, \text{ therefore :}$$

$$mc^2 = \frac{humv}{h} = umv \quad \ldots\ldots\ldots \quad (6)$$

where h is Planck's constant, u and v velocities connected with the mass, and c the velocity of light. We can see here that umv is the function of mc^2 and *vice versa*, in the sense that one can be reduced to the other. But umv represents the longitudinal wave. Hence the atomic energy is the function of this wave.

From equation (6) follows that :

$$u = \frac{c^2}{v} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (7)$$

where v is the mechanical velocity of the particle of mass. This is the known expression for De Broglie's mass wave, where u is the velocity of the wave, and c the speed of light. As v never reaches the velocity of c (otherwise the mass would become infinite according to relativity) it is apparent that u is faster than light.

What is the nature of this wave ? No answer has been given to this question by any physicist up till now. What is known is that it is not of electromagnetic nature, that it is faster than light, and that it is the other component of the mechanical velocity v. It has been shown also that it has no mass attached to it, as otherwise this latter would be infinite, as mass reaches infinity when acquiring the velocity of light. It is therefore an immaterial wave without even any photonic mass attached to it. It may also be presumed that, as according to relativity time and the velocity of light are identical, this wave is faster than time. Hence it is outside time and therefore also outside space. (Such a solution is not impossible. but the writer believes that the problem should be posed in a slightly different way, but this is not the subject of the present lecture).

As $mc^2 = h\nu$, where ν stands for frequency, therefore combining this equation with (6) we get:

$$u = \frac{mc^2}{mv} = \frac{h\nu}{mv} \quad \ldots\ldots\ldots \quad (8)$$

from which it is concluded that u is inversely proportional to the mechanical velocity of the massive particle, as is apparent also from equation (7). I call it the antigravitational wave, as a counter-component of the mechanical velocity v. The reasoning is based on the Newtonian principle of action and reaction. As

this paper deals with the gravitational wave only, this problem of the anti-gravitational wave is not dealt with here.

From equation (6) it is seen that the longitudinal wave, which is connected with the expression mv and is linked up with gravitational and antigravitational phenomena, has as components a double wave corresponding to the velocities v and u. One of these components has a velocity smaller than light, the mechanical velocity of the particle, and the other component is faster than light (3). Both are the result of group phenomena. Lord Rayleigh showed a long time ago that in group velocities one of them is less and the other greater than the velocity of the fundamental wave. Here the fundamental velocity is that of light, c (4). As both components of the right hand side of the equation (6) are obviously of longitudinal nature (umv being reckoned along the path) it results therefore that mc^2 is really the function of the longitudinal wave. The way of splitting the atom, shown by Lord Rutherford, by electrical particles, is not the only and, fortunately perhaps, the easiest way of doing so. No more will be said about it.

Considering in particular the mass wave, it is to be noted that it:

(1) is of an unknown nature,
(2) is associated with the mass in motion (mv component),
(3) is faster than light and therefore than time (u component,
(4) must depend on one of the fundamental laws of nature,
(5) has a longitudinal character,
(6) is a wave.

On the other hand from the analysis of formula (1) it appeared that gravity was essentially connected with the expression mv. It was noted then that gravity:

(1) is of an unknown nature,
(2) is associated with every mass in motion (mv component),
(3) acts *in instanti*, therefore faster than time (if c = velocity of time),
(4) is a fundamental law of nature,
(5) has a longitudinal character,
(6) is a wave.

These and other similar analogies were so striking, that it was natural to try to find a mathematical link between the fundmental formula for gravitation and one of the fundamental equations of de Broglie's mass wave. The whole argument on the mathematical side is far beyond the scope of this present lecture. We may say only that the fundamental formula, $G = c^2 \left(\frac{P}{U}\right)^2 \beta$ can be reduced to the fundamental formula for De Broglie's mass wave:

$$\lambda = c^2 \frac{h}{W\,v} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (9)$$

where h is Planck's constant, v the mechanical velocity of the particle and $W = mc^2 = h\nu$, and is a constant of energy. This formula is derived from the equations:

$$\lambda = \frac{h}{p} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (9a)$$

where p is the quantity of motion, and:

$$|p| = \frac{m_0\,v}{\sqrt{1-\beta^2}} = \frac{W\,v}{c^2} \quad \ldots\ldots \quad (9b)$$

where m_0 is the rest mass of the particle, and β stands for v/c, the mechanical and light velocities.

Owing to the small velocity of the moving mass in comparison with the velocity of light, the difference between the rest mass m_0 and the moving mass mv can be neglected; as when such small particles as electrons and molecules are being considered, the difference of mass is extremely minute relative to objects of everyday life. But the change of this electromagnetic mass of our earthly globe, for instance, relative to the size of our bodies—we being in this case minute particles in comparison with the mass of the earth—is not negligible at all, even for small velocities, and can be measured.

If we plot these changes of the magnetic mass of the earth against the orbital velocity of the globe $\pm$ the spin velocity (during the day and night) most interesting results appear. We can see here at least one of the reasons for the change in the magnetic field of the earth. The aphelion and perihelion velocities should be taken into consideration as well. It must be remembered that the change in the magnetic mass of the earth is due to the change in the $\Sigma \triangle m$ electromagnetic masses of our globe. Here is the reason for the existence of the magnetic field of the earth generally (see note 3 of Part I). The $\sqrt{1-\beta^2}$ in the formula (9b) is the Lorentz transformation expression. It must be noted, that in this formula (9b), only the numerical value for p is considered for the computation of λ (5).

From the very fact that formulæ (1) and (9) were reducible to one another, it resulted that gravity is a wave; that this wave is the function of the mass in motion, &c., and that the same law controlled atoms and stars (see note 5 about Lorentz transformation). Blackett is right when he states that it is possibly a general law of nature, but he did not take into account the full results of the mechanical side of the problem. This gave also the *clue to the relation linking gravity to electromagnetic phenomena*. Finally, as we know from wave-mechanics, the fundamental equation of the mass wave is strictly connected

with the possible energy states of the atoms and also to Schrödinger's interpretation of the so-called ψ and $\psi\psi^*$ function with the eigenvalues and eigenfunctions. In the light of the above consideration the possible energy states of the atom were due to the gravitational wave.

From the above statement it follows that exactly the same phenomena as in atoms should appear in macrophysics (ψ functions eigenvalues, &c.), where there is no doubt that gravity is acting. Taking Schrödinger's interpretation of electrons as a "charge cloud"—a sort of electric mist—may we be allowed to call it a MICROionised area around the massive nucleus of the atom; then similar shells of a MACROionised state should appear around the earth for instance, or other objects. Further if electricity is due to the change of the gravitational potential at a locus, then at a nodal point in this gravitational wave an electric charge should definitely appear, as such a nodal point is equal to a sudden drop of the gravity potential in relation to the antinode. Also, if such ionised area around the earth corresponded, in analogy to the atom, to a MACROquantised state of our globe, being the function of the gravitational wave (that is the function of the product of the mass in motion and its velocity), then these shells should be the outcome of gravity fluctuations. They should change according to the position of the earth's surface relative to the sun, combined motions due to the earth's spin, and also according to the orbital motions and position of the globe relative to the sun. The phase of the moon should also have some influence.

It can then be realised that the so-called ionospheres of the earth are exactly such shells of (macro) ionised areas, which fluctuate according to the above-mentioned requirements. It is believed that here for the first time a reason for the existence of these ionospheres can be found.

The above-mentioned distances of the shells are related (according to Schrödinger) to eigenvalues and eigenfunction (in atoms). It appears then that the ionospheres are the eigenvalues, &c., of our globe. They correspond to the well-known ψ functions of wave-mechanics, but this time applied in astronomical size. No calculus has yet been done for the numerical data of the distances at which such ionospheres should appear around the earth. From a purely theoretical consideration it is believed that by analogy, as in all compound molecules, many more than the known ionospheres should exist around the earth, but have not yet been discovered.

From atomic physics it is known also that such eigenvalues of the atom are the result of a standing wave around the nucleus, and are the function of the *harmonic oscillator*, the nucleus. ψ is a standing wave. By analogy the ionospheres should also be a result of a standing wave (6). As the energy states of the atom

are given by integral numbers, forming thus the quantised possible states of energy, the ionospheres should be "a sort of" and "correspond to" macroquantised possible states of energy of the massive body of the earth, which thanks to the $\Sigma \Delta m$ vibrations of its elements of mass is again a harmonic oscillator. (See below).

It seems that this supposition and possible solution should indicate the general direction, in which future research should proceed. In any case interesting projects can be seen by a keen research man.

III

Sound as an Electrostatic and Gravitational Phenomenon

To complete the theoretical picture, it remains to say a few words about the mechanical wave of sound, and re-check the above results from that point of view.

From the analysis of formula (1), the observations of motions of heavenly bodies, as well as from the wave mechanics theory, it appeared by cross checking in each of these particular cases, that gravity is due to mechanical phenomena, and that it produces a wave of mechanical nature. *Electrical phenomena result from these mechanical motions and not vice versa*, as was hitherto supposed in physics. Here then appears the essential result of the assumption made at the beginning concerning the nature of electricity.

Looking for such a gravitational wave in our daily life, where mechanical momentum would play the main part, it was natural to draw attention to the phenomenon of sound. This is a mechanical wave; it has a longitudinal nature; concerning the velocity in a material medium it behaves inversely proportional to the velocity of light. (It is known that in passing form one medium to another, light and sound behave inversely. When the velocity of light increases the speed of sound decreases and *vice versa*, other conditions being constant). These observations were in perfect agreement with equation (2) of wave-*mechanics*, where the mv expression represents the inertial mechanical vibration and, as appears from the formula, is inversely proportional in velocity, frequency and wavelength, to the λ of the left term (h/λ) which stands for the electromagnetic component, i.e., light. By the word "sound," of course, is understood all mechanical and inertial vibration of a wave nature, as for instance ultra and supra-sounds, or infra and sub-sounds. (1).

