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A UNIFIED THEORY

OF

PHYSICAL PHENOMENA

BY

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THE INNER WORLD

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PREFACE.

When I was studying for the Mathematical Tripos, Part II, in 1909, at Cambridge, a new theory of gravitation, dependent not on external attraction as is so far supposed but on internal action of a matter occurred to me. I made some notes at the time in a Note Book of mine, which also contained some other stray notes of new theories of light and electricity. That Note Book is still preserved though it is eaten by worms. But unfortunately I could neither develop my theory nor publish it, and was hoping to be able to find time and opportunity for it later on. But owing to unforeseen circumstances my energies had to be diverted towards Law, and I got more and more out of touch with Science. During the following years I always thought of developing my theory, but owing to my occupation I was quite unable to do so. As owing to want of practice my knowledge of Mathematics and Physics had been continually decreasing, I did not feel courageous enough to publish my theory.

I however felt that some great Mathematician or Physicist might suddenly hit upon the same idea and being well-versed in all the modern scientific discoveries might develop the theory still further and publish his researches. No one would then imagine that the idea had struck me first. I accordingly thought it advisable to devise some method of keeping a permanent record of the priority of my claim and so wrote down notes, enclosed them in a sealed cover, and got the same sent to myself in a registered and insured cover; and that sealed cover has been kept intact ever since as proof and evidence. In the light of the present knowledge, the old cruder ideas as to the constitution of light have had to be more fully developed, and help has been sought from the modern conception of matter, and the various aspects of its manifestation. But the idea as to how gravitation is caused still stands in the original form as it stood some 24 years ago. I have

also ventured to suggest a new though imperfect theory of unified electric charge deduced mainly from the conception of atomic structure during recent years.

I am fully aware that a theory conceived many years ago before Einstein's conception of a curved space and gravitation, the Quantum Theory of Light and Wave Mechanics, will be considered by most people as wholly out of date. But as no theory can be absolutely perfect and the last word has not yet been said on the modern concept of physical phenomena, I venture to publish this theory, antiquated though it may seem, in the hope that even if its falsity is ultimately established either mathematically or experimentally, it will help to provoke thought leading to further discovery.

ALLAHABAD,
(INDIA)
September 23, 1933.

S. M. S.

PART I.

Section I.—THE STRUCTURE OF MATTER.

Human knowledge is still in its infancy and is very much limited. Our perception just as our vision is within a very narrow range. We see our Universe, but we do not know what is beyond it. No doubt there are Universes outside our own Universe, but we can only guess them and do not know.

In the same way there are Universes within Universes, but we do not know how far the process continues. Our perception is limited in both directions by an outer range and by an inner range. We know about the world of molecules and their actions. We also know about atoms within molecules. And we have also come to know of a new world within an atom, comprising of negatively charged electrons with a nucleus of a positive charge, the former revolving round the latter at tremendous velocity. We know that these electrons are now and again darted off from an atom causing a partial disintegration of the atom. We also know that α and β particles emerge from the nucleus. But our present knowledge stops at that. We do not yet know what is inside an electron. Is electron the last indivisible particle conceived of by the old philosophers ? When our knowledge is so very limited and there is such a bright prospect of its rapid and vast expansion, why should we assume that there is not a smaller world within an electron ? Why should an electron not have a similar structure within itself as an atom has ? I fully believe that an electron is a small world in itself, which also consists of a large number of small particles revolving within the electronic system at a more tremendous velocity than that of an electron, and now and again they dart off from the electronic system just as an electron is shot off from an atomic system. For want of a better word, I name

this un-named tiny particle as "RADION". Indeed it will be seen later that it is an appropriate name. It will be shown in Part III that the nucleus is constituted like an electron, only the velocity and number of radions in it are different. I also believe that each radion is a smaller world in its turn consisting of smaller particles revolving at a still more tremendous velocity. I give such a particle the name of "GRAVITON".

Within each graviton there is another still smaller world consisting of still smaller particles, which I call "COSMIONS". These nomenclatures will be explained later. The gravitons dart off a radion and cosmions dart off a gravition in a similar way. How far this process of sub-division continues, it is impossible to say at the present stage of human knowledge. But there is every reason to believe that the sub-division continues at least up to radions, gravitons and cosmions.

Section II—COSMIONS, GRAVITONS AND RADIONS.

The existence of gravitons fully explains the force of gravitation, *i.e.*, attraction between two particles of matter. Einstein conceives of gravitation as an apparent result of motion ; and the path as being curved because of a curvature in space. But physicists have found out that this attraction is a reality. It can be accurately measured. One can therefore safely believe that two particles of matter exercise an apparent force on each other. But such a conception implies that one matter pulls another. Now such a pull at a distance is really impossible unless there were some medium having a strain which would serve the purpose of a string. How can one body pull another without there being a medium in which there is a strain ? Scientists in the nineteenth century assumed the existence of a medium called ether, but it was difficult to explain the pull. It will be seen later that ether is not any continuous elastic medium, but merely the sum total of the cosmions and gravitons flying about in space. To my mind the idea of an external pull is illogical. The position has been inverted just as it

was when the old philosophers thought that the Sun revolved round the Earth, or that light was something sent out from the eyes. The force of attraction is not a pull from outside, but an apparent push from inside : Each particle of matter behaves in a particular way because of its own constitution and the state of things in its immediate vicinity, and not because of what the state of things is at a distance from it, though the state of things in its immediate vicinity will be found to be in a measure due to the emanations from other bodies at various distances from it. I believe that the conception that gravitation is the result of an internal action is new, and is the direct opposite of the assumption that it is due to an external force. Even Einstein's conception that the presence of matter causes curvature in space admits therefore the existence of matter having the property of bending instead of the old undulating ether. Gravitation is no doubt the result of motion ; but how is motion caused ?

The composition of an electron and the constitution of radions in it will be discussed later. Let us first consider the composition of a radion. According to my belief, radion is a tiny world in itself. It has a large number of gravitons revolving within a limited space. The space may be spherical, ellipsoidal or of other similar shape. I believe that the space goes on changing its shape and also its size. The changes are periodic and are due to the impact of the gravitons on one another. These gravitons are revolving in all possible directions. Assuming the spaces to be ellipsoids, the paths of these gravitons are along such surfaces, revolving round shifting focii—a focus depending on the position of all the gravitons for the moment. But the major axes of the ellipses are not equal. Some gravitons move round smaller orbits, others round larger, and they move in all possible directions. It would be explained later that the emergence of a graviton takes place only when the orbit reaches its maximum, which will be found to be an approximation to a circle. But they all are

enclosed within a limited range of space confined to the world of a radion, which I have called a radionic system. This sphere may contract or expand, as it constantly does, but there too the change is periodic, and within two limits. If these limits were exceeded, the constitution of a radion would disappear. When the limits are narrowed below the lower limit, a force of repulsion due to the emergence of cosmions from, the constituent radions becomes strong enough to balance the attraction, and the orbit cannot contract further. The emergence of cosmions causes repulsion, just as light from the Sun repels a near comet. This will be explained in greater detail when discussing an electron. When the outer limit is exceeded, a graviton escapes, and there is a partial disintegration of a radion, just like the disintegration of an atom when an electron escapes. The state of a radion is unstable. When a graviton revolving round reaches the maximum limit, *i.e.*, its orbit is enlarged to the maximum limit, it is shot off immediately. The force of the radionic world is insufficient now to prevent its escape. How the gravitons revolve round each other can be explained in a similar way. The apparent force is the result of a similar emergence of cosmions from gravitons. For the present let us conceive a radionic world, containing numerous gravitons revolving in all possible directions—up and down, right and left, clockwise and anti-clockwise, etc. But all ultimately attaining one velocity when they reach the maximum orbits. This velocity is the speed of the graviton in its outermost orbit and is the same velocity for all gravitons that emerge. This is a constant velocity D.

As our perception does not go beyond radions, the velocity of a radion is the maximum velocity known and it is found to be constant. It is the well-known constant C. We do not perceive of any higher velocity yet. So C is believed to be the maximum velocity attainable. But if we could observe the velocity of a radion inside a proton, it would be found to be higher. And

when in future we come to perceive a graviton, I believe that the velocity of a graviton will be another, but much greater constant, which I have called D. But so far, our scientific instruments have not been so powerful as to measure or even notice D. When human knowledge progresses and we get a perception of not only a graviton, but also of a cosmion, I believe we shall find that the velocity of a cosmion is another bigger constant E. The radions apparently remain within our Universe, and so C is the maximum perceptible velocity. But if gravitons and cosmions escape from our Universe and go to other Universes, they would have velocities D and E respectively outside our Universe. When a cosmion can escape from a graviton and pass out of our Universe into another Universe, released cosmions must exist in our Universe also, for the disintegration of a graviton would let loose cosmions, which must traverse our Universe before they pass out of it ; and so the velocity D must exist in this Universe also. But we have no means of knowing it at present.

Section III—THE THEORY OF INTERNAL GRAVITATION.

Now gravitons revolving as they do in all possible directions must dart off in all possible directions. Thus a radion would send out gravitons in all directions, and the position would be similar to that of a point radiating spherical waves, which go on expanding in spherical shapes as the radius increases. The intensity (which corresponds to the superficial density) of the gravitons will in such a case vary inversely to the distance from the centre. To avoid confusion I take the liberty of coining a new word "graviation" to connote the discharge of gravitons from a radion, and I shall restrict the use of the common word "radiation" to the discharge of radions from an electron. It is also clear that that density would be proportional to the strength of the graviating centre, *i.e.* proportionate to the mass of matter at it. The intensity of graviation at a distance r from the mass m would therefore be $\propto G\cdot\frac{m}{r^2}$ where G is in the first instance a constant. For the sake

of simplicity, Einstein's theory of relativity and time as an additional factor are not taken into account.

Now when a graviton suddenly shoots off an unstable radionic world, there is a sudden change of position in that world, for one member of it which was exercising an influence on the other members has suddenly disappeared from that world and ceases to exercise any effect now. For that world it has suddenly ceased to exist. The outgoing graviton has carried away its momentum with it. The loss of momentum causes internal motion. This necessitates an alteration in the system. Thus the darting off of a graviton along a tangent, causes a reverse action, *i.e.* reaction in the system. This is the well recognised principle of the conservation of momentum along a direction. Each particle as it darts off carries away a small bit of momentum. Thus the total momentum when decreased = MV – mv. The rate of change of momentum is the cause of motion, which is represented as force acting in the reverse direction. In common parlance this is the reaction, which is an equal force in the opposite direction. The flying off of a graviton from a radion is like a little explosion inside the radion. The graviton goes off at its velocity D, and involves a loss of momentum to the radionic system. If m be considered to be the mass of a graviton, the momentum = m.D. The rate of change of the momentum for each graviton darting off means backward motion or an apparent backward push. The resultant of the momenta off all radions when resolved along one direction will correspond to the sum total of the force in the opposite direction.

It follows that with each graviton leaving a radionic world, there is the impulse of moment m. D. in the opposite direction. If a radion were the only particle under consideration, gravitons will break off from all sides, the inward pushes will neutralise themselves, and the radion will remain hung up in the Universe.

Now a particle of matter is a conglomeration of radions and thus of gravitons. When two particles of matter are separated by an appreciable distance, their action on each other is the cumulative effect of the two conglomerations of gravitons on each other. Thus the behaviour of two particles of matter is the resultant behaviour of two groups of gravitons on each other. The result is as if the two groups were throwing off gravitons in all directions, and both experiencing apparent inward pushes. Had the presence of another matter in the vicinity no effect on the rate of discharge, the two particles of matter would not affect each other in any way, and no force of attraction would be observed. But matter is a concentration of mass in space, *i.e.*, a concentration of gravitons. It is a point of high material concentratin, so to call it. If a particle of matter stood by itself in a vacuum it would be sending out gravitons at equal rates in all directions. Thus gravitons would be travelling from the place of a high material concentration to a low material concentration all round. That is to say matter would be flowing from a point where it is concentrated to points where it is not so dense. The position is similar to that of a gas effusing in vacuum out of an orifice in a chamber containing the gas. Concentration at one point in space is unstable. The internal motion of gravitons causes an unstable graviton which has reached its maximum orbit to escape. For purposes of illustration merely, one may say that pressure at one point is relieved by transfer of pressure to other points, as if there were an ether transmitting and equalising the pressure. But the quantity required for transfer will depend on the difference in the two concentrations. Obviously if the difference were reduced, the flow will decrease. Now material concentration is the result of the number of gravitons present. If, therefore, there were another stream of gravitons coming from the opposite direction, the amount of graviation will be affected. It is as if the incoming gravitons by impinging on the emerging gravitons

suppress or rather hinder the release of some gravitons from it. I believe that the impact of gravitons coming from the opposite direction and remaining in the vicinity of a radion retards the shooting off of gravitons from it. Their presence raises the material concentration and there is no longer the same facility for equalisation. These opposite gravitons do not for practical purposes impinge on the radion, because they can enter it and pass through it, but they hit the gravitons that have left previously. The gravitons are more perfectly elastic and therefore on impact they rebound without losing much energy. The gravitons arriving at the surface of a radion prevent other gravitons from emerging out of the radion. This retards the emanation of further gravitons.

I believe that the arrival and the obstruction of opposite gravitons has a direct effect on such emanation, which I have called "graviation". The graviation on one side, on which there is another matter sending out gravitons, is decreased proportionately but the graviation on the opposite side is unaffected.

If A and B be two particles of matter, (**See Fig. I.**) consisting of masses m and m′, which really represent the total numbers of radions in each, the graviations from A and B in the directions B→A and A→B respectively remain unaffected, and the loss of momentum due to these on A = N. m. D. in the direction A→B where N is the number of gravitons leaving per unit of time per radion resolved in the direction B→A; and that on B is N′ m′. D. in the direction B→A where N′ is the number of gravitons leaving B resolved in the direction A→B. But as owing to the presence of gravitons in the space between A and B, the concentration there is increased and the graviations also decrease, and there are smaller discharges or emanations of gravitons from A and B in the directions A→B and B→A respectively, the loss of momentum on A is n. m. D. in the direction B→A and that on B is n′m′.D. in the direction A→B where n and n′ are the numbers of

gravitons leaving A and B respectively per unit of time per radion. It follows that the momentum of the resultant push on A is (N-n) m. D. in the direction A→B and of the resultant push on B is (N′-n′) m′. D. in the direction B→A.

But obviously (N-n) which denotes the decrease in graviation of A brought about by the graviation of B is proportional to the intensity of this graviation of B, *i. e.* to m′. Similarly (N′-n′)∝m. So both A and B feel pushes towards each other in the ratio m.m′. This is the force of attraction experienced by two bodies, when the graviations on the sides close to each other are diminished, while those on the sides away from each other remain the same. It is the internal push felt by the two bodies which is mistaken to be an external force exercised by one on the other. Really each is moved because of the difference in the number of gravitons flying off on its two sides and a consequent change in the resultant momentum. These internal actions create apparent internal forces tending each to move in the direction of the other. This has so long been supposed to be a force of attraction. There is in reality no such thing as external force of attraction, but merely motion. And as motion is mathematically a corollary of force, it is supposed that a force exists. According to Einstein's conception also, in reality only motion exists and not any force of attraction. When bodies are moving, their paths are explained mathematically by the conception of a force acting on them. The motions of bodies are along the least lines of resistance, and the equations of their motions can be expressed in terms of a supposed force. The Universe consists of motions only, and not forces of attraction. In the same way a potential is an imaginary mathematical conception. It is really the further result of a force having been mathematically deduced from motion.

In order to translate my idea into a colloquial language I have used the word "push". But in reality there is no push at all. When a graviton leaves a radionic system, there is a loss of momen-

tum causing motion, and so the remaining radions are re-arranged, which means a new motion. The darting off of a graviton causes a re-action in the form of an internal motion in the radion. This in a mathematical formula is expressed by a reverse impact or backward push.

Section 4.—THE LAW OF FORCE.

Now let us proceed to measure the strength of this supposed force of gravitation. My theory assumes that every radion in a mass of matter, no matter where situated, emits gravitons. Thus the number of gravitons discharged per unit of time is proportionate to the total number of radions in the matter, *i.e.* proportionate to the mass. It is also obvious that this graviation is independent of the surface of the matter. Hence the strength of graviation is a multiple of mass. As the graviation must expand outwards, the expansion must be in the form of spherical surfaces. This is the necessary result of the hypothesis that every radion wherever situated emits gravitons in all directions. The number of the radions per unit of time is the same, but the surface on which they are spread over increases in the ratio $4\pi r^2$. The intensity of graviation, *i. e.*, the number of gravitons per unit of surface must therefore be proportionate to $\frac{1}{r^2}$. It follows that the original graviation which was proportionate to m is also proportionate to $\frac{1}{r^2}$ and is therefore $\propto \frac{m}{r^2}$.

Now the effect of this discharge from a matter at A of gravitons in proportion to $\frac{m}{r^2}$ on a particle of matter at B situated at a distance r from it is to hit a number of gravitons about to emerge from the radions in that particle B. The number of gravitons that would be hit in this way would obviously be proportionate to the number trying to emerge from B at a given moment; and this number must in its turn be proportionate to the total number of radions at B, *i.e.* the mass at B. Hence the apparent force of gravitation $= G \cdot \frac{m.m.'}{r^2}$ where G may be assumed to be a constant.

This is the net result when two bodies are at a distance from each other.

The graviations as pointed out above expand in spherical surfaces as they must, and their density is proportional to $\frac{m.}{r^2}$ That density increases proportionately to the mass, and in the inverse square of the distance. It follows that owing to the presence of another mass the graviations must decrease in the same proportion. It also follows that that effect would also increase in proportion to the mass of the other matter. Thus the apparent force of attraction between them would be represented by $G \cdot \frac{m.m'}{r^2}$ This is the necessary result of uniform spherical expansion of graviations from two sources. The reason why the ratio is $\frac{1}{r^2}$ is that the only possible method is that of spherical expansion, which it must be if every radion emanates gravitons. (**See Fig. 2.**) For the same reason, the gravitation is proportionate to both the masses, *i.e.* to their multiple. When the velocity of a graviton is the constant D, then all the gravitons must travel at the same speed. And therefore as they spread out in space, the effect is as if they are expanding in spherical waves, their density decreasing in the inverse square of the distance travelled. The numerators are the multiples of the two masses, because the intensity of the graviations must be in proportion to their concentrations. Thus graviations are decreased in the ratio $G \cdot \frac{m.m.'}{r^2}$ and there is an apparent gravitation in the same ratio; but really the illusion is due to the resultant motion of the two masses towards each other.

As gravitons escape from every radion wheresoever situated it follows mathematically that the resultant effect is as if all the radions were concentrated at the centre of gravity, *i. e.* the total mass were a mere point at the centre.

We have assumed that G in this ratio is a constant, which is the unit force of gravitation. But it is submitted that G may be

found to vary with the relative velocity of the two particles, and will then be a function of time. It is surmised that later observations may disclose that the effect of the relative velocity of two particles is to gradually alter the orbits of both. As both particles are continually losing mass passage of time accordingly will result in one matter being more and more separated from the other till they part off. If an external force were applied then they can be drawn together and would coalesce until a fresh explosion takes place.

It will be explained in Volume II that without an external force, a moon cannot coalesce with a planet, and become part of it, but it will gradually fly off to a larger orbit and may leave the planet, and become a flying comet in the solar system. Similarly the planets may ultimately leave the sun, and the solar system itself may leave this Universe and fly off into another Universe. These are the necessary result of continual loss of mass due to dissipation of gravitons, provided the ultimate velocity of the planet, the sun, the solar system or the Universe comes to be less than that of the moon, the planet, the sun or the solar system respectively.

But just as the velocity D of an emerging graviton is considerably smaller than the velocity E of a cosmion ; and velocity C of an emerging radion is considerably smaller than D, so the velocity of an emerging electron is much smaller than the velocity C of a radion. In the same way the velocity of an atom is smaller than that of an electron ; and the velocity of a molecule is smaller than that of an atom. The velocity accordingly goes on decreasing as the mass increases. We get increasing velocities as we proceed in the series molecules, atoms, electrons, radions, gravitons and cosmions. It will however be shown in Part III that where the mass itself goes on decreasing, the orbit increases, the velocity decreases and the periodic time increases.

Section 5.—EXPERIMENTAL PROOFS.

Whether two bodies discharging particles with equal force on both sides attract each other when brought closer can be easily tested.

I. Water is brought from a water tap by means of a rubber tube A B C, to which is attached one glass tube EFGHLK. From these hang other long rubber tubes HM, LN ; to these are attached glass tubes MOP and NQR. At the ends of these glass tubes are perforations (one can substitute tin tubes with perforated ends). First each tube is separately tested to see that the flows at both ends are equal. If not, then perforations at one end are enlarged. Then they are placed opposite to each other to see whether they attract. (**See Fig. 3.**)

II. Gas is brought through a rubber tube AB, fixed at B, to a tube BB'B''. CDE is a brass tube with regulating taps at the two ends. By means of screw caps holes can be opened out more. C'D'E' is a similar brass tube.

First each tube is separately regulated, and the flow of gas at both ends equalised by the screws, so that the brass tubes hang vertically. Then the two are brought face to face together to see whether they attract. (**See Fig. 4.**)

III. Two cylindrical fireworks have small holes at both ends. They hang by means of strings tied to two brass rings resting on a horizontal rod.

They are fixed together so that the discharges at both ends are equal. Then the screen is removed. (**See Fig. 5.**)

RESULTS.

In Figure 3, when water is coming out of the glass tubes with force from the four sides and glass tubes are brought close together :

(1) A force of attraction is seen. Indeed, when they are brought very close the tubes appear to move up towards each other. But in between, when water is impinging on the opposite ends, the repulsion exceeds the attraction.

(2) When the tubes touch each other and are left free to move, they remain joined as the force of attraction does not allow them to separate. It is because there is loss of momenta on the outer sides so that if one end is closed the other remains pressed. If one tube is gently pulled along a little then the other also would be dragged along.

The above experiments are not so satisfactory because the flow being superficial the pressure is great as compared with the attraction.

If instead of all the ends being open, we have knobs at the outer ends with perforations so that sprays of water come out on all sides, the pressures on the inner knobs are reduced to the minima. Then the fact of attraction when the glass tubes are brought close together is observed better. **(See Fig. 19.)**

The experiments in **Fig. 4** and **Fig. 5** have not been tried.

PART II

Section I.—THE EMISSION OF RADIONS.

I now pass on to a consideration of the behaviour of radions which are in electrons. Had every electron wherever situated been emitting radions, then the position would be identical with that of gravitons; and if the nomenclature "Raditation" be used for the force resulting from radiation of radions, analogous to gravitation, then that force would have been $K\frac{m.m'}{R^2}$ where K is the unit force of raditation. And if raditation also varies with relative velocity, the force would be a function of time. But owing to a different constitution of an electron to be explained presently, the raditation is not from every electron in the matter, but only from the electrons on the surface of the matter.

The force of attraction due to the emission of gravitons $=G.\frac{m.m.'}{R^2}$

Similarly there would be a force of attraction due to the emission of radions. But the intensity of radiation, even though purely superficial, must also depend on the total number of radions contained in the body, and would be proportional to its mass. So this force of radiation also would be one of attraction and may be represented as $H.\frac{m.m'.}{R^2}$. These two forces act internally on a body and are due purely to the loss of momenta on the outer side.

Gravitons are too small. They pass through radions, and have no impinging effect on electrons and atoms. But radions being bigger impinge on the surfaces. So the bombardment of the radions that have already emerged on the two bodies would cause a force of repulsion similarly measured from surface to

surface only and not centre to centre. $=I.\frac{i.i'.}{[R-(r+r')]^2}$ where i and i' are intensities.

If R approaches (r+r') the force of repulsion would exceed the attraction. This would maintain equilibrium.

Thus the resultant force $=(G+H)\frac{m.m'.}{R^2}-]\frac{i.i'.}{[R-(r+r')]^2}$.

The rate of radiation depends on the intensity per superficial area, *i.e.* superficial density. But that rate is also ultimately affected by total mass. Thus the force of attraction due to graviation and radiation combined together varies proportionately to $\frac{m.m'.}{R^2}$, but there is also a force of repulsion due to the bombardment of radions which varies inversely as the square of the distance between the two surfaces and becomes very large when the two surfaces are close together.

In the same way temperature also must affect intensity of radiation; but the effect has not been measured yet. Again emission of electrons, atoms and molecules must all give rise to a force of attraction proportional to the mass due to the loss of momenta, varying inversely as the square of the distance, and also to a force of repulsion due to the bombardments varying as the intensities and the inverse square of the distance between the two surfaces. When R is too large, the force of repulsion is insignificant, but when we come down to the inner world, these forces begin to have an appreciable effect and can no longer be ignored. **(See Part III.)**

This is why the apparent force of gravitation between the Sun and Jupiter, both luminous, are practically of the same order as that between the Earth and the Moon, which both throw off only reflected light.

But the force of attraction due to the loss of a momentum

by emission of radions ought to be measurable. And when our instruments become more powerful, it will be measured. There is, however, no doubt that at a long distance this force is insignificant as compared with the force of gravitation $G\frac{mm'}{r^2}$.

That radiaton causes force and exercises pressure is now well-established. A dark body like a comet when approaching the Sun experiences the pressure of light, which forces its tail, consisting of the smaller particles, away from the Sun. The pressure on the other side of the comet is almost nil as compared to that of the light from the Sun. Hence it is repelled away. When $[r+r']$ approaches R, then $[R-(r+r')]$ approaches zero and so the force of radiaton becomes greater and greater till it overbalances gravitation, and there is a repulsion.

This can also explain how a system can be temporarily stable. There is an apparent force of attraction when bodies in a system are at some distance from each other. But when they come too close then the pressure of the emanation continually increases till it exceeds the force of gravitation, with the result that the smaller body is again repelled. Thus gravitation and raditation acting in opposite directions may balance each other.

Now why should the graviation, *i.e.*, discharge of gravitons be from the entire mass of radions and therefore proportionate to the total mass, while radiation, *i.e.*, emanation of radions be confined to the surface of the body mainly ? The answer is to be found in the different structures of the two systems.

A system can be of three main types :—

(1) Analogous to our Universe—where there are innumerable independent suns and stars revolving round each other. In such a system the stars or suns at the outer limit of the Universe can with some ease pass out of the Universe, as there is no central core or nucleus in it.

(2) Like the multiple stars system—where a limited number of bodies are revolving round one another like a double star; but there is no central nucleus. The application of an external force can separate the distances between such stars, and can ultimately separate them altogether, which would break up the system itself.

(3) Like the solar system—where there is one huge central body, and a large number of planets are revolving round it and also round one another. Here there is a great central force; and nobody can be thrown outside this system with ordinary force. The force required for such a purpose must be tremendous and must exceed the attraction of the Sun.

Now each of the planets of our solar system contains particles which are in the first instance composed of molecules. These are definite in number and have no nucleus. They can be split up by application of energy in the form of heat. After they have been split up, the molecular system disappears. There being no central core, the splitting up of a molecule is a comparatively easy affair. Heat is a form of molecular energy, *i.e.*, internal motion of the components of the molecule. Increased heat means greater internal motion, and therefore larger internal distances inter se. Thus by increasing the application of heat all molecules can be split up. When split up they give out independent atoms.

Now an atom is analogous to the solar system. It is now known to consist of a huge nucleus of a positive charge at the centre, and a large number of electrons of negative charge moving round about it. By application of energy a negative electron may be forced to leave the atomic system; but the central positive electron would require a still more tremendous force to split it up. Thus the force required to disintegrate an atom completely would be enormous, and so it is more difficult to explode the nucleus of

an atom. This is why the artificial explosion of a molecule is much simpler than that of an atom.