For a very long time the present writer has seriously suspected that the very nature of the sonic wave was still an unknown factor. One of the problems was, for example: if sound is a mechanical phenomenon, produced by periodic inertial vibration

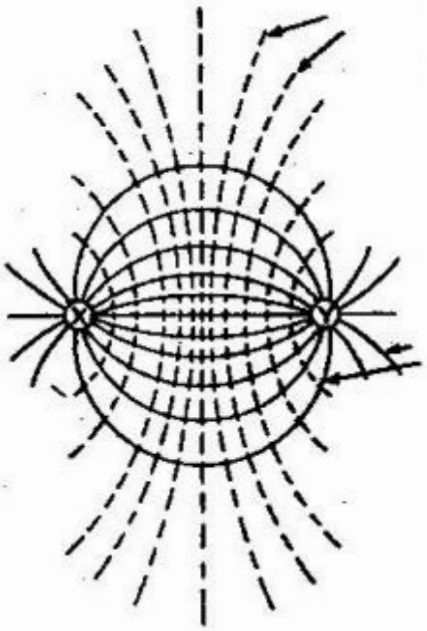
of molecules, then atoms with their periodic mechanical vibration should produce a high ultra or a supra sonic wave. On the other hand, a sound wave of astronomical size, of motions of stars and planets, produced by a sudden mechanical impulse and polarised in a certain direction, could be perfectly well imagined. A big infra-sonic wave of astronomical greatness in the Kepler sense, would naturally cause colossal gravitational disturbances (2). This immediately pointed to the conclusion, that " sound " must be a gravitational physical fact. Kepler's tables confirmed this supposition.

There was no doubt that the mv factor or say momentum, played the essential part as well in the gravitational phenomena of stars and planets as in the inertial vibration of molecules of a sonic beam. The same should be applied to atoms or subatomic particles. Finally, according to wave-mechanics and modern theories of light, the same mv expression was present in the light wave. Such considerations *immediately showed the possibility of finding a unifying factor for the whole of physics, linking astronomy, atomic physics as well as waves of sound and light into one.*

Such alternatives forced the present writer to investigate more closely the very nature of sound, and to attempt to find the actual link between this purely—as it was believed—mechanical and inertial beam of vibrations and electromagnetic phenomena. As the whole of the mechanical part of physics grows from the law of gravity, as correctly pointed out by Eddington, and as also according to relativity, inertia and gravity are interchangeable (3), the inertial and mechanical vibration of sonic waves should also be a genuine gravitational fact on a microphysical scale.

Were there any electrical forces in a sonic wave? (From the equation $h/\lambda = mv$ these forces appear as inversely proportional). It has long been known from the Heisenberg and Pauli Quantum Theory of Fields that the longitudinal wave of light (the longitudinal component) and the longitudinal photon, were essentially connected with electrostatics, that is with Coulomb's law. From the former consideration it was known to the present writer that every longitudinal wave was due to the mv expression. Hence wherever this factor was present in a wave, it followed from the Quantum Theory of Fields that Coulomb's law and electrostatics should play a part in it. From a deeper inspection of these possible connections, it appeared also that in a sound wave electrostatics must be of vital importance. Diagrams A and B on page 121 draw attention to this. In A the continuous dark lines represent the electric lines of the field, whereas the dotted ones symbolise the equipotential surfaces or the magnetic lines, when the points x and y represent conductors, in which the electric current flows in opposite directions, away and

A



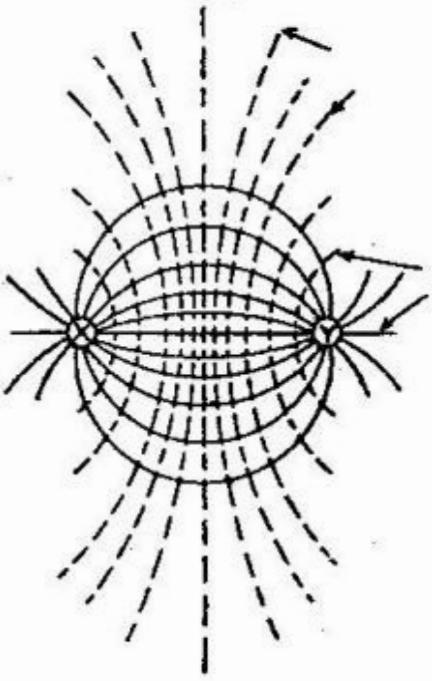
Equipotential or magnetic lines

X and Y are two conductors with an electric current going away from the observer at X and towards him at Y.

Electric lines

It can be seen that the diagrams are reciprocals. If B is an interference pattern of two mechanical waves, then A should have a wave attached (longitudinal wave). It agrees well with the equation $h/\lambda = mv$, where one is the reciprocal of the other, i.e., mv = reciprocal of the electromagnetic waves of h/λ of Fermat's principle.

B



Nodal points of the mechanical wave

X and Y are two sources of a sound wave.

Interference pattern

(After W. E. Weber, *Die Wellen Lehre auf Experimente Gegründet*, Leipzig, 1825).

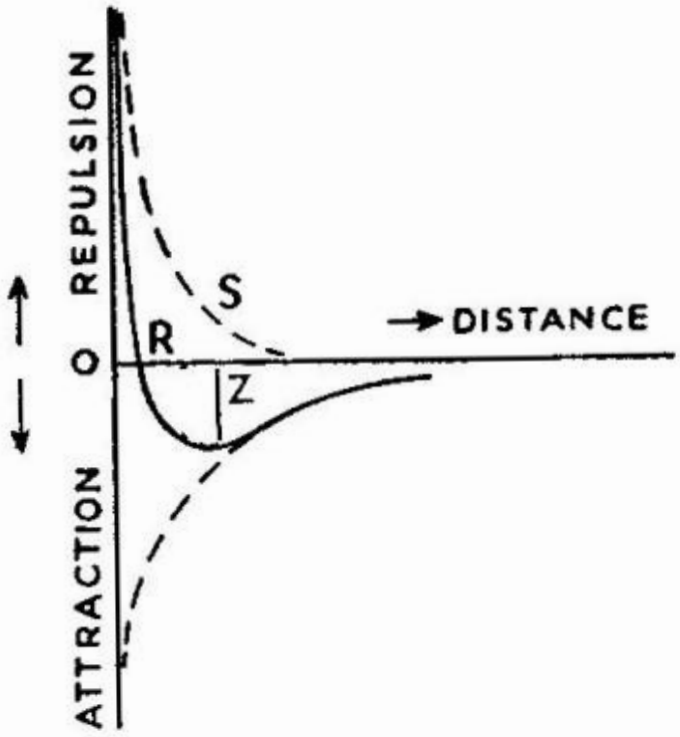
toward the observer. In B can be seen the interference pattern of two sonic waves emitted from the points x and y. It is natural to suppose that if diagram B represents the interference of two waves producing a standing interference pattern, the same could be assumed in the case of diagram A. A purely theoretical analysis, proving the correctness of such an assumption is given in note (4) of this Part.

It is well known from molecular physics that thanks to the forces of "attraction" and "repulsion" existing between molecules, there is no immediate mechanical collision between them. The curve shown here, called the attraction-repulsion curve, demonstrates graphically the distribution of these forces. It follows

that if there is no mechanical collision between the molecules in any sonic wave, the translation energy of this wave must necessarily be transferred from one molecule to another *only and exclusively* by the electrical field existing around the molecules, which are subject to Coulomb's law (they are electrostatic and magnetostatic fields) and are incidentally identical with the gravity fields, according to our assumption and previous arguments. Hence *from necessity a sound wave must be a gravitational phenomenon and electric forces must play a part in it.* There is no escape from this conclusion.

A water-tight proof that every mechanical stress and strain is essentially and inseparably connected with electric phenomena (current) has been supplied by J. C. Bose's experiments beautifully described in his numerous works. These experiments were conducted mostly with plants and metals. An excellent experiment concerning sonic vibration (longitudinal) described in his *Comparative Electrophysiology* (p. 6, 1907), proves beyond doubt the correctness of the previous conclusion, that the sonic beam and electric coulomb forces are inseparably linked together(5).

It becomes quite clear that because of a periodic change of pressure between the nodes and antinodes of the sonic wave, a



Attraction-Repulsion curve

S—repulsion curve

O R—distance apart at equilibrium

Z—theoretical breaking stress

(See E. Grimsell, *A Textbook of Physics*, Vol. 5, 401, Blackie, London, 1945).

stress-strain relation will exist there obeying Hook's law and producing a sort of "piezoelectric" effect (6). As in several mediums the pressure of the longitudinal wave reaches very high values, the electric charge in the nodes, where the pressure is highest, should reach considerable values as well. It is simply because Coulomb's law, ruling the potential gradient of the electric field of the molecules, is vitally active there. The ratio of e/r, where e is the electric charge and r the radius, will accordingly grow considerably in the nodes in comparison with the antinodes. Such electric fields will immediately change even the electrically neutral molecules into dipoles. It follows that whereas in the nodal points we shall have the maximum of the voltage pressure V_{max} in the antinodes, where the velocity of the particle reaches its maximum we shall have the I_{max} (I denoting the electric current). Thus around the antinodes will appear the magnetic field, thanks to the motion of the charges. Hence Coulomb's law, concerned alike with electrostatic and magnetostatic phenomena is of vital importance in any sound wave (7). (See also the graph in note 5 of Part II).