As to the partial disintegration of an electron, I believe that such a splitting up takes place when light is emitted from a body. The reason why it has been found easier to produce light is that an electron consists of a large number of radions, which are independent particles revolving round one another without any central core or nucleus. The electronic system resembles our Universe. It is therefore comparatively easier to separate a radion from this electronic system. Thus with the application of a sufficient amount of energy, the radions near the maximum range of the electronic system can be thrown farther away, which will result in their leaving the system.

Now radiation is the emission or discharge of radions from an electron. In such an event, radions revolving in different directions would fly off in such directions at their velocity C. Within a certain range, they become perceptible to human senses and instruments devised by human agency—they are then known as light. Within this range the periodic motion of radions is comparable to those of molecules and atoms, and so it is perceptible to human senses. Beyond the range either way it is imperceptible.

That the number of radions in an electron is enormous is evident from the fact that out of 2000 atoms of radium, probably about one atom breaks up in a year. It is wrongly supposed that it is one single atom that does so. Really the total emissions of radions from all the electrons in all the atoms amount in aggregate to the total number of radions in an atom. So the net result is as if one atom is lost in a year. Thus the number of radions in an atom is so large that radiation goes on for a whole year before $\frac{1}{2000}$ of an atom is exhausted.

Section II.—THE ROTATIONAL THEORY OF LIGHT.

1.—Motion of Radion.

I now proceed to examine the motions of the radions inside an electron, and see their effect. Similar to the motion of gravitons, radions also revolve in all directions within a radion. Radions also are emanated from electrons, radiating in all directions. Let us have a distant object which is a conglomeration of atoms containing electrons giving out radions. We may confine our attention to one fixed direction in space say AB. As radions are revolving in all directions the positions of those which leave electrons from the group of atoms would be that of a group of radions travelling outward in space with a common velocity C.

The radions in an atom do not all move round orbits of equal size, but have changing orbits, and they are always elliptical, though gradually moving along a changing ellipsoidal surface. Now if the projections of the orbits of these radions were taken on a surface at right angles to the path AB while they have not yet left an electron, they will all at a given moment of time be ellipses but they will be of different sizes. (**See Fig. 6.**)

The forward velocity of all the radions after they have left electrons will be the same and will be the constant C along the path AB. But the projections of their initial orbits of revolution will be elliptical, when a section either at right angles to the path or along the path is taken, and the curves will be of different axes. Obviously the longest range from the central axis will be related to the maximum range of a radion within an atom, which would be the size of the electronic orbit or the dimensions of an atom and the smallest may approximate even to zero. This will be so as regards each atom.

It is now considered that force in itself does not exist ; it is a mere mathematical corollary of motion. Be it so, then the

Newtonian idea that if no other force is acting a mass will move with a constant velocity in a straight line requires to be modified. The motion has to be along a geodesic, the curve of least resistance. If a body is moving along such a curve, it is experiencing the least resistance. If the apparent force acting upon it were to cease suddenly, its motion will continue as before along its geodesic.

2.—The Law of Combined Motion.

It is just as incongruous to assume that a body will always move with the same velocity in a straight line as that it will move with the same average angular velocity round the same orbit. Now with Einstein a straight line has vanished, a body simply moves round an orbit of least resistance. It will continue to move in the same orbit if there were no contrary force acting. It would follow that longitudinal and angular motions remain the same giving it a screw motion.

This is a revolutionary idea which is apparently not true for visible objects because perfect elasticity cannot be obtained, and forces of stress and strain come into operation when an attached body is suddenly released. But for more perfect bodies the Law of Motion can be stated as follows :—

If a particle were at any given moment of time to have several motions, one of which is unstable and the others stable for the time being, and if the unstable motion were to cease suddenly, it will continue to have a motion which will be the combination of the existing stable motions.

For instance, if a radion were to have (1) a rotational motion round itself, (2) an elliptical motion equal to the velocity of light along its orbit inside an electronic ellipsoid, and (3) the elliptical velocity of the electron along its orbit inside the atomic ellipsoid, and if the radion were to reach its maximum range within the electron and, the condition being unstable, were to be suddenly released from the electronic ellipsoid, then the motion which it would possess in a free space unobstructed by any obstacles, would

be (1) the rotational motion round itself, (2) the elliptical motion of the electron and (3) its tangential velocity of light.

It would follow that a particle when left to itself would retain its angular momentum at right angles to its forward path. As the Universe is full of gravitons and radions, perhaps the screw or rotational motion is the path of least resistance through space ; it avoids the collisions most, and pierces with the greatest ease than it would do if travelling straight and bumping.

Leaving out the rotation round its own axis which is not observable, the emerging radion will possess a screw motion, with the forward velocity of light and the rotational velocity of the electron.

When there is no obstruction, there is no reason why it should lose any of its motions. The only change is that the circumferential velocity of radion within the electronic orbit is transformed into an equal tangential velocity along an apparent straight line, giving a longitudinal velocity equal to that of light, while at the same time the electronic orbital velocity also remains as an angular or rotational velocity.

A radion will have the velocity (**See Fig. 7.**)

$\frac{dz}{dt} = \frac{d}{dt}(r.\cos.\Theta) = C$, the constant velocity of light.

Its projections will move round an ellipse

$$\left(\frac{r\sin\Theta.\cos\Phi}{a}\right)^2 + \left(\frac{r.\sin\Theta.\sin\Phi.}{b}\right)^2 = 1$$

$$i.e. \qquad r^2\sin^2\Theta.\left(\frac{\mathrm{Cos}^2\Phi}{a^2} + \frac{\mathrm{Sin}^2\Phi}{b^2}\right) = 1.$$

As the major and the minor axes of each ellipse are definite the motion will continue to be elliptical round the path of ray. The combined effect of the longitudinal and rotational velocities would be a screw motion of the radion round the surface of an elliptical cylinder, the velocity along the axis of the cylinder and also the period of revolution round the axis being both constants. (**See Fig. 8.**)

When a radion is revolving, it has a tangential velocity C, but relative to the fixed direction A→B it has an elliptical motion as well. When it leaves the electron, because it has reached the maximum limit of the electronic world, the limit after which it cannot be kept under control, it suddenly darts off following a path similar to the thread of a screw on an elliptical-cylindrical surface. If there were no collision, reaction or deflection at the muzzle, a bullet emerging from the barrel of a gun would dart off in a screw fashion having both an outward velocity, and also a rotation along an axis. (See Experiment in Section IV of this Part.) This double motion resembles that of a vortex moving along a surface or a rotating smoke ring thrown out when smoking a cigarette. The two motions, viz. the forward velocity and the rotation round the axis give its path a screw form on a definite elliptical-cylindrical surface. I believe that this cylindrical surface motion is due to the circumstance that a radion is a world in itself having dimensions, and that while inside an electron it has motion along its own curve of orbit with velocity C and also a rotational motion when carried along by the electron in its orbit. The combined effect of these motions is a cylindrical screw path after it has left the electron. As the initial rotational velocity is not increased in its transit, the path remains cylindrical and cannot assume an expanding conical form.

3.—The Conservation of Angular Momentum.

If angular momentum is constant, then the curve is nearly an ellipse with a definite major axis. The angular momentum $m.r.\frac{rd\Theta}{dt}$ is constant *i.e.* $m.\frac{2d\Delta}{dt}$ is a constant h and $=m.\frac{2\pi ab}{t}$ where a and b are the semi-axes and t is the period of revolution.

Where the force of attraction is in the ratio of the inverse square of the distance $=\frac{\mu}{r^2}$, then $h^2=\mu\frac{b^2}{a}$ so that $t=\frac{2\pi}{\sqrt{\mu}}a^{\frac{3}{2}}$

The square of the periodic time is proportional to the cube of the major axis.

It follows that the periodic time increases with the orbit; the bigger the size of the orbit, still longer the time. If the period be constant the size of the orbit will be fixed.

4.—The Constant Periodic Time.

Now if a beam of radions emerge from a number of electrons of the same period in a large number of atoms, they will move forward with a velocity C, and will also have rotational elliptical motions of the same periodic time. The necessary result of the identity of the periodic times is that the resultant effect of all the radions will recur at constant intervals. The resultant will rise from a mean state, reach the highest state, then return to the mean state in an opposite direction, then go down to the lowest state and then return to the mean state in the same direction.

It is the identity of the period that leads to the effect of wave propagation. A beam of light of one wavelength is a bunch of radions of one periodic time. Their resultant state varies because they are moving in different ellipses in the same plane. But those same states will recur exactly at the same intervals. Thus the resultant effect on an electron will be that of a maximum and a minimum and therefore also a mean intensity. This process represents a harmonic motion which has a fixed periodic time. Graphically it can be represented as a wave. (See Fig. 9.)

The **Intensity** merely means the number of radions moving along the path of the beam per unit area per unit of time found by resolving along that direction all the radions which are about to move in all directions from points in an instantaneous plane at right angles to the path.

Those moving in opposite directions will cancel each other. The intensity at any point is their resultant for the time being.

5.—Wave Propagation.

Owing to the large number of atoms out of which electrons emit radions, we get a number of similar states starting simultaneously. Assume a number of states starting from the same phase

viz., the mean phase. Coming from different electrons in different atoms, but having the same period, they will assume the shape. (**See Fig. 10.**) The same state will return after each periodic time, thus there will be a maximum intensity, a mean intensity and a minimum intensity recurring alternately. The behaviour of a radion along a wave path is the necessary geometrical result of particles moving with a constant forward velocity and rotating round the axis of longitudinal motion in ellipses which complete the revolution in the same fixed time. The resultant effect is a periodic rise and fall in intensity. So when the motion is looked at along the path it is like a wave motion. The periodic motion along an ellipse can be easily resolved into periodic motions along the path of ray and along two axes in the plane at right angles to the path. **Fig. 9** shows the projection of the screw path on a plane through the axis of forward motion.

The effect of superposition of such waves can be easily explained, showing amplitude and therefore intensity altered by multiplication of waves. The new resultant will fix them.

On the other hand when the motion is observed on a plane at right angles to the path, the various particles will be seen to describe confocal ellipses each of a different size, and differently inclined to any fixed axis. But they will all complete their revolution in the same period of time.

As the orbits of different radions must have different inclinations to the tangent when they leave, *i.e.* their orbits are differently inclined, they have different cylindrical paths. The projection of a screw path on a plain surface at right angles to its axis when the screw is on the surface of an elliptical cylinder, must always be elliptical. (**See Fig. 11.**) The projections on a plain surface along its axis will be in the form of a wave. (**See Fig. 9.**)

The height of the wave will vary from zero to the maximum major axis of the electronic orbit. The former would be the case

when a radion emerges almost in a straight line. But the height of the wave, though it may be zero, cannot exceed half the major axis of the elliptical orbit. The path when seen on a projection on a plane section of the screw path, passing through its axis or course would show crests and troughs. The motion of the radion is of course continuous and screw-wise, but along a cylindrical path ; and so its latitudinal projection is an ellipse and its longitudinal projection is a wave. That radions have a definite mass and weight is shown by the fact that a photographic plate gains in weight by being exposed to light.

Rotation of radions inside an electron also means the spinning of the electron round its axis. They are held together by the force of graviation arising from the emission of gravitons. It will be seen in Part III that so long as superficial spinning is less than C, radions escape. The spinning goes on increasing as the orbits become smaller till a limit is reached when the velocities are equal; after this the radions cannot escape from the electron. Radiation becomes possible only when the velocity of the electron is less than that of the radions in their maximum orbits.

If the speed is stopped, all the radions will escape. This means that the electron and proton as such will cease to exist and all the radions will be liberated as a flash of radiation.

6.—Wavelength

Now the wavelength of the radion will obviously be proportional to the periodic time. Suppose t is the periodic time in which an electron describes its own orbit, and λ is the wavelength of the radion after emergence. Then the distance travelled in time t at the velocity of light C is $\lambda = C.t$. Thus C being constant λ is proportional to time. It follows that from the wavelength of a ray, the period of the electron from which it emerges can be known and therefore the major axis of its orbit. We may take the simple case of circular motions. Suppose a radion is revolving

round the circumference of an electron of the order $2\pi . 2 \times 10^{-13}$ with velocity 3×10^{10} cm. per sec., and also suppose that an electron is moving round the circumference of an atom say $2\pi . 2. 10^{-8}$ with a velocity 4×10^{7} then the period of the electron's revolution $= \frac{2\pi .2.10^{-8}}{4.10^{7}}$ But during this period the radion will rotate once but will at the same time move forward by one wavelength with the velocity of light 3×10^{10}. So the measure of the wavelength will be

$\frac{2\pi .2.10^{-8}}{4.10^{7}} \times 3 \times 10^{10} = 9 \times 10^{-5}$ nearly, *i. e.* less than $\frac{1}{10,000}$ cm.

It will be at once apparent from $\lambda = C.t$ that as the orbit of the electron increases, and therefore t increases, the wavelength will go on increasing. On the other hand as orbit shortens, and period decreases the wavelength also will decrease. (See Part III.)

So infra-red rays are radions with long periods of rotation and therefore longer wavelengths ; while ultra violet rays have short periods of rotation and therefore shorter wavelengths. The difference between radions of long and short wavelengths is that the former are spinning round more slowly than the latter. If this difference in the speed of the rotational motion is borne in mind then the different effects of refraction would be apparent.

When projection is taken on a surface at right angles to the axis, they will be all elliptical, though the axis will be different. The periods in which the various elliptical projections will be revolving determine the wavelengths. The violet rays have quicker rotational speed than the red rays, and so shorter wavelengths. The same longitudinal velocity coupled with different rotational motions mean different periods of revolution round the axis of the cylinder. Thus difference in the wavelength is due exclusively to a different period of revolution.

7.—Spectrum.

In solids atoms are very close and influence each other. So electrons have all sorts of orbits and so all sizes and inclinations. And so radions have all possible wavelengths giving rise to continuous bands. In gases the electrons have fixed orbits, so radions have definite wavelengths. And so a gas only gives lines in its spectrum.

In a spectrum of a gas, we see definite lines first, then they go on increasing and also getting closer, till they merge into a continuous band on the violet side, *i.e.*, when wavelength, time and orbits of electrons are smaller. As will be explained in Part III, this means that the orbits of the electrons are closer and closer as we approach the orbit at which radions cease to emerge, *i.e.*, as mass decreases the orbit increases more rapidly, for $t^2 \propto a^3$.