Owing to the periodic change of pressure and velocity of molecules common to every longitudinal wave, there must also exist a periodic change of the electric fields of these molecules. Hence a faint electromagnetic wave must necessarily be transmitted by any sonic wave. This reasoning can be reinforced by applying the Lorentz transformation principle. Owing to the change in motion the magnetic and electric mass will grow or diminish accordingly. Because of low velocities the change of electromagnetic mass in an individual molecule will be negligible. But the sum of the changes of mass of all the molecules will not be negligible relative to any one molecule. Any molecule will therefore become an electrical dipole and, moving in a magnetic field, will acquire a spiral motion (to and fro). (Hence the rotation of the wave). A sort of Hull effect will appear also. An experimental proof of the electric part is comparatively easy. A simple ionisation counter of sufficient sensitiveness, introduced at the nodal points of a standing wave of sound will show the correctness of the above reasoning.

Assuming that electricity is a sudden drop or change of the gravity potential at the locus, it is then evident that at the nodal point of a longitudinal wave where matter is considerably compressed, the gravity potential, which grows with, say, the "amount of matter" or mass in its vicinity, would be different from that at the antinodes. We have thus arrived by an analysis of the sound wave through a reverse process, at the same conclusion we came to when discussing the fundamental equation of wave-mechanics (equation 2), i.e., that, in both cases, mechanical inertial vibration and electromagnetic waves are inseparably connected together, and are both linked up with gravity forces.

A very interesting analysis on theoretical and mathematical grounds concerning the electrostatic field and its link with sonic vibration has been given by Professor T. J. J. See, in his voluminous work *Wave Theory*. He finally compares static electricity to a singing bell. Just as a bell sounds for a certain time after being struck, in the same way—he says—does a condenser retain for a time its electric charge (8). No experimental proof is given, and the reasons stated here were apparently not known to him.

On these grounds, the humming of transformers; the piezo-electric effect (defined as *electric polarisation produced by mechanical strain and proportional to it*) (9); the photoelectric effect produced by ultra-sounds (discovered first by Trillat and Marinesco, and concerned specially with the nodal points of the wave); friction which, as Tyndal rightly pointed out, is always periodic, for any rubbed material must always react with a strong periodic vibration (sound), and friction is in every case accompanied by an electric charge; all these and similar phenomena are easily understandable in the light of the foregoing reasoning (10).

Finally one interesting example should perhaps be brought forward here concerning the simultaneous existence of the electrostatic field and the sonic wave. It is known that all matter, and especially living organisms including the human body, is surrounded by a faint electrostatic field. On the other hand Robert Hooke (11) has already pointed out that all, especially human organisms, owing to various frictions caused by flow of blood, muscular movements, heart beat, &c., must be surrounded by a very slight sonic hum, as is any factory. Lately H. Kayser showed in a beautiful argument how all plants grow according to musical relations where the logarithmic ratio is essential (12). He proves by harmonic computations and by measurements that beneath the shape of every plant, musical chords and melodies can be underwritten. Interesting remarks are also made concerning the integral numbers appearing always in sonic relations, leading to a sort of macro-quanta. The well-known Fechner-Weber's *Psychophysical law*, to which he often refers, is based on the same theoretical grounds. The comparison of these three phenomena, electrostatics, the sonic field surrounding the human body and other organisms, and growth according to a musical relationship, leads to fascinating conclusions concerning the mystery of life. To realise this in full, it is necessary to study the whole argument and to see Kayser's tables and computations.

We have discussed here a very few points concerning the relation of sound to Coulomb's law. All experimental evidence is here omitted through lack of time, but it is believed that enough has been given to merit the matter being given further serious consideration.

IV

The Gravitational Wave and Medical Problems

After this short theoretical and philosophical discussion about these fundamental laws of nature, we now pass to the human being and the medical problems involved (1). I am forced here again to give only a very summary account.

From atomic physics, it is known that the shells of the charge cloud, or orbits in which the electrons revolve, correspond to respective quantised states of electrons, and therefore to the atom itself, as these shells are the function of the nuclear harmonic oscillator. The smaller the distance from the respective shell to the nucleus, the lower the corresponding state of energy. The atom is in the highest state of energy when it is ionised, that is when the lost electron is supposed to be at infinity. Only certain energy states are permissible, and therefore they are called " quantised energy states." (2). Integral numbers represent their value. An electron can pass from one state to another only by sudden jumps, emitting or absorbing respective quanta of energy. These quanta correspond to the difference between the two states which are involved in the passage of the electron. This is well known.

Transposing these data to macrophysics (we are authorised to do so by our former conclusions), and in particular to humans, it has been found long since by radiesthetic methods, and then by electronic apparatus—in the first place by Mr. Cecil Maby with an ionisation counter—that around objects (now it is possible to say all objects), and in particular around the human body, such ionised areas do really exist.

According to some experimental results, the main ionised area related to perfect health exists at a distance of about 60-80 cm. from the body. This distance varies to a certain extent, as experiments seem to show, according to the time of day, and the period of the year. This distance denoting a state of perfect health is familiar to all radiesthetists, and has been confirmed by, as far as I know, Mr. J. Cecil Maby's ionisation apparatus as well as by Mr. F. J. Billington's instrument, consisting of a detector, valve amplifier and cathode-ray tube oscilloscope. Dr. and Mme. Maury, of Paris, are known to be the first (1946) to make such an apparatus with the aid of a radar specialist, Mr. De Gouvenin, E.P.C.* A similar apparatus of his own construction was in use by the writer himself from late 1947, but has been discarded as it draws too much energy from the human body. It was based on ultrasonic detection. Dr. M. Ash, London, has made with his sensitive hands a very interesting chart of distances referring to health, bacteria and diseases.

* Ecole Politechnique Centrale.

Its validity in the latter capacity remains to be proved by electronic means. It can be presumed that as other distances predicted by radiesthetists have already been proved electronically, these too will be found correct.

The main distance of 60-80 cm. approximately in respect to health may be called the zero point of reference. In the present hypothesis, this should correspond to the proper or eigen-value of the physically balanced state of the human body. The physical part is here emphasised, as there are shells which correspond to the mental state (15 cm. about) and to the emotional state (48 cm. about) around the human body. There is something peculiar about these two latter distances. On many occasions I could not get them by electronic detection at all. On others they were perfectly traceable on the cathode ray oscilloscope, but the instrument reacted only after a lapse of several seconds or even minutes following the change of emotional or mental state. No explanation for this has been found.

Whatever may be said about these peculiar distances, there is no doubt now that they do really exist, and according to the lecturer's hypothesis, they are the function of the mechanical vibrations of the elements of the body itself. If the body or a particular organ has " i " particles, and each of them has its own ψ function, then the resultant function corresponds to $\sum_i \psi_i v_i$

where v is a constant corresponding to a respective group velocity wave.

In the case of perfect balance in the vibrations of the human cells, that is when they are in biological resonance, the nodal point or shell of the resultant gravitational wave in the ionised area exists at the right distance. The group velocity v_i is constant. By resonance we mean that the capacitive side of the human cell is equal to the inductive side ($\omega L = 1/\omega C$, after Lakhovsky) (3). It can be seen that the balance of the body is reduced here to the electrical concept of resonance. Omega stands here for the phase velocity of the group wave. Through lack of balance some of the components of the group will change, which will influence the velocity of the group, and hence the distance will change. The thing is reduced to the ratio f/l, where f stands for phase velocity and l the linear velocity of the group, in other words to the ratio of the frequency to the velocity of the group.

The very moment that an organ is out of balance the whole of the body will be affected and its energy state lowered. Experience shows that the respective shell is found at a shorter distance from the body in relation to the perfect health distance. The strange thing is that the changes in these distances appear always in sudden jumps, anyway as far as my experience goes. The picture is exactly like the changes in the energy states of

atoms. It seems as if only certain distances were allowed. Therefore I call them the macroquantised energy states of the human body. (4).

All this fits well with the former theoretical discussion. You may perhaps gather that these distances are connected somehow with the potential gradient of the human body. Actually it is something closely analogous. Just as around the earth and above the ground the equipotential surfaces of the potential gradient follow the undulations of the ground up to about 1,000 yards, but above this height start to level up, so can the same phenomenon be observed with these shells surrounding the human body, especially at short distances of a few inches. So far the shells follow the curves of the body, but beyond one or two feet hardly any shape can be traced.

When one of the organs is out of balance there is a definite change in the distances. Usually there is an increase of the local distance, accompanied by a lowering of the general condition. The fact is mathematically understandable for, when a part of the first component of the particular group wave changes, the velocity becomes greater, and therefore the distance increases. I have not yet got a precise mathematical explanation for the other phenomenon, which concerns the lowering of the general energy state.

By a convenient electronic apparatus, it is possible not only to measure the general state of energy of the body, but also to localise the root of the trouble by noting the extent of a sudden increase of distance. This, of course, is a subject for future development (5).

Thus by measuring the distances of these quantised states of energy, after a certain amount of practice and experimental research a far more exact diagnosis (also a prediagnosis, i.e., when the symptoms are not yet pronounced) should be given automatically by an electronic apparatus. A partial solution has been made by Mr. F. J. Billington, who has constructed an instrument which shows nodal points on an oscillocsope.

It must be mentioned here that between the body and the 60-80 cm. shells, there exist a great number of similar shells, as can be shown mathematically. The total picture *seems* to correspond, strangely enough, to a hydrogen light spectrum band, with its Lymann, Balmer, Paschen, Brackett and Pfund series. In each of these series around the human body, first sharp particular distances are noticed (electronically detected) but further away these lines appear at smaller and smaller intervals and finally a large band of lines can be noticed. After this large band a new series begins. They are not harmonic of the first band, in the sense we usually call harmonic. The distances are different. As has been said, the whole *seems* to correspond to a hydrogen light spectrum. No definite state-

ment can be made about it yet. It would be interesting to know whether some kind of Rydberg constant holds here as well.

Although the lecturer is not a medical doctor, from the purely physical point of view it is believed that future treatment should consist in reversing the process. After measuring the wavelength and waveform of the damaging factor, a wave of the same kind should be introduced into the body. This will produce a standing wave with this damaging factor and nullify its effect. During this time the organ will be able to reconstruct itself to such an extent that when the instrumentally transmitted wave is cut off the organism will be strong enough to fight for itself.

What has been here said has been told only in a very short and simple way. The most simple cases have been discussed, in order to make the general picture as clear as possible. Many theoretical and experimental proofs have been omitted.

Finally it may be perhaps useful to recapitulate the main points covered.

At the start it was shown that gravity and the mechanical motions of masses are essentially linked together resulting in a harmonic phenomenon of undulatory nature. Then, through the analysis of the wave-mechanical problems, the link between micro- and macro-physics was outlined. Through the discussion of the very nature of the inertial vibration of the sonic beam, the relation between the gravitational wave and electromagnetic forces was shown, confirming the conclusion already deduced from the wave mechanical analysis. Finally all this theoretical survey has been applied to practical medical problems where, it seems, a new base for this science has been found.

In spite of all these extremely interesting problems which appear before us, actually perhaps the most important is the appearance of the antigravitational phenomena arising from the analysis of the gravitational wave. It is believed that it opens an entirely new chapter of human knowledge.

The future will tell us whether the general lines of the above hypothesis are correct.

NOTES

I

1.—Blackett, P. M. S.: "The Magnetic Field of Massive Rotating Bodies," *Nature*, May 17th, 1947, Vol. 159, 658.

2.—Quoted from p. 658 of the above mentioned article.

3.—" It is considered . . . that the above equation must be taken seriously as a possible general law of Nature for all massive rotating bodies . . ." *loc. cit.* p. 658 in the Summary. It is a great pity

that Blackett did not take into account in his extremely interesting argument that G is a tensor (see further our text), and that this is the function of the sum of the mechanical vibrations of all the elements of mass ($\triangle$ m) of the respective rotating body ($\sum_{i}^{n} \triangle$ m). As a result a stress strain relation must appear in the spaces (assumption 2 of the introductory part) between the respective vibrating particles. It will obey Hook's law. From further tensorial analysis must follow immediately the necessity of the spin of the body (resulting spinor). If Table VI represents a section through a spherical body at right angles to the axis of rotation (the axis is normal to the plane of the paper) then the spiral and radial lines represent the distribution of the forces. As this spiral distribution moves in a clockwise direction, on the principle of reaction, the whole body gets an opposite spin. (As we can not give here the full proof for it the reader may disregard this statement). Dirac writes correctly: "The spin angular momentum of a particle should be pictured as due to some internal motion of the particle, so that it is associated with different degrees of freedom from those describing the motion of the particle as a whole, and hence the dynamical variables that describe the spin must commute with x, y, z, p_x, p_y and p_z." (P. M. A. Dirac, *The Principles of Quantum Mechanics*, 142-3, 3rd edition, Clarendon Press, 1947). From this spin motion the orbital rotation results, as long as the body is freely suspended in space. On this supposition the magnetic field (say of the earth), can *only* be due to the same $\sum_{i}^{n} \triangle$ m vibrations of the elements of mass of the respective body (see further text and notes, especially those concerning the Lorentz transformation and note 4 of Part III). The full argument is not given here.

4.—The reader is asked to recall assumption (1) from the introduction. It may be objected that there is no justification on the experimental side for such an assumption. On the contrary "The theory of magnetism familiarises us with an inverse fourth power between magnets at distances great compared with their length." (W. Sutherland, "The Electric Origin of Molecular Attraction," *Philosophical Magazine*, Ser. 6, vol. IV, 625, Dec., 1902. See further in his text). It has been pointed out several times that this relation shows ". . . that gravitation can not reside in electrically bound ether, since the efficacy of the gravitative force is related to the inverse *square* of the distance." (See Frank W. Very, "The Luminiferous Ether," *Occasional Scientific Papers of the Westwood Astrophysical Observatory No. 2*, 8, Boston, 1919). From formula (1) it is

seen that G is related to a square power of P/U, therefore a more close analysis will show that the argument of the 2nd and 4th power discrepancy falls. Concerning the experimental side, starting from M. Faraday it is true that strictly speaking no such relation between gravity and electriticy could be found. But in assumption 1, as here understood, the relation between electricity and gravitational potential has complete anology with the FitzGerald's law of contraction, where there is no way of detecting the contraction along the path of motion. This analogy is responsible for the fact that it has never been possible experimentally to detect that gravity and electricity are linked together. Concerning the motion of mass and gravity, this is the description of the principle of equivalence in *Ency. Britannica*, 1947 edition, vol. 19, 95, article " Relativity " : " A gravitational field of force at any point of space is in every way equivalent to an artificial field of force resulting from acceleration, so that no experiment can possibly distinguish between them." And further : " Guided by these two principles—relativity and equivalence—Einstein was led to the view that all gravitational ' fields of force ' must be illusions. The apparent ' force ' arises solely from acceleration and there is no other kind of gravitational force at all. In this statement, as in the statement of the principle of equivalence above, the word acceleration is used in its widest sense. Acceleration results not only from change in the amount of a velocity, but from a change in its direction also." See also the chapter on " Force and Gravitation," *loc. cit.*, 100.

5.—Concerning the difficulties of the motion of the moon around the earth it is worth while to note that it revolves generally speaking in accordance with Steiner's theorem !

6.—It is not essential that we should here accept the space concept of relativity—geometric properties of space obeying Weyl's and Eddington's geometry—or some other representation of space, such as space filled with ether. Both interpretations can be reduced to the tendency of space to uniform distribution (assumption 2), as gravitational potential does. Actually space and gravity are two aspects of the same thing (compare note 4 above, (See also H. Weyl : " Gravitation und Electricität," *Sitzungsberichte Berliner Academie*, 465 (1918) ; A. S. Eddington : " A Generalisation of Weyl's Theory of the Electromagnetic and Gravitational Fields," *Proc. Roy. Soc.*, A. vol. lxxxxix (1921) ; A. Einstein : " Einheitliche Feldtheorie von Gravitation und Electricität," *Sitzungberichte Berliner Academie*, 414 (1925). Such properties of space as in assumption 2 are the cause of the mutual codependence of motions of bodies freely suspended in space. This should be understood not in the Newtonian way of presenting gravity as a " pull," but in accordance with the relativity theory and with the space distribution and the stress-strain relation produced through the tendency to uniformity.

7.—See A. Einstein: *The Meaning of Relativity*, 55-56 and 85-86, Methuen & Co., London (1950), as well as his new theory, pp. 127 ssq., together with his tensorial solution. For the distinction between these masses *in this particular problem* I am partly indebted to Mr. J. Dreszer, M.Sc.

8.—H. A. Lorentz tried to prove that this mass is due to the magnetic field. Against his hypothesis all sorts of difficulties have been proposed. The present writer believes that in the light of the new formulation of gravity and its nature in this lecture, these difficulties may vanish.

9.—Actually U should be split into two components, the spin moment and the orbital velocity momentum where the latter is the function of the former, in the theorem of mutual codependence of motions of bodies freely suspended in space, where tensorial relations exist between them. Further, from the tensor analysis it results that, in its turn, the spin is the function of $\sum_{i}^{n} \triangle m$ periodic motions (where $\triangle m$ stands for the element of mass), of the respective massive body freely suspended in space. As the elements of mass, say of the earth, are in constant vibration (see Dirac's text quoted above in note 3), e.g., brownian, thermal, tidal, &c., these motions necessarily produce a resultant tensor and a stress-strain relation in the mass of the earth itself (see also note 10 of Part III). By multiplication of the affinor a tangential force results in such a way that a body freely suspended in space will receive a turning moment producing a spin of the mass (spinor). In their turn the spinor " forces " will produce a periodic orbital motion, e.g., planets around the sun (expansor). They follow Maupertuis' principle of least action in choosing the extremum. The well-known Magnus Effect is another example. Re expansor see P. A. M. Dirac, " Developments in Quantum Electrodynamics; Com. of *The Dublin Institute of Advanced Studies*, A. No. 3, p. 21, Dublin (1946). It is remarkable that all these quantities, tensors, spinors and expansors, are to a great extent related to the longitudinal wave. (Compare note 5 in Part II and the graph there given and also note 2 of the same Part in relation to the expansor. Also Dirac's *Developments*, p. 23, formulas 4, 11; 4, 12; &c.). Usually in quantum and wave-mechanic discussions, the utmost effort is made to eliminate the longitudinal wave, as " some sort of unknown quantity," *causing much trouble*. See, for example, P. A. M. Dirac's *Developments*, &c., pp.8,13, 14, &c.; also W. Heitler: *The Quantum Theory of Radiation*, 2nd edition, pp. 48 ssq., O.U.P. (1947). The real reason of this " trouble " is that the longitudinal wave is strictly connected with Coulomb's law, i.e., electrostatics (and magnetostatics), where this field is still considered as an entirely static one. Therefore no real physical meaning seems to be attached to this wave.

Actually it is regarded as a " fictitious " wave. Now, the electrostatic field is not in the strict sense a static one. It is only statistically static (see note 4 of Part III). It has a " standing " wave attached to it, with a progressive group wave (very slow, see further text where the velocity limit of the group wave is shown to be 1/c). This seems to be a contradiction. The reason is that the standing wave is only apparently standing ! Returning once again to Dirac's expansor it is worth while to note that it is related to " infinite but enumerable components," where Fourier analysis is used. See Dirac *op. cit.*, pp. 21 ssq., and formulæ 4, 1 ; &c.