The decrease of mass effects an increase in the period of time; but less increase in the size of the orbit. (See Part III.)

For a given temperature, every atom will possess outer electrons of the same orbits, and therefore every such electron will give out radions of the same periods. Thus every atom will have characteristic spectral lines.

Section III.—APPLICATIONS OF THE THEORY.

1.—Colour.

It is well-known that in the case of light differences in wavelengths mark the differences in colour. And therefore colour is due to the difference in the rotational speed of a radion, the faster the impinging radion that strikes the retina the more the colour would vary from the red side to the violet side. The speed of forward motion for all rays is the same, but their rotations are different, and the molecules and the atoms of the retina notice the difference arising from the varying rotational motion.

Human vision is limited. Scientific instruments also have a limited range. One can notice things within two extreme limits only. Beyond either limit, our instruments fail to detect any radions. It follows that our instruments detect only those whose rotational motions are between two limits—they do not detect them when they are smaller or larger. The cumulative effect of radions of all wavelengths capable of being seen is what is known as white light. Different radions give different colours ranging from infra red to ultra violet rays. The radions which during the time of travelling round the cylindrical path owing to their slow rotational motion cover a longer distance forward in one revolution as the forward velocity is the same have correspondingly longer wavelengths—these are infra-red. Those which in one revolution cover a shorter distance have shorter wavelengths. These are ultra violet. The latter have quicker rotational motion than the former. The colours differ, because the wavelengths differ, but they all have one constant forward velocity, and so travel together with equal speed, though their paths are along different confocal cylindrical screws. Some are visible to us, the rest are not. Now light of one colour can easily change into one of another by any impact on a radion which changes its rotational motion round the axis, which will alter its projection and therefore its rotational motion with a consequent change in the wavelength. Difference in colour is due merely to difference in rotational motion. Violet rays have shorter orbits and revolve very fast, red rays have bigger orbits and revolve very slowly. It is this motion which affects the retina. Colours would therefore be interchangeable, if external rotational force can be used.

2.—Refraction.

Radions of different wavelengths bend in different degrees when passing through a new medium. Ordinarily those with shorter wavelengths bend more than those with longer wavelengths. (**Fig. 12.**)

The corpuscular theory failed because it was assumed that in a refraction horizontal velocity remains constant. This resulted in a greater velocity for greater refraction which is contrary to experience. In fact velocity is decreased in a highly refracting medium. The assumption was wrong because velocity must be decreased in all directions. The wave theory can explain it only on the hypothesis that every point in the path is a new source. But this would then result in the bending of light in all directions, if the aperture is large. If we increase the aperture by multiples of wavelengths, complete interference sideways will be impossible.

On the rotational theory, velocity is decreased only along the tangent to the spiral curves and remains zero along the normal to it. But as the progress is of ellipses in a plane inclined to the surface of the medium, some ellipses enter the medium earlier than the others. Those which enter earlier have their velocity decreased earlier. By the time the rest enter, the wave front is deflected.

Every visible object that we see, indeed every source of light, has definite dimensions compared to wavelength. So it is always an image that we see and not one single particle of light, *i.e.* radion.

In **Fig. 13**, A B is an object, A′ B′ the next position of the line of rays travelling from A B. A′ b is the surface of a thicker medium. If the medium had been the same, then its position would have been at a b. But as the ray at A will travel more slowly while the ray at B will travel at the former velocity upto b, the distance A′ a′ travelled in the new medium will be actually shorter than A'a. As velocity decreases more, the bending is accordingly more towards the normal. In this short interval although the ray at B will reach b, the ray at A will not reach a but will only reach a′. So with lesser velocity, the image would be bent towards the normal to the surface and so

the axis of the ray would be refracted. That is in a thicker medium the velocity is lesser. Violet radion going faster along the curve loses more than red because of the greater resistance to its tangential speed. So it is bent more than red.

The wave theory without another dispersive theory utterly fails to explain why violet rays with shorter wavelength should bend more than red rays. But on the rotational theory, the position is clear because the diminution of velocity is along the tangent to the curve, and therefore faster waves which have greater velocity along such tangents are resisted more.

A straighter screw is resisted less than a more spiral screw. So the loss of longitudinal velocity is more for violet than red.

Violet radions which are refracted more have accordingly smaller forward velocity than red radions. Ordinarily the shorter the wavelength the greater the refraction, but the longer the penetration. But when we come to the dimensions of an atom, the piercing goes on increasing but the diminution in forward velocity stops.

Every ray of light has definite dimensions proceeding from millions of electrons. At a given moment they are all in ellipses differently situated—some moving one way some opposite way, and so on. The net effect at a time is the resultant effect of all such motions.

It follows necessarily that when light passes through a medium, there is not only a refraction but also more "reddening" as rotational motion also is affected, *i.e.*, a general shifting towards the red.

The result is that the paths of radions of various wavelengths are separated and they are perceived differently. The effect on the human retina is a difference in colour.

Refractions of different radions are different because the rotational motions being different the radions are differently re-

fracted. The explanation is simple. Red light, with its slow rotation has straighter projectional wavelength and so is resisted less and is therefore refracted less. The blue light with its rapid rotation has less straight projectional wavelength and is therefore resisted more and deflected more. The radion with a quicker motion and smaller orbit has its velocity decreased more and so is bent more, just as a faster bullet touching a leaf is bent more. The other shades lie in between. It is submitted that this supposition of a rotational motion gives a true picture of the differences in refraction. Light after emergence can be re-converted into its former colour.

On the wave theory, the smallness of the refraction of X-rays cannot be explained without assuming another dispersive theory, whereas on the rotational theory, when the orbit is smaller than an atom, the result is obvious. Radions will pierce through; there will be a slight refraction.

3.—Penetration.

A solid body has its atom packed together. Hence a thinner screw which is rotating fast, though with less forward velocity, can drill through for a longer distance. In a screw motion, it is the faster rotation which has a greater boring capacity.

A longer screw, with slower rotation is like a nail pierced through by means of a small hammer. If the body is solid, it would not go as deep as with a small rotational force, a screw will drive. The ray takes advantage of the inclined plane principle and finds a lesser resistance against piercing when it has faster rotation. The shorter the wavelength and the quicker the motion, the greater the penetration. The cosmic rays penetrate further than X-rays and X-rays further than ultra-violet rays. The atoms in a medium are packed together closely. The thinner and faster rotating screw can go deeper than a larger and slower moving screw. In a rare medium like air the difference in piercing would be less.

4.—Reflection.

As in reflection the medium is not changed, the different rotational velocities do not cause any change in the longitudinal velocities of the various radions, hence no spectrum is seen on reflection from a smooth surface.

As light radions fall rotating on a surface, the effect is different for different wavelengths. Up to a certain range, the surface behaves as a smooth one. But when we come to small wavelengths, it is no longer smooth. So some rays cannot be perfectly reflected. There is **scattering**. The Raman effect will be discussed in Part III.

5.—Interference.

When it is clear that radions have periodic rotational motions which have the effect of a wave propagation, the phenomenon of interference is easily explained, which was not explicable on the hypothesis of the pure corpuscular theory. The rotational theory of light combines the effect of both the corpuscular and wave theories of light, and fully explains the riddle of supposing that it is uncertain whether light will behave as a particle or a wave. There is no such dual character, nor any uncertainty but light particles have simultaneously a double motion—longitudinal and latitudinal, which produces the effect of a wave because the latitudinal motion is harmonic, the period of rotation being constant for one wavelength.

When two beams of light cross each other, there is bound to be interference when the propagations have the character of waves. Difference in phases will cause interference.

The effect of interference of beams of electrons can be explained on the same principle. As they have rotational motions as well, the effect is that of a wave propagation and interference when they are let through two small holes close together. It would be absurd to say that an electron passes through both the holes

simultaneously, simply because if one hole is shut electrons will be noticed where they were not noticeable before. Now scintillation destroys the wave theory, but strongly confirms the rotational theory.

6.—Diffraction.

If in a wave propagation every point in the wave were a new source of propagation, light would not be found to travel practically in straight lines. When the aperture is many times bigger than the wavelength, the propagation would spread out on all sides. (**Fig. 14.**) Those at distances which are perfect multiples of wavelength would enforce each other. But light travels practically in straight lines, and does not bend round much. (**Fig. 15.**)

The phenomenon of diffraction when the pinhole is small is not due to the fact that every point on the path of light is a new source of propagation, but due partly to the fact that the emerging radions which collide against the uttermost extremity of the pinhole are deflected in various directions. (**See Fig. 16.**) It should be borne in mind that the collisions at this extremity are only against the electrons in the atoms there. This is why Fresnel found no difference whether light passed over the back or edge of a razor.

If we conceive what is happening at the last extremity of the pinhole, we shall at once see that rotating radions strike it at different angles and are at once deflected—the result being that all the deflected radions form a cone. As the pinhole becomes smaller and comparable to the size of the elliptic orbits of the radions, the angles made by the ellipses with the plane of the pinhole approaches zero. The result is that the radions that are deflected proceed from the plane of the pinhole at angles nearly zero. They accordingly tend to fill up all the space beyond the pinhole. But as the pinhole becomes larger and larger than the wavelength, the bulk of the radions pass along the axis without impinging at all. Hence the main light becomes more cylindrical. But inasmuch as the

radions near the surface do impinge at the edge, they are deflected. So those which are deflected go to form the irregular edges of the image. But if the diameter of the pinhole becomes smaller than the major axis of the elliptical motion of the particular rays and therefore smaller than orbital range, the rays will so to speak be straightened out within the thickness of the material containing the pinhole, and the emerging radions will be practically straight and will proceed in all directions. Thus the rotational theory completely explains the effect of diffraction so far as the fringes are concerned.

Experimentally, shots emerging from the barrel of a gun would spread out more and more as the bore of the gun is increased. They emerge rotating. But if the bore becomes nearly equal to the bullet, it will go out in a straight line.

Diffraction is the necessary result of interference. If there be a difference in phase of a half wavelength, *i. e.* $\frac{\lambda}{2}$, then two rays will cancel each other. If d be the diameter of the aperture and the line from the centre of the aperture to a point on the cone beyond which there is no diffraction make an angle with the central path, then it is well known that Sin $\theta = \frac{\lambda}{d}$ **(See Fig. 20.)** So red light will be diffracted more than violet light; and therefore electromagnetic waves would be bent round most of all.

As it is now discovered that electrons also can be diffracted, the fallacy underlying the assumption that only waves can be diffracted has become patent. Rotating radions can be similarly diffracted.

7.—Cavity Radiation.

Would be explained similarly, because the radions inside can not easily get out. They are reflected and reflected again many times before they can emerge. By this time their motion has been considerably affected and the speed of the rotation decreased. So the emerging radiation will be deflected towards the red side of the spectrum if the light going into the cavity is of

one wavelength. The cavity behaves like a dark black surface, which practically absorbs radions and does not reflect them, when light is coming into it from outside.

Conversely the heat, which is merely the motion of the radions will depend on the temperature inside and will be independent of the surface inside, and also of the material.

One temperature will produce the same motion in all atoms, and the same orbits in all electrons, no matter what the material of the cavity. Hence heat emitted will not vary with the material.

8.—Pressure.

Pressure of light can be easily explained, when it is known that light consists of particles or radions which are masses. The bombardment of these particles causes momentum resulting in a force of repulsion. Comets are attracted by gravitation and owing to their velocity pass right round the focus, viz. the Sun; but owing to the pressure caused by radions their tails are thrown outward.

That radions have a definite mass and weight is shown by the fact that a photographic plate gains in weight by being exposed to light.

9.—Filling of Space.

It may be suggested that on the rotational theory of light, as distance increases there would be inter-spaces between cylindrical paths which would have no radions, and so at some angles the object would not be visible at all.

But it must be remembered that every source of light which we see has a finite size. The radions emerge from all points in the source. Thus the emissions from all the points cross each other, resulting in a sort of a network or mesh. **(See Fig. 17.)**

These practically fill all the inter-spaces.

But as distance increases, the number of radions per area decreases in the ratio of the inverse square of the distance, hence the intensity goes on diminishing rapidly, and the object looks dimmer and dimmer.

10.—Polarisation.

When light consists of radions moving in elliptical orbits inclined to the path, one can easily understand how a crystal can let through only such radions as have elongated orbits with major axes parallel to its axis. The light is polarised. Such radions will not pass through if another crystal with its axis perpendicular to the former were to intercept it. Only a very small number of radions which have elongated orbits along the path of ray can pass through both such crystals. Elliptically polarised or circularly polarised light is even easier to understand.

11.—Quantum of Light.

When light consists of similar particles of definite weight and size, it is obvious that a quantity of light emerging from an electron will always be a multiple of the radion. This will make an intermediate fraction impossible. In a wave motion, the quantum theory would be out of place as there is no reason why there should not be a further subdivision giving rise to a fraction. There would also be no explanation why the emission of quanta of light should be periodic in the sense of jumps at intervals. But on the rotational theory the quantity would depend on the orbit and therefore the period and the wavelength. In a revolving orbit the period is fixed by the major axis of the orbit. On a pure quantum theory one would expect purely compressional waves—expanding and contracting. These ought to give longitudinal displacement. But on the rotational theory of light the displacement is mostly latitudinal, only a very small percentage of radions would have a longitudinal displacement along the path.

Planck's Quantum theory rejects the assumption that change of energy is gradual and adopts the conception that change in energy is by sudden jump, represented by multiples of a certain definite unit, not allowing any fractional number. This conception is in perfect harmony with the idea that energy to an electron

is imparted by the addition of one or more radions to the electronic ellipsoid, the additions being only in multiples of a radion.

Planck's constant is a fundamental constant, because we can only perceive particles through the means of light, *i. e.* radions. And so the mass of a radion is a fixed quantity for practical purposes. Gravitations being wholly massial all radions have been reduced to the same common size.

There is a separate quantum of energy associated with each wavelength, because a definite wavelength means a definite orbit and therefore definite velocity, period and mass.

12.—Absorption of Light.