10.—From the above formula of Schuster it can also be seen immediately that the electromagnetic constant c is strictly connected with the mechanical motions of mass. If we eliminate c to the left hand side of Schuster's formula it is seen that c is due to the ratio of U/P multiplied by G^1, that is the ratio *between the mechanical motions of two kind of masses*, multiplied by a square root of a value of a tensor G—which is a tensor of a symmetrical nature in the case of light—(see p. 114 of the text where the longitudinal wave is the result of tensorial multiplication of the magnetic and electric vectors of light). It looks as if the electric and magnetic vectors of the light wave would correspond to U and P. This interesting point should be verified. Such solution of the electromagnetic constant c is in perfect accordance with modern quantum and wave-mechanics theories of light. It is also related to the Newtonian concept of light (theory of accesses or emission), and comprises as well Maxwell's solution of the electromagnetic wave. Assuming for this problem as for that of gravity that all electric phenomena are due to a sudden drop or change of gravity potential at the locus or area, as well as the effect of mass in motion, it follows that the electromagnetic wave-function of light is due to the mechanical motion of the mass of the photon, or the mass of the wave packet as a group phenomenon. No difficulty arises here, thanks to the assumption that every mass is due to the distortion of space and, so viewing the photon first as a mass and then relating it to electromagnetic forces, such distortion of space progresses with the speed of light, and thanks to this motion the electromagnetic fields result as the function of it in the transverse direction, but the mv factor of light vibrates along Poynting's vector thus causing alternating fields. (Compare P. A. M. Dirac " Developments . . . " p. 23). Just as Copernicus in his theory set the problem at 180° out of phase with the accepted theory concerning the motion of the earth and sun, thus in the present hypothesis the problem of light, electricity and gravity is, speaking analogically, turned in relation to existing theories. The above reasoning shows that light in itself is a gravitational phenomenon, where the mv factor—in the general sense of this expression—is essential to

the concept of gravity and light. We shall see later on, from the analysis of the fundamental equation of wave-mechanics ($h/\lambda = mv$) that the right hand side of this equation can be regarded as a link between these phenomena and gravity.

Such interpretation of the constant c is permissible on the basis of formula (1) where this holds for micro-physical phenomena as well. This has been shown to be the case by Blackett in formulæ 2-7 of his paper quoted above, where electrons and magnetons are involved.

11.—See note 7.

12.—It is impossible to give here a more detailed picture of the connection between the tensor's matrices and those used in harmonic computations. Anyone willing to study this matter should refer first to Kayser's works, in particular to *Grundriss eines Systemes der Harmonikalen Wertformen*, Occidentalverlag, Zurich (1946) and *Der Hörende Mensch*, Lambert Schneider Verlag, Berlin (1932), also to *Handbuch der Harmonik*, Occident Verlag (1950) Zurich, where *per longum* harmonic laws and possible computations are shown. Group relations are essential.

The present writer found that Kayser's harmonic tables can in many cases be transferred to tensor matrices. Some hints are given below how to start this particular work in the most simple cases. Let us take a simple square matrix such as :—

Table A

$$\Phi = \begin{bmatrix} k_{xx} & k_{xy} & k_{xz} \\ k_{yx} & k_{yy} & k_{yz} \\ k_{zx} & k_{zy} & k_{zz} \end{bmatrix}$$

where Φ is the affinor. If we put the subscripts 1, 2, 3, instead of x, y, z, as is often done (such indices can be multiplied to n), and we realise that xy, xz, &c., give us the respective ratios between two or n co-ordinates, then the matrix will appear thus :

Table B

$$\Phi = \begin{bmatrix} k_{1/1} & k_{1/2} & k_{1/3} \\ k_{2/1} & k_{2/2} & k_{2/3} \\ k_{3/1} & k_{3/2} & k_{3/3} \end{bmatrix}$$

It is essential to compare such matrices with several arranged by Kayser and to study his way of viewing the problem, in order to see not only the astonishing similarity between tensors and harmonic matrices, but also how greatly computations are simplified. It is of the greatest importance to realise that all harmonic computations are related to group algebra where logarithms are in constant use (see Kayser's *Handbuch*, p. 39 ssq. and his other works). The method entails a very simple calculus for the Fourier series analysis, &c. In all harmonic analysis subscripts are integrals, and can be used for denoting the well quantised states of energy in atomic physics, where the nucleus is a *harmonic* oscillator.

The astonishing fact is that by such computations Kepler obtained the solution for his second and third law.

13.—See H. Kayser: *Der Hörende Mensch, op. cit.*, p.185.

14.—See, e.g., B. L. van der Waerden: *Modern Algebra*, 2nd edit., F. Ungar, New York (1943); also A. Speiser: *Gruppentheorie*, 2nd edit., Berlin (1927).

15. J. Cecil Maby: "Fundamental Ray Analysis," *Radio-Perception*, Vol. VIII, 64 (June, 1949), p. 251 ssq. His most interesting results and tables are based on experimental data obtained by ionisation tube connected to a valve amplifier.

16.—Works quoted above.

17.—See A. S. Eddington, *Space, Time and Gravitation*, p. 139-40, Cambridge (1935), ". . . there is only one law of mechanics, the law of gravitation;" p. 140.

18.—It is enough to consult any student's book of physics as, e.g., A. Wood, *Acoustics*, p. 2 ssq., Blackie, London (1947). Still better the voluminous work of Prof. T. J. J. See, *Wave Theory*, Vols. 1-9, ed. Wheldon and Wesley, Nicols Press, Lynn, Mass. (1938-49). For this particular subject see Vol. 1-2.

19.—It means that to reduce all phenomena to electricity, is to reduce all to gravity. To the objection that no experimental proof was ever brought forward to justify such an assumption, apart from the answer given in the former notes, it can be added that starting from the famous experiment of M. Faraday, experimenters, fascinated by electrical forces, presumed automatically that gravity must be due to some kind of electricity. On this assumption the experiment was carried out accordingly, and therefore could never give a result, because the thing simply works the other way round, and can never be detected (principle of equivalence). As M. Faraday says himself when describing his experiment (see his *Experimental Researches in Electricity*, vol. III, 161 ssq., London, 1855, sections 2702-3) that he was looking only for the link between these two physical facts. He never attributed gravity to electrical forces!

II

1.—See, e.g., A. S. Eddington, *op. cit.* 137.

2.—This leads to the further forced conclusion, that light runs along Poynting's vector in a spiral way. The sine appearance is only its projection on the plane parallel to the direction of the wave motion. It should be remembered that a multiplication by tensor, results necessarily in a spin motion (spinor) and an orbital motion (expansor—the present writer thus understands the expansor; a new quantity is yet required, an impansor) for any mass of any size freely suspended in space, when in motion. (See notes above). The reason for a tensor multiplication in the light problem is, that the relation between both vectors of light, electric and magnetic (according to assumption 2 in the introduction of this paper) is a stress-strain relation, which

reduces it to a symmetrical tensor. The formula for the constant c showed the same (see above). As far as it is known to the writer Prof. Ehrenhaft, of Vienna, had already published a paper in 1944, where he points out a spiral progression of a light wave. Unfortunately the paper could not be found by the present writer. Therefore Ehrenhaft's argument cannot be quoted here and is unknown to me. This paper was received with great scepticism by the scientific world at the time. In spite of this, the recent experiments of Prof. Ehrenhaft concerning the spiral motion of fine graphite powder in a vacuum tube, under the influence of a light ray, as well as his known photophoresis, show experimentally the correctness of his supposition.

The quoted tensor multiplication gives the mathematical grounds for his experiments (so it is believed), as well as for the spiral shape of the light wave in the direction of motion. As, in addition, there is a resulting spinor the photon acquires a spin. From the ratio of the spin of the photon to the " orbital velocity " of the photon along the spiral, an explanation for the wave-trains is forthcoming and coherence is given. On this principle the continuity and discontinuity of light can be solved. (This is the subject of a separate paper).

In addition it should be remembered that, thanks to the reduction of Fermat's principle to Maupertuis' principle of least action, the former, being related to geometrical optics, shows that light running on Poynting's vector chooses its extremum along it. Here this extremum must be a path of a spiral along the direction of motion, just as the orbital path of a planet is also the extremum owing to the same tensorial forces of G from formula (1) but acting in a case of a planet on an astronomical scale. From this formula it is easy to see that $c = \beta \frac{U}{P} . G^{i}$, where G as a tensor influences the constant c.

The reader may realise from the text that the mv factor of light is active along Poynting's vector, and therefore follows Maupertuis' principle of the extremum path.

Finally the spiral shape of light progression results also from the transverse nature of the wave, for, by definition, the transversality consists of rotation at right angles to the direction of motion. It is easily seen that such rotation at right angles to the forward motion, must result in a spiral. Thus Ehrenhaft is right in his statement, although he was met with complete scepticism.

The *Comptes Rendus* of the Paris Academy of Science (vol. 196, 1045-7, April 3rd, 1933) contained an interesting report by Abel Desjardine: " Vibration de l'Organisme," in which he describes the spiral nature of all movement in living organisms, the tortion of heart, flow of blood, sap, &c.

3.—This very interesting result as an antigravitational phenomenon does not belong to the subject of the present paper.

4.—As there is no such thing as absolutely monochromatic light, even in the so-called "monochromatic" light, group phenomena must result and all three components of equation (6) will appear there.

5.—See L. De Broglie: "La Nature Ondulatoire de l'Electron," a lecture given at Stockholm at the presentation of the Nobel Prize on December 12th, 1929, printed in *Matière et Lumière*, 181-197, Albin Michel, Paris (1937). In our case see p. 188.