Absorption of light is due to the fact that radions with the same period of motion are taken up by the electron, because they have orbits of the same size and are retained. The radions having other periods of rotation are let through. Hence elements absorb the same kind of radions as they would themselves emit when incandescent, because the orbits and therefore the periods both in absorption and emission must be the same.

All the radions would not affect an electron. Only those radions which have a periodic time equal to that of the electron and a similar orbit can affect it. Those having different periods would simply pass through. The phenomenon of atoms emitting rays of the same wavelength which they absorb, both having the same periodic time has already been referred to.

Thus the wavelength of light which depends exclusively on the rotational period, depends on the period and therefore the orbit of the electron from which it has emerged. All rays emerging from electrons having the same period will have the same wavelengths. If a body is at one temperature, the electrons of the various atoms have similar periods. Thus a group of rays from the outer electrons from all the atoms will have the same periods and therefore same wavelengths, while those from the electrons with smaller orbits and therefore shorter periods will have smaller wavelengths.

If absorption of one Planck's quantum ejects only one electron, then one quantum=the number of radions required to give an electronic orbit sufficient expansion so that the atom may leave the system. This is a constant measure.

The impact of more radions to the outer electron means more velocity to the electron which drives it out still further. As the process continues and more radions impinge the electron leaves the system. When radions are artificially made to fall on an electron, it moves to bigger and bigger orbit till the maximum is reached, and the electron leaves the atom.

It will be clear that just as an electron will give out light of a wavelength corresponding to its period, so an electron can take in another electron only if its period is the same, *i.e.*, it will absorb radions which have the same periodic motion and no other. This will also explain the dark lines in the spectra.

Section IV.—EXPERIMENTAL PROOFS.

A 12 bore gun is first fixed horizontally well tied up with wire so as not to move when fired. Several paper screens are fixed on the ground in a line with the barrel and last of all there is a wooden board as a target. Cartridges have been specially prepared so as to contain only one shot each. The shots are of different sizes and the quantities of gun powder are also different. (**See Fig. 18.**) Then paper screens are replaced by cardboard screens. In the first two experiments, the gun is fixed and the screens are of paper. In the next two experiments, the gun is placed on the cross bars and is fired from the shoulder; and the screens are of stiff cardboard. The distances in the last two experiments from the muzzle of the gun are:—

A, 36 ft. B, 43 ft. C, 44 ft. D, 45 ft. E, 54 ft. F, 61½ ft. G, 66 ft. and H, 71 ft.

The shots used are:—No. 6, No. 4, No. 1, B. B., and S. G., and the quantities of powder are 1 dram, ¾ dram, and ¼ dram.

The holes made by the same shot are given the same number on all the screens and shots are numbered serially. The following four tests are employed, the first two of which cannot be considered satisfactory, so only the last two are relied upon.

(1) A piece of thread is passed through all the holes made by one shot, and observation is made whether it is in a vertical plane.

(2) Light is passed by means of an electric torch through a hole in the first screen and observed from the hole of the same number in the last screen to see if it is visible.

(3) Light is passed through holes bearing the same number in two consecutive screens, its patch is seen on the next screen to judge whether it falls on the hole of the same number or is deviated from it.

(4) Lines are drawn joining three holes bearing the same numbers on all the screens so as to form triangles, then angles which these triangles make with the horizontal and vertical lines are observed.

It must be admitted that there are many disturbing factors, *e. g.*, shrinking of the papers or slight motion of the cardboards, slight moving of the muzzle of the gun, slight vibrations of the fixtures containing the screens, deflection of the shots on impact and their gravitational falls. But allowing for all these possible causes, it can still be said that in each of the four experiments there were some shots which indicated a rotational motion. Of course all the shots emerging from the gun would not have rotation, because some may travel horizontally inside the barrel, only those which hit the sides can rotate.

The shadows of the holes are found to move from left to right when we pass from screen to screen as regards some of the shots. Similarly the triangles of some of the shots were observed to rotate relatively to the vertical. These effects were seen on the distant screens when the velocities had been diminished.

PART III.

Section I.—THE STRUCTURE OF AN ATOM.

It was the assumption that if light consists of particles, they must travel in straight lines which broke down the corpuscular theory. It has been supposed that the wave theory of light is the only possible theory which can explain refraction, interference and diffraction. This wave theory has led scientists further and further on to make more startling assumptions, leading to the quantum theory, the different levels of energy and wave mechanics. Then there is the uncertainty principle, that an atom can behave either as a particle or as a wave, it not being known how it will. A unique conception of the structure of an atom has led to the utter annihilation and destruction of matter itself so that matter is not supposed to exist at all. We are supposed to have nothing in this Universe except waves. Mass does not exist in itself, it increases with velocity, *i. e.* a body gains weight when moving. It seems to me that all these are inversions of the true processes of nature. If we start with the reality of mass we have a better foundation.

It has been seen that an electron is merely a system or group of radions revolving within it. In that sense it may be imagined to occupy the whole space.

When an electron moves from a larger to a smaller orbit it is supposed to give out bottled up energy. But the real truth is that when a radion escapes from an electron, the latter loses mass, the attractive force towards the nucleus is decreased, and therefore the diminished force of attraction cannot now keep it along the old orbit, and it moves on to a slightly larger orbit—So its orbit increases with the loss of mass.

If the force of attraction varies in the ratio of the inverse square of the distance, and the mass of the nucleus be M, that of the electron be m, and the major axis of the electronic orbit be a, then taking the motion round the centre of gravity of the two masses, it is known from dynamics that the period t is determined by the ratio $t^2 \propto \frac{4\pi^2 a^3}{M+m}$

So period increases more rapidly as a increases, and also when m decreases. Loss of mass increases the period, and also the orbit, but the former more rapidly. And therefore if the smaller body is losing mass gradually while the bigger body is not losing mass at the same rate, the small body will move farther and farther till it may go off altogether. Accordingly the tendency will not be to lose energy, fall to a lower level, but to lose mass by giving out radions and go farther and farther away. A nearer body has greater energy, and not lower.

Electrons do not tend to coalesce, but to separate. When they coalesce, it is not annihilation of matter ; but the two cease to exist as independent units when their spinning motions are stopped. Their radions are completely released and they pass out as radions or light. How the vast emission of energy can be maintained by Suns and Stars by the existence of very heavy elements with highly condensed nuclii and therefore with vast energy will be explained in Vol. II.

Now raditation depends on the relative velocity of radions and electrons. Inside an electron, radions are moving with tremendous velocity. Their rotation within the system is maintained by similar emission of gravitons. By emission of gravitons each radion loses mass, its orbit is increased, its period is increased and its velocity is decreased. The orbit is also increased by their mutual collisions. By the time a radion reaches the

maximum electronic surface its velocity has been decreased to almost the constant C which is the velocity of light. This is the value when an electron after expanding reaches its maximum volume. After this limit is reached the radions which constitute the electronic surface will begin to escape ; they will no longer be kept in the system, because C is greater than the velocity of the electron. As each radion escapes, the electronic mass will decrease, then the volume will decrease, till another radion attains a slower velocity and comes to the surface. It then escapes, and the process of alternate expansion and contraction of volume continues. The emission of radions is mainly superficial and not massial. But the rate of emission must in the long run be related to the total number of radions in an electron, because the fewer they are, the greater their orbits and the slower their velocities and so the sooner they will reach the surface with velocity C. It is the motion of the electron round its orbit, and also its spinning motion which keep the radions contained in it.

Section II.—TRONS, ELECTRONS AND POSITRONS.

Now so long as an electron has a resultant superficial velocity less than C, the velocity of light, radions will continue to escape from it off and on, the mass of the electron will decrease and its orbit increase. On the other hand, if we take electrons with smaller orbits, we shall find that their masses are larger, as a number of radions have not yet escaped. By continuing this process in-wards, we come to an orbit where the resultant superficial velocity of an electron equals that of light. If the spinning of the electron be ignored because that is really the motion of the radions, and the orbit only be considered, then the time taken by light to travel a distance of its wavelength λ will be the same as that taken by a point in the circumference to spin round once with the same velocity C.

So $\lambda = 2\pi$ a, where a is the radius of the orbit. We shall give the name "tron" to the group of radions in this stage.

When we go further inward, the process is different. The resultant superficial motion exceeds the velocity of the radions at their maximum range, hence it becomes more and more impossible for radions to escape. Indeed if a radion were to come anywhere near, it will be sucked in and entrapped and will not be allowed to escape. We shall see later on that electron, tron and positron are all similar groups of radions forming a system ; in electrons the velocity of the system is smaller than that of light, in trons it is equal, and in positrons it is greater than that of light. We shall see later that a tron will have a zero charge, an electron a negative charge and positron a positive charge. Thus for electrons, radions are escaping, mass is decreasing, velocity is decreasing orbit increasing, till it leaves the system. Trons are momentarily in a stable condition. In positrons, the velocity is still greater than that of light and no radion can ordinarily escape. Only when some electron or radion with lower velocity comes into the positron, and thereby reduces the velocity of the radion at the outer fringe, the latter can escape. This is why light is found to be emitted from electrons only, the ordinary visible light from the outer electrons and X-rays from inner electrons ; and practically no light from positrons. But γ rays with very small wavelengths have been found to be emitted from the radium nucleus. Cosmic rays also will be shown to come out from the electrons in the neighbourhood of the nucleus. It will also appear that the heavier the element, e.g. uranium and therefore the greater the condensation of mass in the nucleus, the greater is the spontaneous emission of radions and consequently the larger the rate of disintegration or dissipation.

Thus a nucleus consists of positive trons rotating with velocity higher than that of light ; their orbits are very small, and

their periods of revolution very short. This is why 1845 trons of the size of an electron can be condensed into a proton volume smaller than that of an electron. A proton is merely a much larger group of trons revolving within a smaller compass. It comprises the same species of particles; but owing to its much smaller orbit, the average density per volume is much greater. Only when trons or radions of lower velocity are caught in, that the average velocity is decreased. Such a process is slow compared with the disintegration of an electron. But gradually more radions are thrown off, decreasing the mass. Sometimes if the diminution of velocity by the impinging of slower particles is great, positive protons and negative electrons also emerge, e.g. α and β particles. These must necessarily have smaller velocity than the escaping radion, *i.e.* 3×10^{10}. The velocity of α particle is of the order 10^{9}, while that of β particles is nearly that of light. It means that the process enables the velocity to be reduced just below that of radions, to enable not only the radions in the form of X rays to escape, but also negative electrons and positrons to leave the nucleus. In a nucleus there are numerous trons revolving at high velocities. As they go on colliding, they are separated more and more; thus expansion of volume is going on. Those with smaller velocities occupy outer orbits, those with greater velocities occupy inner orbits. When the outer trons reach the limiting velocity of light they are on the verge of being transformed into electrons. These electrons will then go on losing radions and therefore their mass till their complete disintegration.

Section III.—POSITIVE AND NEGATIVE CHARGES.

It will be seen that the difference between a negative and a positive charge is merely one of degree. When there is a balance, and no radions are escaping from it, we have a tron with

a zero charge. Where the revolution is slower and radions are escaping, then we have an electron with a supposed negative charge ; and when we have greater rotational motion and a tendency to absorb radions instead of emitting them, we have a positron with a supposed positive charge.

The stability of a tron, *i. e.* a stable system of radions held together by the force of gravitation is caused by the emission of gravitons, just as the galactic system is held together. It will be explained in Volume II that the position of a positron somewhat resembles the solar system in which the velocity of the sun and therefore of the system is greater than that of its constituent parts, the planets, and so no planet will be able to escape until some external force reduces the velocity of the solar system to that of the planet.

It will be seen that the emission of radions from electrons is in all directions ; while a proton can only absorb radions if there are any in the neighbourhood. These can come from the attached electrons mainly. Thus while the effect of gravititation is to hold the electron in its orbit round the nucleus, the force of repulsion caused by the bombardment of the radions on the absorbing nucleus, which having regard to the nearly equal volumes is merely in a cylinder, of the same diameter as the electron, out of the entire spherical surface of radiation, is small, until the electron comes too close to the nucleus, when the force of repulsion caused by the superficial radiation may overbalance that caused by graviation. (**See pp. 16.**)

The reason why radions can be held in an electron or why electrons can revolve round a nucleus is that although the masses are very small, the distances are equally small, so the force is sufficiently great.

Section IV.—ORBITS AS LEVELS OF ENERGY.

It has been seen that as positrons are trons with greater velocities and smaller orbits than electrons, which are trons with

larger orbits, they contain 1845 times the mass in the case of radium. This is because 1845 times larger number of trons containing radions are contained within the same space. The mass is greater because it has more radions and therefore more gravitons. **(See Fig. 21.)**

The explanation of the idea that electrons with greater velocities have greater mass is that in such a state the electrons are moving in smaller orbits, when so many radions have not yet escaped. It is not that mass increases with velocity, but that velocity is greater because the orbital motion is quicker, therefore fewer radions have escaped by that time, and therefore the mass itself happens to be greater.

The conception that an electron tends to occupy the lowest level of energy by emitting energy and therefore tends to the smallest orbit round the nucleus is inaccurate. It is true that when an electron is in the stage of a tron occupying the limiting velocity it ceases to emit any more radions. In that sense it has reached a stage of small orbit, when no more energy can be emitted by radiation. But it is quite wrong to suppose that because no more energy is being emitted therefore it has reached the lowest level of energy. The position is just the reverse. The emission of energy becomes possible when the orbit is reached. As more energy is lost by radiation of radions, the level of energy decreases. There is less energy in an outer orbit than an inner one. Red rays have less energy than violet rays, and have also less mass. The result is different because the mass is changing.

It is equally wrong to suppose that smaller orbits are not possible, because the electron is at the lowest level of energy. As the rotational motion increases inwards, the orbits decrease, and they will go on decreasing still further till the nucleus is reached. I imagine that we percieve only those electrons which have smaller velocity than that of light ; but those within smaller orbits are

not observed. These smaller orbits must exist as the nucleus consists of trons and positrons moving within the smaller ranges and with much greater velocities.