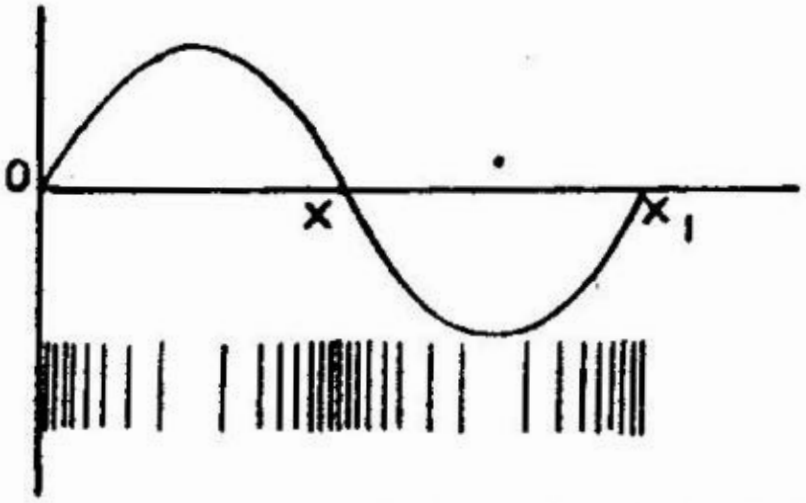
At first sight dimensional objections could be put against the conclusion concerning the reduction of formula (1) to (9). The answer is not a simple one, and requires more space than is available, but some hints are here given. The constant G is described in all textbooks of physics as the astronomical *unit of force* where the numerical values of the dimensions are 6.658×10^{-8} (dyne cm^2/g^2). The numerical values of 6.658 are given with slight difference by different authors, but the dimensions are always the same. It is everywhere called a *force* (see for example E. Grimsehl, *A Textbook of Physics*, Vol. I, Mechanics, 179, Blackie, London, 1946).

Now it is usual in the scientific world to call "force" a unit which corresponds to the dimensions *of a dyne*, i.e., gr. cm/sec^2. Why then is G called a "force"? We should keep to a scientific agreement and call "force" something which always corresponds to one particular set of dimensions, otherwise all concepts are muddled, and one hardly knows where one is. Further a "force" is a vector. But in the equation $P = f m_1 m_2/r^2$ neither is P a vector, being the resultant of oppositely directed "vectors," nor is f a vector. In our particular case G stands for f, and G is a tensor, as is apparent from Einstein computations. There is something definitely wrong in denominating G as a unity of *force*. So long as the concept of a gravitational "pull" in the Newtonian theory was accepted, the concept of "force" for f or G was permissible, but then the dimensions were wrong. Now as in relativity the idea of "pull" has been entirely dismissed, G as a force cannot be maintained at all. We know that the mutual co-dependence of motions of bodies freely suspended in space is due only to the space deformation and not to any kind of "pull." Another problem that arises is the kind of mass we mean by m_1 and m_2; is it the electromagnetic mass or the gravitational mass? To all these problems no answer has been given at all. Again for these very precious remarks I am greatly indebted to Mr. J. Dreszer, M.Sc.

There is yet a lot to be said about it. The problem is whether the actual dimensions of G are right. Now λ of equation (9) refers to the wavelength of the electromagnetic component, the transverse wave and the fundamental for group phenomena

where these are the carriers of energy. It has been said that G is a tensor and results from the stress-strain relation; it is also known that tensors are related to the algebra of groups of linear equations, where a matrix is a symbol of a group. We know further that the longitudinal wave is a group phenomenon, appearing in Poynting's vector and closely related to the amplitude (intensity) of the wave. It is clear that G is connected with this longitudinal wave and with the phenomena of groups. Let us see how G is involved in it.

In the graph below the distribution of mass in a longitudinal wave is shown.



Distribution of mass or disturbed space in a longitudinal wave.

It is seen that the mass is accumulated at the points x and x_1, whereas in between these points the distribution of space is rarified. It is evident, then, that a stress-strain relation will exist between the nodes and the antinodes, and that the gravity constant G will be active between these two masses concentrated at the points x and x_1. It is easily seen from this graph that G must be operating in a longitudinal wave, with which the mv factor is connected. It is also to be noted that G is operating in the half wavelength, which in harmonic computation means that it must be related to the whole wavelength by a square power or root, just what is shown by formula (1) in relation to formula (9). The reader studying Kayser's argument will immediately see the line. We cannot devote more space here to this particular problem, and must refer the reader to the works of H. Kayser.

6.—In this solution the function ψ is not a scalar, but a particular kind of tensor, corresponding to the gravity potential at this locus. As far as the knowledge of the writer goes ψ has up till now been taken as a scalar in wave mechanics. It may be that the latest developments, of which the present writer is not aware, have changed the concept of ψ in this respect.

III

1.—Sub and infra correspond respectively to ultra and supra.

2.—May I take the liberty of mentioning here that the end of the world described in the Bible is of such a nature!

3.—See S. Einstein, *The Meaning of Relativity, loc. cit.* in note (7) of Part I.

4. Let a body m, situated not far from other objects, e.g., in a room, be suddenly charged electrostatically with, say, a plus charge. At that precise moment the lines of the electric field will move with a certain velocity x (at approximately the velocity of light), towards the walls, and will end on a minus charge. On reaching the walls they will induce an additional charge of minus sign, which in its turn will reverse the process. Owing to slow discharge, the process will be maintained for a certain time, and a damping phenomenon will take place. But in addition it must be taken into account that the body m vibrates with its molecular thermal, Brownian or other agitation; and statistically at a certain moment t, 50% of the molecules of the body m will retreat from the direction of the wall and at a moment t_1 will again approach the wall. Owing to the $\sum_{i}^{n} \triangle$ m vibrations of the body, a resultant wave will be produced, and an extremely faint mutual exchange of induction and radiation between these two bodies, the wall and the body m, will take place. This change will be extremely small relative to the size of our bodies, but by no means small relative to the size of the molecules in the surrounding air. This mutual process between the body m and the walls will naturally produce a standing wave. Such reasoning can be applied to all bodies—especially when freely suspended in space, as it is known that all bodies have their own electrostatic field, which, incidentally, according to our assumption, is identical with the gravity field, thanks to the mv factor or $\Sigma \triangle$ m vibration of the body. Thus atoms or stars and planets will have their own standing wave around them, otherwise called ψ. Here is the reason for the radiation of all bodies which was postulated by K. v. Reichenbach. It is evident also that this wave will have a longitudinal nature. Further, such a standing wave will naturally be the function of the mechanical vibration of the body and the walls. The intensity of such standing wave will be the function of the distance of surrounding objects from the body m.

This 50% statistical resultant wave is naturally a group phenomenon, having billions of components superimposed on one another (Fourier series) and the resulting waveform will have its own wavelength. To some extent by Fourier analysis but more easily by harmonic computation, it is possible to discover that by taking certain groups of vibrations respective nodal points

will appear at different distances, which in their turn, taken together, will have a resultant group waveform and wavelength. This is what can actually be traced electronically around any object. In this we can see the reason why certain sensitive persons can feel these distances with their hands. What is actually felt is the difference of charge between the nodal points and the antinodes. The physiological process of muscular reaction has been beautifully described by Mr. J. Cecil Maby in his book, *The Physics of the Divining Rod*, Bell, London (1939). Other people can see it, as the researches of Reichenbach, Kilner and the like have proved. A resonance principle can be quoted in order to explain why certain people react to one vibration and others to different group phenomena.

Now, between the mass of the body m and the walls of the room there is a material medium, the air. What happens to its molecules ? We know that they vibrate with thermal agitation in all directions. Suppose that to a great extent they are electrically neutral. The moment we charge the body electrically, all the neutral molecules of the air, now in an electric field, will become electrical dipoles, and thanks to this bipolarity, their thermal agitation will be polarised to a certain degree ($\pm$ an angle φ) in the direction of the field lines. This polarisation will be the function of the intensity of the electric field of the body m.

Owing to this polarisation of the vibration of the molecules, a sonic wave will necessarily result. Actually the so-called "musical thunders" are of this origin. W. J. Humphreys in his *Physics of the Air*, 441, McGraw Hill, London (1940), describes the effect thus: "*Musical Thunder.*—It occasionally happens, when one is near the path of a lightning flash, that the thunder heard begins with a musical note. This is due to the fact that some lightning discharges—the flickering type—consist of a series of rapid flashes that, occasionally, are near enough regular, and of such frequency, as to produce a quasi-musical note." Compare it with Federsen's experiments described for instance by E. Grimsehl in *A Textbook of Physics*, Vol. III, *Electricity and Magnetism*, 581-2, Blackie, London, 1944.

Here the musical note can be heard as a function of the intensity of the electric field, whereas, in the case given above, the intensity is too small to produce an audible noise. Usually, instead of a musical note, there is an ordinary noise—thanks to the peculiar and irregular waveform—which is known always to accompany every discharge. Thus it is clear that every electric field in a material medium must necessarily produce a periodic mechanical vibration.

Let us conclude. As sound must necessarily produce electric phenomena, so also electric phenomena produce mechanical waves of sound. Prof. T. J. J. See rightly compares the

charged condenser to a singing bell (*op. cit.*, Vol. 5, 94-102). He concludes that sound and electrostatics are in the highest probability linked together. The problem is attacked by him from the mathematical side and from a different angle.

5.—J. C. Bose, *Comparative Electrophysiology*, 6, Longmans Green, London (1907). See also his *Responses in the Living and non-Living*, Longmans Green, London (1922). Most of his thousands of experiments were made with *mechanical impulses*. The electric response is of the order of 10^{-9} amps. A d'Arsonval sensitive galvanometer was used. He measured only the D.C. component.

6.—See note 5 of the former chapter towards the end, and the graph given there.

7.—On this principle an ultrasonic directional beam can be compared to a high frequency transmission line.

8.—*Op cit.*, vol. 5, 94-102, also see p. 106 ssq.

9.—W. G. Cady, *Piezoelectricity*, 4, McGraw Hill, London (1946).

10.—An explanation can be given as follows : it is well known from experience that when a mechanical wave passes from a less dense medium to one more dense, the less dense medium always ends with a node ; on the other hand the more dense medium always finishes with an antinode. But the maximum pressure exists at the nodal point of a mechanical wave, and the minimum at the antinode. Hence there must exist at the edge of these two media a stress-strain relation. In the antinode, that is, in the denser medium, there will appear a kind of " suction " (toward the mass of the medium) and, inversely, in the less dense medium, a kind of " push " pressure toward the denser medium. Such a difference will naturally produce a sudden drop of gravitational potential, and hence an electric charge. The actual cause of surface tension is here apparent. Now, by friction, thanks to its periodicity, for friction is always rhythmic, a strong mechanical wave will immediately be produced in the rubbed medium, resulting in an electric charge, according to the above reasoning, and taking the mv factor at its maximum at the antinode into consideration. As gravity and electricity are the function of the mass in motion (compare with the equivalence principle) the electric " forces " will appear near the antinode, that is at the surface. From the " suction - pressure " point of view the attraction of small pieces of paper by a rubbed insulated rod is thus perfectly explainable. The explanation by the accumulation of electrons on the one side, and positive charges on the other side of the rubbed medium, is full of difficulties.

(1) there is no explanation of this attraction. Why does a charge generally attract ? What are the physical reasons ? No answer has been given to this question except that it is

an experimental fact. An explanation on mechanical grounds is much simpler.

(2) if we accept the electric attraction and repulsion of Coulomb's law, we have to explain why such large charges of the same sign accumulated together do not split in all directions. Again the mechanical explanation gives a perfect answer to this question.

In other words in the explanation as given above, everything is simple. From this point of view the gravitational " pull " is on one side a " suction " and on the other a " pressure." There is a double reason for this so-called " pull " of gravity. The reason why things fall towards the mass is the longitudinal wave, which causes space distortion. It is the function of mass in motion as " electricity " is also.

On the other hand, the nuclear cohesive forces are also immediately understandable, as in the so-called centre of gravity must necessarily exist the nodal point of the longitudinal wave, pressing from all points of the surface where lie the antinodes. But in the nodal points of the longitudinal wave lies the maximum presssure—hence the cohesive nuclear force.

In the stress and strain relation between both media, where group phenomena are evidently involved in the vibrations (see note 4 of this Part), arises the tensorial nature of the gravitational potential and the constant G. This does not need any explanation, as it is apparent from the definition of the tensor. To the objection that mechanical forces cannot be responsible for action through the " vacuum " of interstellar spaces (Tyndall's experiment with a bell in an evacuated glass bell) the question at once arises how the energy of the sonic wave is transmitted from one molecule to another through the " empty " spaces existing between the molecules themselves, tremendous relative to their size, as we know there is no immediate collision between them. It is enough to compare the ratio of the diameter of the molecules to their average distance apart, in order to see that the range of these ratios is proportional to the ratio between the masses of heavenly bodies and their distance apart.

Finally, as it was assumed that electricity is a sudden drop or change of the gravitational potential at the locus or area, it is apparent that the energy is transmitted through the " empty " spaces by the electric fields and by no means through mechanical collision.

11.—Quoted from J. Tyndall, *Sound*, 41, Longmans Green, London (1898). " . . . it may be possible to discover the motions of the internal parts of the bodies, whether animal, vegetable, or mineral, by the sound they make; that one may discover the works performed in the several offices and shops of man's body, and thereby discover what instrument or engine

is out of order, what works are going on at several times, and lie still at others, and the like; that in plants and vegetables one might discover by the noise of the pumps for raising the juice, the valves for stopping it, and the rushing of it out of one passage into another, and the like? . . ."

12.—H. Kayser, *Harmonia Plantarum*, Benno Schwabe (1943).

IV

1.—The following argument should be applied *mutatis mutandis* also to animals, plants, crystals and inanimate matter.

2.—In all descriptions of quanta and quantised states of energy of atoms in wave and quantum mechanics, reference is made again and again to mechanical vibrations of sound, e.g.: "Just as a mechanical system subjected to boundary conditions (e.g., string fixed at its end, or a membrane fixed at its edge) can only assume certain discrete modes of vibration, so the atomic system is regarded as subject to certain boundary conditions and therefore capable of assuming only certain discrete modes of vibration, i.e., the stationary states." (E. Grimsehl, *op. cit.* vol. 5, 259, 1945).

And also: "If certain definite boundary conditions are prescribed (in the acoustic case, for example, the definite boundaries of a stretched string or of a plate, the position of clamping, &c.) a physically significant solution is only obtainable when the parameter (the energy in the above formulation) has certain definite values. By a physically significant solution, we mean one which is everywhere single-valued, finite, and continuous. In the acoustic case, this property of the equation finds expression in the fact that the system can only perform certain so-called proper vibrations. The special values of the parameter for which the physically significant solution is possible, are called the proper values (*Eigenwerte*) of the differential equation, and the corresponding solutions are called *proper functions* (*Eigenfunktionen*)." Quoted from Grimsehl, *op. cit.*, Vol. 5, 262.

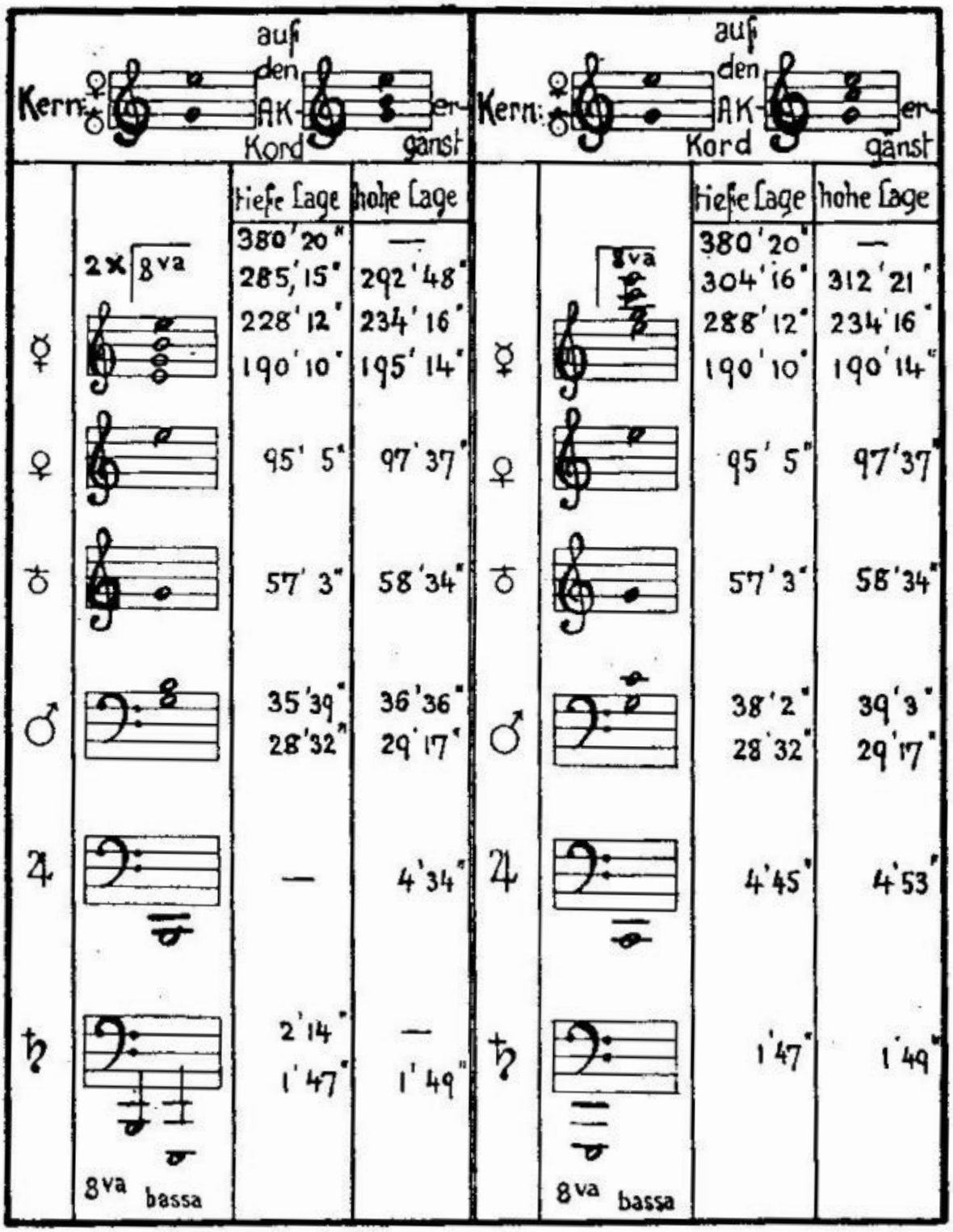
3.—The general idea is due to Lakhovsky, although he did not formulate it mathematically as is done here.

4.—H. Kayser, *Grundriss eines Systemes der Harmonikalen Wertformen*, Occidentalverlag, Zurich (1946).

5.—From the point of view of the sonic wave, it is quite evident that when a particular organ is attacked, thanks to the stronger or weaker inflow of blood, rise or drop of temperature, stronger or weaker electric resistance, &c., the resultant vibration of the respective organ will change. The friction arising from this

vibration will grow or lessen, and will therefore produce a changing electric field, which will, in its turn, change the gradient of the potential of the body in that particular place. Also the resultant sounds (ultra or infra possibly) will then be more or less pronounced than in the surrounding places where the balance is still maintained. Such changes traced by electronic means will make it possible to localise the root of the trouble. This is exactly what Robert Hooke predicted (see note 11 of the preceding chapter). Such considerations show in a very simple manner the common sense side of the proposed hypothesis from the medical standpoint. We have discussed here a very simple case, in order to give a clear picture of the general lines on which future research should proceed.