It will follow that the tendency for an electron is not to lose energy and assume a lower orbit; but the tendency is to lose radions and therefore mass and momentum and move on to larger orbits. The orbits are larger because the mass has diminished. Accordingly the contrary to what is generally supposed is true and the larger orbits are really the levels of lower energy.

Of course an artificial impinging of the electrons by radions or other electrons is not the ordinary natural process. By that means more velocity is imparted to the electron which moves on to a larger orbit, and can be ultimately knocked off. Merely because by increasing the velocity artificially the orbit is enlarged, it is wrong to infer that by a natural process an electron gives out energy and falls to a smaller orbit.

If kinetic energy be measured as $\frac{1}{2}$ m v^2 then for a larger orbit from which red radions emerge, both mass is smaller and velocity is smaller, and therefore the energy is smaller than for violet radions emerging from smaller orbits.

It will be shown in Volume II that stars which appear to give a blue light must be much hotter bodies than those emitting red light. The stars of white light have temperatures in between. Thus the tendency of nature is not concentration, but spreading out. More concentration means higher potential and the flow must be from higher to lower potentials. This is the direct result of the collision of gravitons within a radion. By collisions they are moved further and further apart; volume increases and so density decreases. Again a radion by loss of mass owing to the emission of gravitons assumes a larger orbit and so also volume increases.

It may also appear that radions must be emitted when heavier elements are formed out of lighter elements. If 4 hydrogen atoms

combine to form one helium atom then the orbits of three of the atoms must become larger or else they cannot easily rotate like a stable system. The enlargement of the orbits, means loss of mass which means the escape of radions.

Section V.—ELECTRICITY.

According to this conception, light ordinarily consists of radions emerging from electrons with velocity C and with a rotational velocity equal to the velocity of the electron in its own orbit, which will depend on the size of the orbit and therefore its period, giving light a characteristic wavelength.

On the same analogy, electricity consists of electrons themselves emerging out of atoms, with their longitudinal velocity (which is necessarily less than C) coupled with a rotational velocity equal to the velocity of an atom in its own orbit. That the rotational velocity also exists may be gathered from the discovery that β rays when deflected by a magnet assume a spiral path round the lines of magnetic force.

A body becomes negatively electrified when a larger number of electrons are added to the body and the orbits of the electrons inside the atoms are brought parallel to each other. The electrification is the process by which not only more electrons are added to the atoms in the surface but also more and more electrons are made to rotate in parallel orbits. In unelectrified matter, the planes of rotational orbits are indiscriminately situated. Electrification means a parallel arrangement of these orbits. **(See Fig. 22.)** As electrification in a conducting material is a purely superficial condition, it is obvious that the electrons must tend to place their orbits parallel to the surface. Of course all cannot be brought immediately in parallel planes. The process is gradual. At any given time, the excess of the number of electrons over the positrons gives the measure of the negative charge and the

excess of the number of orbits in one direction in a plane over that in the opposite direction in a parallel plane fixes not only the intensity of the charge but also the direction of that charge. For instance, when the number of orbits in a right-handed direction exceeds the number of orbits in the left-handed direction in parallel planes, then the body has a positive charge in the direction of the axis of the right-handed screw. If there is deficiency, then there is a negative charge in that direction. The path of the emerging electrons and radions is along the normal to the planes to which the orbits are brought; it is from the surface outward in the case of a negative surface. A negative electron revolving in a right-handed screw direction moves forward, it is said to be moving from a negative pole to a positive pole.

Similarly, a positive charge on a surface exists when the positrons exceed the number of the electrons in the surface, and the direction of the charge is along the normals to the surface which are in the paths along which the discharged positrons would travel.

But it will be noticed that the excess of rotations in any one direction merely means the sending out of more radions with rotation in that direction. But this rotational effect is not along any particular line at all, but there are separate though similar rotational effects along all the normals to the surface. At any particular area the forces caused by them are neutralised as at any point on it the radions are impinging from all directions. This is why no magnetic field is created by a statically charged surface. Its only effect is to induce an opposite charge. When the sense of the directions of the radions in the two surfaces are the same, then as the surfaces are opposite to each other, say one faces upwards and the other downwards, the induced charge must be opposite otherwise the impinging radions and the induced radions would not have the same sense for their rotational directions. **(See Fig. 23.)**

Why electrification should involve rotation of electrons in one direction will become clear when we see in Section VII that electrification is brought about by passing current from a wire in which the electrons are revolving in one direction at right angles to the wire.

Section VI.—FORCES IN AN ATOM.

For the system inside an atom, *i.e.* for electrons and positrons the force of attraction is the sum of the apparent forces caused by massial gravitation and raditation minus the repulsion caused by superficial bombardment. So long as the distance between them is not too small so as to bring into play the force of repulsion caused by superficial bombardment even two negative electrons would attract each. The motion of the whole atomic system is exactly like the solar system. The repulsion is experienced only when the proximity is so close that the repulsion caused by superficial bombardment overbalances the attraction. (**See Part II, Sec. I pp. 15-16.**)

If this were not so, and if electrons repelled each other, then it would be impossible to obtain a beam of α or β particles, as they will disperse in all directions as soon as they emerge; the repulsions inter se will separate them more and more. This is not so. Hence intrinsically trons do not repel each other merely because they happen to be either both electrons or both positrons. But the exact gravitational law cannot apply to the whole system, because the nucleus is not emitting radions in proportion to mass, only electrons are and in this small system raditation is appreciable when compared with gravitation, and cannot be ignored.

Section VII--ELECTRIC CURRENT.

A current is a flow of electrons all rotating in planes at right angles to the length of the circuit. As soon as the electrons are separated from the nucleus or position, the electrons move along

one course, and the positrons along another course. As the positrons are heavier bodies, their longitudinal velocities are smaller, but their rotational velocities are greater. Hence protons are not shot off easily and therefore cannot move through a vacuum with the same facility as electrons. In a vacuum the electrons emerge from the negative pole, the cathode. The positrons are not found to emerge from the positive pole, the Anode to the same extent. **(See Fig. 24.)**

If there is a continuous circuit, there is a continuous flow of electrons in the conductor and ions inside the cell, and a current is created. But if the two poles are separated, even then electrons emerge from the negative pole in all directions, but converge on the positive pole. A field of force as mapped out by Faraday is created. The paths of the electrons lie along these lines of force. A magnet placed on the way would be deflected along that line. The apparent force along a Faraday's tube is supposed to consist of a strain in the tube, and the tube is said to have a tension. Really as the electrons and radions are moving along the path, they tend to drag along with them anything that is capable of being affected by their motion, and rotate them in the direction of their own motions.

But as negative electrons coming from the negative pole have all rotational motions in planes at right angles to their path ; there is a right-handed rotational force exercised at right angles to the line of force or Faraday's tube. Thus a magnet placed in the path at right angles to it will rotate. Thus at every point in the line of force there is a rotational twist. This is supposed to be a sort of stress in the medium and Faraday's tubes are said to exercise a lateral pressure. It will be seen later that it is this rotational twist which causes an induced current.

Now when a current is passing along a very long and straight wire, the electrons (or the ions along the other circuit) are revolving in ellipses at right angles to the wire. Some

force their way through the wire after considerable resistance losing rotational velocity considerably and causing more heat and light ; but others emerge at right angles to the wire in all directions from orbits that have the reduced rotational motions. These latter continue to have the same rotational motions, which are now in planes at right angles to the wire and they are all in the same right-handed or left-handed direction no matter what the direction in which they emerge. The radions which emerge from these electrons (or positrons) have exactly similar longitudinal and rotational motions. **(See Fig. 25.)**

Thus an electro-magnetic field is created in consequence of the radions, (and of course also some electrons) moving forward with rotational motions. Being heavier, the electrons move more slowly, particularly because owing to the resistance of the wire their velocities, both longitudinal and rotational have been decreased. The radions have the same rotational velocity, as the electrons, but their forward velocity is of course C. The rotational motion of the radions now is not in planes at right angles to their path, but in planes containing their path, and at right angles to the wire through which the current is passing.

If the current is passing through a circular circuit, the electrons and radions emerge with rotational velocities in planes passing through the centre. The resultant twist of all these from all parts of the circle will be a force normal to the plane of the circle, along the axis passing through the centre. Similar observations can apply to any curve.

Now if there be two parallel long wires carrying currents in the same direction, then each electron and radion emerging from either will have elliptical motion in the same direction—in a plane at right angles to them—say both are right-handed. **(See Fig. 26.)** So when electrons and radions from one wire collide against others from the other wire, they will at the point of collision be

moving in opposite directions. They will thus impede each other. **(See Fig. 26.)** Moving instantaneously in opposite directions they either bring each other to rest if their speeds are equal or at least retard each other, when they collide. If they do not collide they join together to form an atom or electron because their rotational motions are equal and in the same parallel direction. The net result is that more electrons or radions linger on in the space between the two wires. They diminish the emission of electrons and radions on this side. Some by collisions are driven back and hit the wires. But emissions on the other sides are going on without hindrance. So the loss of momenta outward results in an apparent motion inwards, and the two wires experience an attraction.

But if the currents in the two parallel wires were following in opposite directions, **(See Fig. 27)**, the electrons and radions emerging from one wire would have a right-handed rotational motion while those from the other would have left-handed motions in the same plane. When two such electrons meet in the space between the two wires they have at the point of contact instantaneous motions in the same direction, but their rotational motions are in opposite directions. **(See Fig. 27.)** Accordingly they are not brought to rest, but on the other hand bounce off and leave the intervening space altogether. The space between the two wires has now practically no electrons, so more electrons are emitted from both the wires, as compared with those emitted towards other directions. This means a loss of momentum towards the intervening space, and an apparent push away from each other, which is experienced as a force of repulsion. As the rotational motions of the impinging electrons and radions are in opposite directions they cannot possibly join together to form an atom or electron respectively.

The same principles would apply to two circular or similarly curved circuits.

When the currents are flowing through them in the same direction, they would attract each other ; but if the currents are flowing in opposite directions they would repel each other.

It will also be apparent that as radions emerging from the electrons in a circuit are all rotating in planes at right angles to the circuit, electro-magnetic waves will be found to be plane polarised.

Section VIII.—ELECTRO-MAGNETIC INDUCTION.

If there be current in one circuit, and no current in another parallel conducting wire, also forming a closed curve, then electrons up to a certain distance from the circuit depending on the strength of the current, and radions for all distances would have rotational motions in planes at right angles to the straight portion of the circuit A B and have a right-handed motion along axes parallel to the path of the current. (**See Fig. 28.**) As these progress forward in all directions, and reach a parallel wire C D, the latter is under a rotational twist in the same right-handed direction, which keeps the planes of the electrons in the wire at right angles to the wire. There is an equilibrium because there is no current passing, but the position of rotational motion in a plane at right angles to the wire is the same as it would be if a current were passing. Accordingly if the current in the circuit be suddenly stopped the electro-magnetic twist would abruptly disappear and the electrons will momentarily move along the axis C D in order to neutralise themselves. This is seen as an induced current in the same direction as the original current in the circuit. On the same principle, if the current in the circuit is decreased, a corresponding induced current would flow in the wire. The result would be the same if instead of diminishing the current, the intensity of the force is decreased by moving the circuit away from the wire. In all these cases the induced current would be in the same direction.

In the opposite case, the result would be just the reverse. If the current is suddenly introduced, increased or if the circuit is brought closer to the wire, there would again be an induced current, but this time in the opposite direction. This would be the inverse induced current.

It is also clear that the conducting wire need not be really parallel to the current. The radions will bend round to affect the conducting wire in the same way, though the intensity of the effect would be diminished as one travels away from the direction at right angles to the current. The wavelength of an electro magnetic wave being very large, the bending round would be considerable.

Of course the position would be quite similar if instead of the two portions being straight, they were of any similar curvature.

It will also be noticed that although the moving electrons can be deflected in a magnetic field as they carry charges, and their paths owing to their rotational motions, would be spiral round the lines of force, the radions which carry no such charges would not be deflected at all ; but at the same time they will move forward with the rotational motions and so cause induced currents even at long distances.

Section IX.—TWO CHARGED SURFACES.

When the circuit is not closed and there is no continuous and easy passage of electron, but they are assembled on a surface, the latter becomes statically charged. It has atoms and electrons rotating in planes at right angles to the normal at each point of the surface. The directions are all one-sided, either right-handed or left-handed according as the charge is positive or negative. These rotational motions are all parallel to the surface at all points. Thus the apparent force at each point in the surface is right-handed in the case of a positive charge and its axes is along the normal

away from the surface. All electrons, positrons and radions if they could emerge would have right-handed screw motions in the outward directions. But a magnetic field is not created along the imaginary lines radiating from the surface, because the direction of rotation is along all possible normals. At any one point there is impinging of radions from all sides. This has a neutralising effect. If a surface oppositely charged is nowhere near these lines they will continue towards infinity ; but if such a second surface is near by, they will converge to it. Faraday's lines of force will then indicate the paths of the electrons and radions travelling from one to the other.

Now the reason why two negatively charged surfaces repel each other is that when the rotational motions are in the same direction in both the surfaces when they are placed in a line face upwards, the directions become opposite, when one surface is placed above the other face downwards so that they should face each other. (**See Fig. 29.**) The radions and some electrons from the two surfaces hit each other in opposite directions and both are retarded and remain on. They then cause bumping to emerging electrons and radions. Thus both by the loss of momenta when they emerge, and by the momenta imparted when they return to bump again, a force of repulsion is experienced. And as there is no discharge from the opposite sides of the two surfaces diminution in the loss of momenta and the impinging on the inside are in no way compensated by emissions on the outer sides. The impact exercises a pressure, and there is an apparent force of repulsion. The result is the same whether both surfaces facing each other are both positively charged or both negatively charged. In the case of two positively charged surfaces, positrons are emitted and they also cause a repulsion.

But if two surfaces oppositely charged are brought face to face, then the electrons from one would be moving say in a right handed direction upwards, while the positrons from the other would

be moving in a left-handed direction downwards. (**Fig. 29**) Accordingly when they collide, they both would for the time being be moving in the same direction at the point of contact. As an electron has a smaller rotational velocity than a positron, it will at once get caught in and absorbed and would not bounce back. If two similarly charged bodies have necessarily a force of repulsion, one would naturally expect that in the converse case two oppositely charged surfaces would attract. As the radions rotate round the axis of motion with a tremendons velocity, *i.e.*, in ellipses at right angles to the path and therefore parallel to the surface they behave as fastly rotating rings. When a ring coming from outside joins another having the same sense of the direction which is in the surface they move towards each other. This in other words means a pull of the surface which contains the latter ring because the ring does not leave the surface. It is as if its ring drags the surface forward when the ring moves to join the approaching ring. Of course, rings rotating in opposite directions would not join together at all. They will repel each other. These opposite results will be easily explained when we come to examine the results of the Experiments in Section XV of this Part.

If two charged spheres were placed close together, they will on the same principle repel each other if similarly charged, and attract each other if oppositely charged.

As the intensity of the force must diminish with the expanding spherical surfaces, and must be proportionate to the charges, it is quite obvious that the force would vary with the charges and be in the ratio of the inverse square of the distance between them $\propto \frac{(\pm e)\ (\pm e')}{r^2}$.

Section X.—INTERFERENCE AND DIFFRACTION.

Interference and diffraction of electrons have been observed. But as it is wrongly supposed that only waves can cause interference or diffraction, it is inferred that even electrons are not particles

at all, but only waves. In reality they are particles having both constant longitudinal motions, and periodic rotational motions, the combined motion having the apparent effect of wave propagation. The electrons travel with their own forward velocity, and also with the rotational velocity of the atoms out of which they emerge. Their wavelength can accordingly be easily determined.

If the orbit of the atom has radius a, and the atomic motion has velocity v, then the emerging electron with velocity V will have

$\lambda = V \cdot t = \frac{2\pi \cdot a}{v}$ *e. g.* $\lambda = 10^7 \times \frac{2.\pi 2.10^{-13}}{2 \cdot 10^5} = 6.10^{-11}$ of the order of the wavelength of X-rays.

Section XI.—IONISATION.

Ionisation is really the knocking out of an electron from an atom. Now when the radion is moving with a faster tangential velocity, its success in knocking out an electron would be greater than if it is moving more slowly. It would follow that waves of shorter wavelengths would cause greater ionisation than longer wavelengths.

Section XII.—ZEEMAN AND STARK EFFECTS.

Spectrum lines have been discovered to be split up into component parts when the source emitting the light is placed in a strong magnetic field. The magnetic field makes the elliptical orbits of atoms parallel to each other and at right angles to the line of force. Thus their projections on a plane parallel to them when seen from a point in the line are of the same size as the orbits, the projections would have been smaller if they had been inclined to the plane. Hence the radions emerging from the electrons in these atoms rotating in equal and parallel orbits first combine to broaden the characteristic line. But this broad line is the spectral line from all the electrons. And so if the intensity of the magnetic field is increased, even the electrons arrange their

orbits at right angles to the line of force. Their combined effect is to intensify the radions emanating from each electronic orbit. So the broad line is split up into definite lines corresponding to the electrons in the atom.

When seen along the line of force through holes in the poles, the ellipses would become circles in a very strong field, and the light would be circularly polarised. The circular polarisation would be in opposite directions when seen from the holes in the North and the South Pole. But if seen at right angles to the line of force, the circles would appear to be mere lines, hence the light would be plane polarised, both at right angles to and in the plane of the field. (**Fig. 30.**)

The **stark** effect produced by an electrical field is similarly explained.

Section XIII—COMPTON EFFECT.

The scattering of light and the Compton effect were explained by Compton himself on the supposition that X-rays consist of swarms of corpuscles. In fact it is a great proof of the particle theory of light. There is no necessity to resort to the assumption that light has a dual character, and sometimes behaves as a wave and sometimes as a particle, it being uncertain in which way it will behave at a particular moment. If the rotational motion of the X-rays be also taken into account, then it will at once appear that X-rays are particles moving with a periodic rotational motion.

Compton has also discovered that radiation is both deflected and reddened when it encounters electrons in space. This obviously follows from the rotational theory. The impact reduces the rotational velocity, it increases the period, and therefore γ the wavelength, which is the longitudinal motion during the increased time, also increases. And so radiation gets reddened.

It will be shown later on in Vol. II that a good part of the observed recession of the stars can be accounted for by the reddening of light as it travels through space. The collisions

decrease the rotational motion, and make the light redder. The more distant stars are not necessarily receding away faster, but owing to the greater distance and consequently larger decrease in rotational motion there is greater reddening. It has been discovered that the apparent speed at which nebulae seem to be receding from us are almost proportional to their distances. It is the longer distance only which makes them redder, in proportion to the intervening matter. Nearer nebulae appear bluer.

Section XIV.—RAMAN EFFECT.

It has been discovered that when light is scattered some rays are of the same and some of different frequencies from that of the incident light, both higher and lower. Now frequency which is the inverse of wavelength depends on rotational motion which may be altered before scattering. Surfaces which are comparatively smooth for long waves and reflect them, are rough to short waves. Thus short waves would be scattered more than long waves. Now the impact on an atom would reduce the rotational motion, or increase it according as the rotational motion of a radion happens to be in the opposite or the same direction as the rotational motion of the atom or electron. So wavelength of the scattered ray may be greater or less than that of the incident ray. It follows that scattered light can become redder and can also become bluer as it is scattered. That is why there are scattered rays of equal, higher and also lower frequencies.

Section XV.—COSMIC RAYS.

It has been seen that when the resultant velocity of a tron is greater than that of light, *i.e.*, C no radion can come out. The limiting velocity is when the circumferential velocity of an electron is equal to the velocity of light.

In this case $\lambda = C.t$; and $t = \frac{2\pi a}{v}$

but $v = C$

So $\lambda = 2\pi \cdot a$

This is obvious, for in such a case, the velocities being identical, the wavelength must be equal to the circumference of the orbit.

If we calculate the radius of the orbit which emits radions of the wavelength of cosmic rays, *i.e.* $\lambda = 10^{-14}$ cm.

Then the radius of the orbit would be nearly $\frac{1}{6}$ of 10^{-14} cm.

i.e, of the order 10^{-14} to 10^{-15} cm.

But the radius of an electron is of the order $2{\cdot}10^{-13}$

It would follow that a proton of the dimensions $\frac{1}{5}$ to $\frac{1}{50}$ of an electron would just prevent radions of smaller wavelengths than cosmic rays from emerging.

Thus Cosmic Rays are ordinary radiations from electrons revolving in orbits close to the proton ; and a proton is that system of radions which is revolving so fast that no radions can emerge from it.

It would follow that the velocity of cosmic rays would be close to that of light. Had cosmic rays been coming from outside they would not have been uniform in all directions. In fact after travelling for long distances they would have been converted into γ-rays or X-rays. But rays of the dimension 10^{-15} may when coming from stars become cosmic rays.

Of course, owing to the high rotational velocity and much smaller orbit of rotation they penetrate into a solid deeper than even X-rays, as a thin fastly rotating screw would do.

But as regards the longitudinal velocity, the range being smaller than an atom, they would pierce through and the velocity would not be affected.

Section XVI.—EXPERIMENTAL PROOFS.

Fig. 31 shows a fixed rotating disc underneath. There is another rotating disc hung by means of a thread just above it

which passes over a pulley. While the two are in quick motions parallel to each other and close together, the thread is gradually lowered or suddenly cut with a pair of scissors. It may be found that—

(1) When the projections of the two rotating discs on an imaginary plane between them are rotations in the same direction, *i.e.* their rotational directions have the same sense, then the two discs would attract each other and meet.

But (i) if the speeds of revolutions of the two are not equal, then the upper disc would be laterally thrown off the surface.

(ii) If the two speeds are equal, it will remain attached and revolve with the lower disc.

(2) If the projections on the same plane are in opposite directions, the upper disc would be found to be repelled as soon as it touches the lower disc. It will not only be thrown off along the surface but would be thrown upwards.

In **Fig. 32** there are two pairs of discs (or rings) of equal radius, each pair attached by means of a rod so as to resemble two wheels of carriage fixed to an axle. Both of these pairs are placed on two grooved and oiled rests so that each pair can rotate on these rests.

(1) If the two discs (or rings) which are made to touch each other happen to be rotating in the same direction, they would not be repelled. If their speeds differ, there will only be a lateral pressure.

(2) If the discs are rotating in opposite directions, they will be repelled from each other.

In **Fig. 33** there are two persons smoking cigarettes and throwing out smoke rings from their mouths towards each other. The rings as they are thrown out by one person are made to collide with the rings thrown out by the other.

(1) It may be seen that when the rings are rotating in the same directions they meet and merge and move together. They have been attracted.

(2) But when the rings are rotating in the opposite directions, they may be repelled backwards as soon as they meet and proceed in different directions.

Fig. 34 represents a glass reservoir with a liquid in it. Vortices at the bottom are caused by means of the V shaped end of a rod pierced through an elastic rubber patch glued over a hole at the bottom with a rubber solution. Vortices on the top of the liquid are caused by a small V shaped rod held by hand. In this way vortices can be sent up from the bottom upwards and can be sent down from the top downwards.

(1) If the vortices from top and bottom when meeting are moving in the same direction, no repulsion will be observed. There may be only a lateral motion if the velocities are not equal.

(2) If when touching they are moving in the opposite directions, they may be momentarily repelled from the plane of contact.

Fig. 35 shows vortices on the surface of a liquid. It will be noticed that there is no analogy between this experiment and the preceding ones. Here the vortices are moving in the same plane and when they touch each other, it is only their outer fringes or circumferences which just touch. The vortices are not as a whole impinging on each other bodily.

(1) It will be seen that when the vortices are moving in opposite directions at the time of the contact, then—

(i) They will mix up and destroy each other if the motions are exactly equal though in opposite directions.

Fig. 36 shows an apparatus of the same kind as in **Fig. 3.** The difference however is that the outer ends of the horizontal glass tubes at the bottom are wholly closed so that there is no loss of momentum on the outer sides at all. The two will be found to repel each other when brought close together when water is discharged from both.

As the results cannot be certain when only crude methods are employed, and without elaborate arrangements accuracy can not be ensured, the observations stated in this section should be taken as mere suggestions or submissions.

PART IV.

MAGNETISATION.

Just as electrification is the re-arrangement of rotational orbits of electrons in parallel planes so that emerging electrons come out reinforcing each other in the same direction and have rotational motions in parallel planes, magnetisation is the rearrangement of rotational orbits of atoms in parallel planes so that if atoms were to emerge they would have rotations in parallel planes. But atoms do not in fact emerge from molecules so long as the compound material does not change. Hence magnetisation is a static state.Electrons do emerge from atoms without changing the property of the element, and so electric current is dynamic.

The excess of molecules rotating in one direction, say right handed, over those rotating in the left-handed direction, resolved along the plane at right angles to the axis, causes magnetisation. It has north and south poles according to the direction of motion—the north pole being in the direction of the head of the screw in a right-handed rotational motion. The larger the rearrangement of the molecular orbits, the greater the magnetisation. The resultant effect of all rotational orbits is a force along the axis, which will be the path of least resistance in that field. The north and south poles will lie along it.

The difference between a charged surface and a magnet is that in the case of the surface, the rotating electrons inside atoms are all on the surface and spread over it ; they are not inside the material at all. This is so because electrons can leave one atom and pass on to the next till they reach the surface. But in the case of a magnet, the magnetisation is throughout the volume, each molecule is a little magnet in itself, as atoms do not pass on from one molecule to another, and do not congregate at the poles.

PART V.

HEAT.

Section I.—GENERAL.

Heat is well known to be the increased motion of atoms and molecules. The greater motion causes more collisions and expansion for a given number of molecules. Now the apparent heat felt by us is the effect of increased molecular motion. But molecular motion can be increased by—

(1) either imparting direct motion to the molecules by impinging on them other molecules moving with greater velocities.

or (2) indirectly by increasing the motions of the atoms, which in their turn increase the motion of the molecules.

In the first case heat can be produced by mechanical force, when work done is transformed into heat. In the second case by chemical action.

Similarly motions can be imparted to molecules by first imparting them to atoms by means of impinging electrons when electricity and heat become convertible.

And motion can also be imparted to electrons by impinging radions, which ultimately pass it on to atoms and then to molecules. This means conversion of light into heat. By the reverse process we can produce work, electricity and light from heat.

The greater the rotational motion the larger would be the heat produced by radions. Thus radions of shorter wavelengths will produce more heat than those of longer wavelengths. Violet rays will in a given time cause more heat than red rays. On the other hand electro-magnetic waves would cause hardly any heat.

If the path of an atom emerging from a molecule could be observed it would be spiral or screwlike. It will have the forward velocity of the atom, and the rotational velocity of the molecule. Its wavelength can be easily calculated in the same way as that of an electron.

Section II.—SAHA'S THEORY OF THERMAL IONISATION

Heat increases the translational velocity of atoms. So with increased heat collisions between atoms are more frequent and vigorous. In this way by a mere process of heating electrons can be knocked out of atoms. This result is not due to any loss of mass at all, but due to increase in translational velocities caused by artificial heating.

VOLUME II.

The Outer World.

The next volume will deal with bigger astronomical objects like the moon, the earth, other planets, the sun, the stars, the galactic system, nebulae and the universes. An attempt will also be made to show how the obliquity of the Earth's ecliptic, the precision of the equinoxes, the original formation and rotation of the planets round the sun, including the shifting forward of the perihelion of the orbit of Mercury, as well as the spiral nebulae can all be explained on the supposition that a combination of several independent and simultaneous motions can result in an orbit which is not a perfect ellipse but a curve in the form of a helix the curve along the axis of which is an ellipse. For example, the Earth's orbit is not an ellipse but a screwlike curve along the imaginary orbit, which places the Earth above and below the plane of the orbit in different seasons. In the case of Mercury which is very close to the Sun, the motion in a curve of a helix form disturbs the expected result of the law of gravitation because the change in the distance from the Sun as Mercury proceeds along its helix form is sufficiently appreciable.