TABLE I



	tiefe Lage	hohe Lage		tiefe Lage	hohe Lage
	380'20"	—		380'20"	—
	285'15"	292'48"		304'16"	312'21"
☿	228'12"	234'16"	☿	288'12"	234'16"
	190'10"	195'14"		190'10"	190'14"
♀	95' 5"	97'37"	♀	95' 5"	97'37"
♁	57' 3"	58'34"	♁	57' 3"	58'34"
	35'39"	36'36"		38' 2"	39' 3"
♂	28'32"	29'17"	♂	28'32"	29'17"
♃	—	4'34"	♃	4'45"	4'53"
	2'14"	—			
♄	1'47"	1'49"	♄	1'47"	1'49"

TABLE II

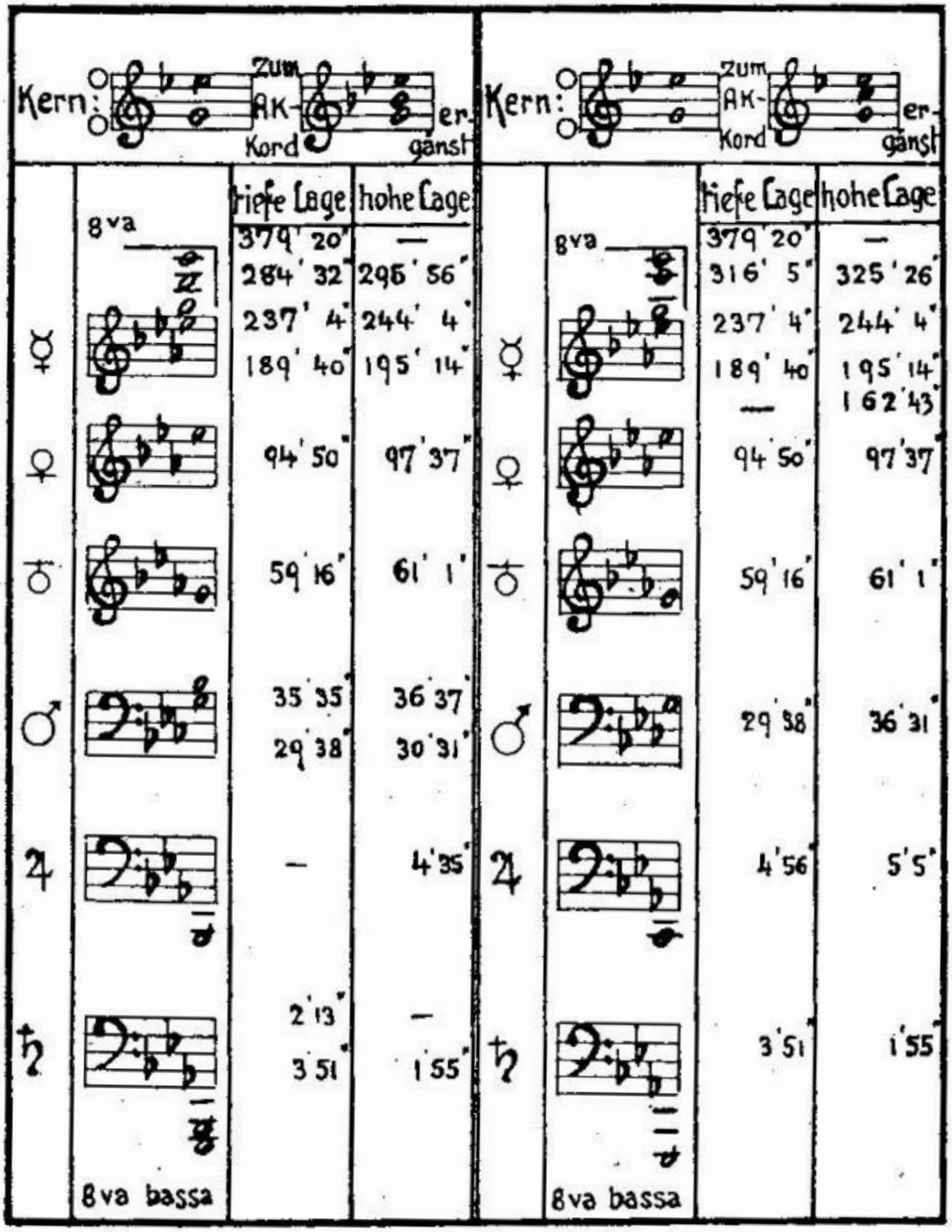

Kern: Zum AK- Kord er- gänst
tiefe Lage
hohe Lage
8va
379' 20"
284' 32"
237' 4"
189' 40"
94' 50"
59' 16"
35' 35"
29' 38"
2' 13"
3' 51"
—
295' 56"
244' 4"
195' 14"
97' 37"
61' 1"
36' 37"
30' 31"
4' 35"
1' 55"
8va bassa
Kern: Zum AK- Kord er- gänst
tiefe Lage
hohe Lage
379' 20"
316' 5"
237' 4"
189' 40"
94' 50"
59' 16"
29' 38"
4' 56"
3' 51"
—
325' 26"
244' 4"
195' 14"
162' 43"
97' 37"
61' 1"
36' 31"
5' 5"
1' 55"
8va bassa

TABLE III

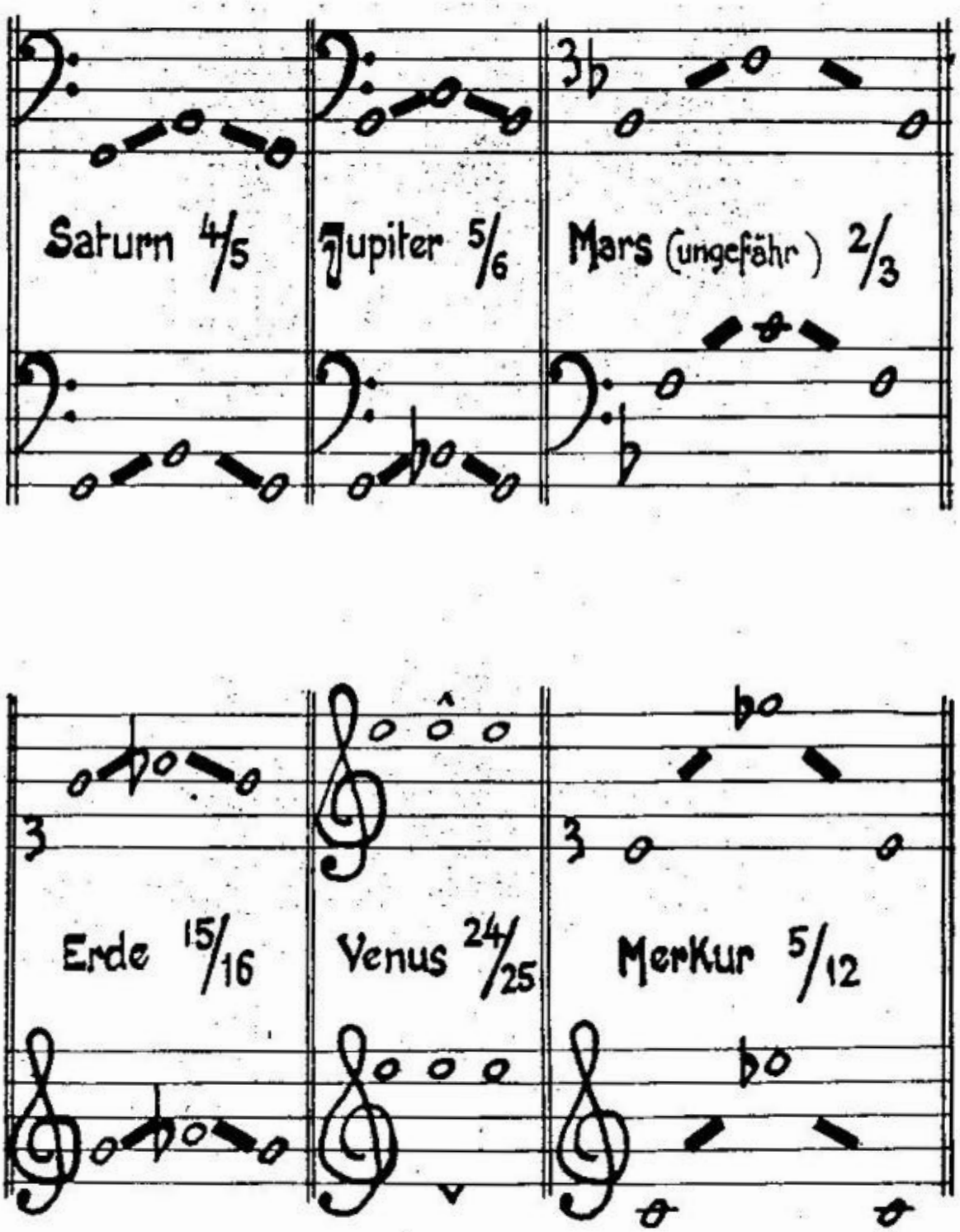

Saturn 4/5
Jupiter 5/6
Mars (ungefähr) 2/3
Erde 15/16
Venus 24/25
MerKur 5/12

TABLE IV

Logarithmen auf Basis 10				Log. auf Basis 2
Planet	Log. der mittl. Abstände	Log. der Aphelien	Log. der Perihelien	Teiltonlogarithmen der Saitenlängen
☿ Merkur	0,000	0,081	0,900 – 1	000 = 1/1 c
♀ Venus	0,271	0,274	0,268	263 = 5/6 s a
♁ Erde	0,412	0,419	0,405	415 = 3/2 s g
♂ Mars	0,595	0,634	0,552	585 = 2/3 s f
Pl. Planetoiden	0,835	1,000	0,670	830 = 9/8 s d und 848 = 10/9 s d'
♃ Jupiter	1,128	1,149	1,107	152 = 9/10 s b und 170 = 8/9 s b'
♄ Saturn	1,392	1,416	1,367	415 = 3/2 s g
♅ Uranus	1,696	1,716	1,675	678 = 5/4 s e
♆ Neptun	1,891	1,895	1,887	907 = 16/15 s des'
I	II	III	IV	V

TABLE V