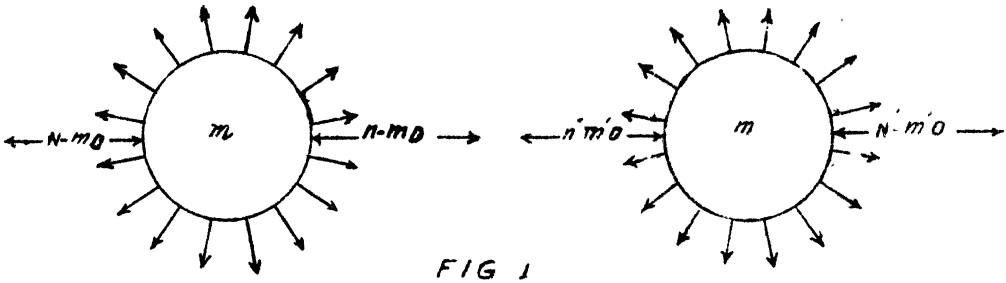


FIG 1

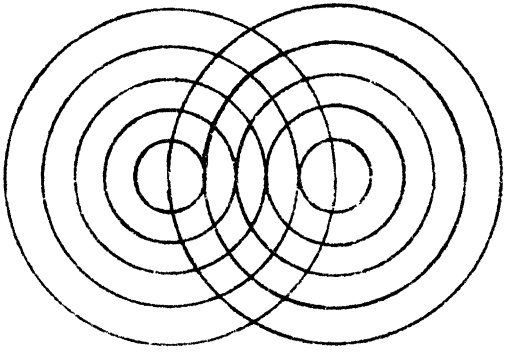


FIG 2

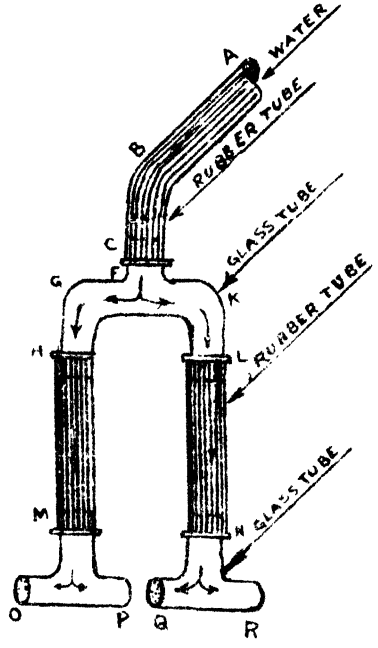
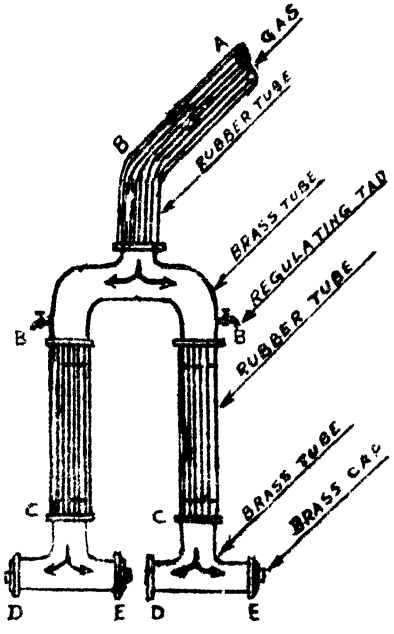


FIG 3



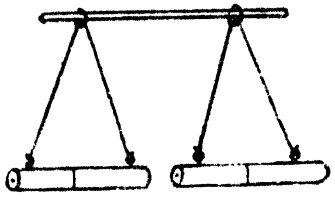


FIG 5

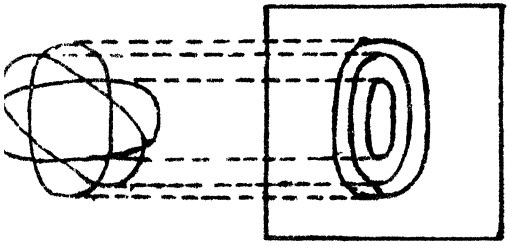


FIG. 6

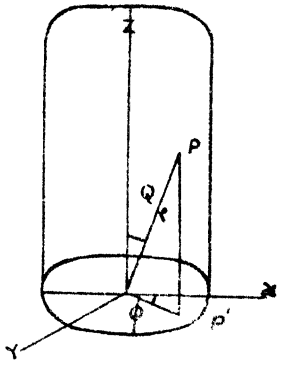


FIG. 7

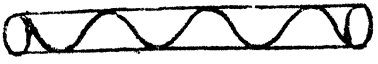


FIG 8

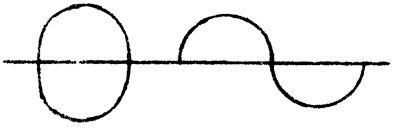


FIG. 9

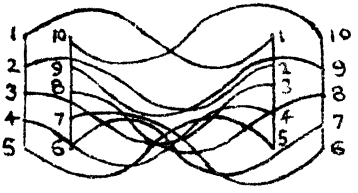


FIG. 10

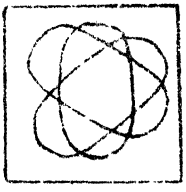


FIG 11

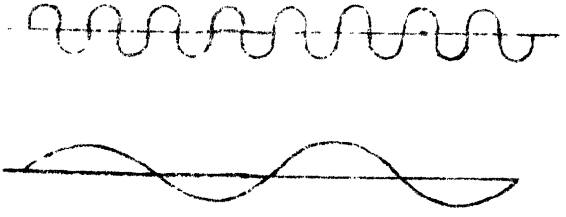


FIG 12

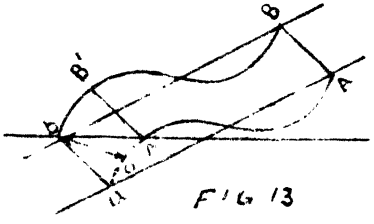


FIG 13

FIG 14 (.)

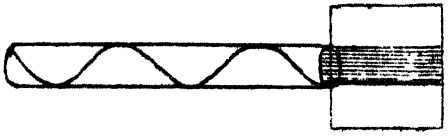


FIG 15

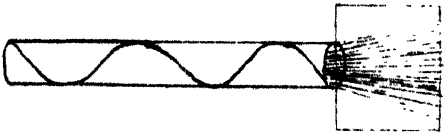


FIG 16

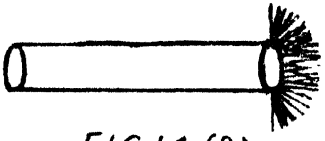


FIG 14 (2)

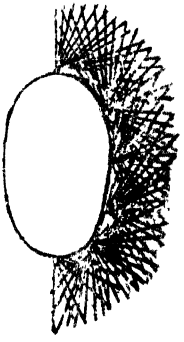
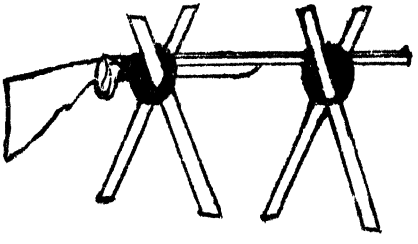


FIG. 17



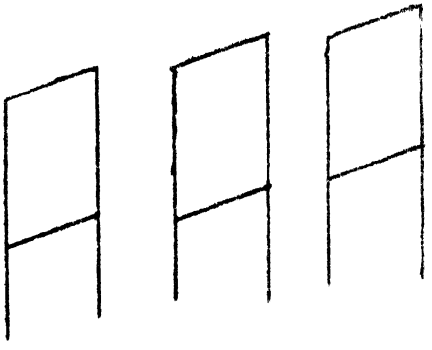


FIG. 18

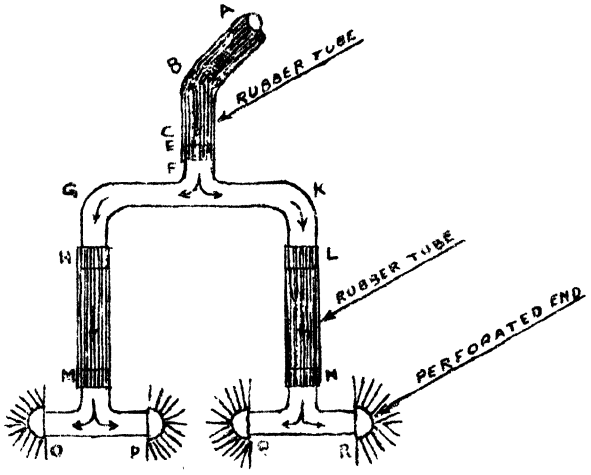


FIG. 19

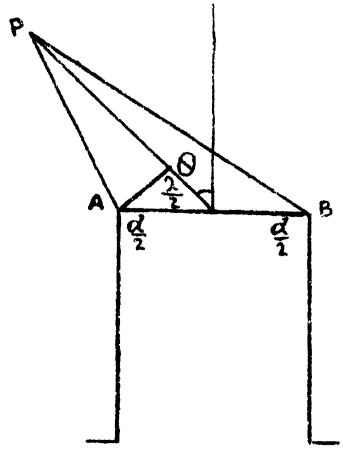


FIG 20

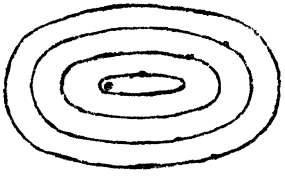


FIG 21

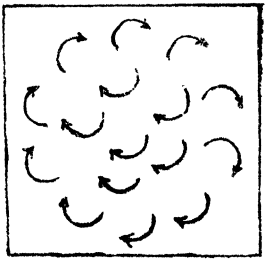


FIG. 22

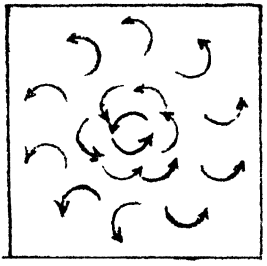


FIG. 23

FIG.24

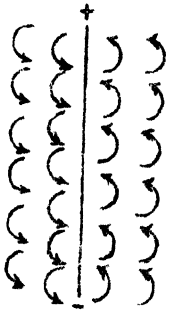


FIG. 25

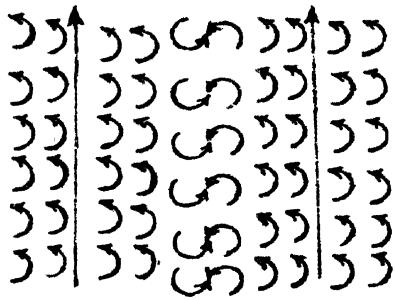


FIG. 26

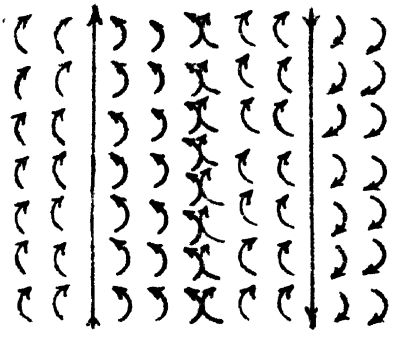


FIG. 27

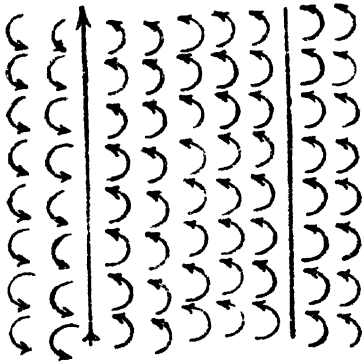


FIG. 28

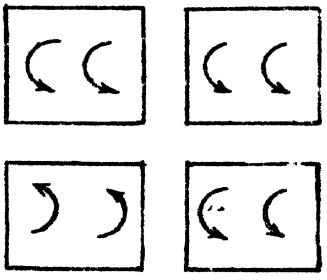


FIG. 29

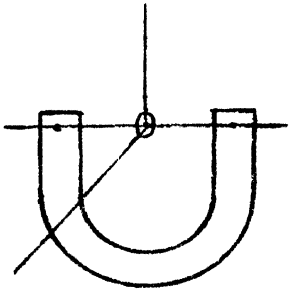


FIG. 30

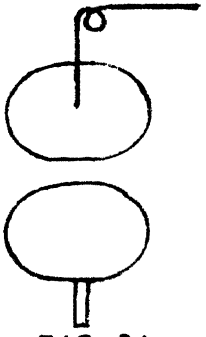


FIG 31

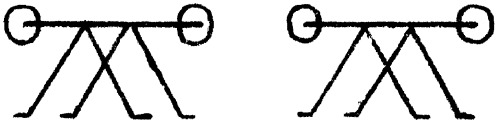


FIG 32

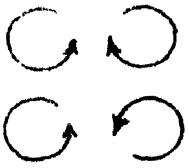


FIG. 33

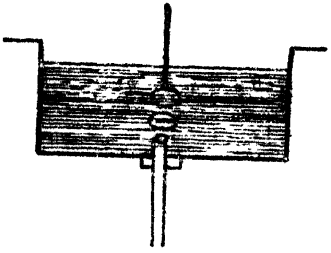


FIG. 34

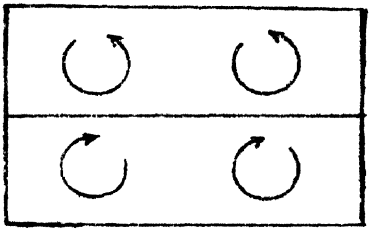


FIG. 35

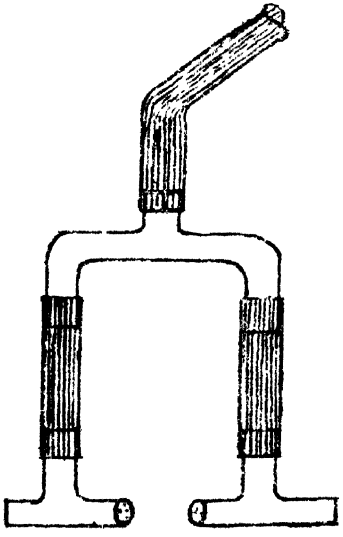


FIG 36