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CAN THERE BE A SHIELD FOR GRAVITATION?

by

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SUMMARY

The essay makes no attempt to propose a shield for gravitation. It discusses the inner mechanisms of shielding and absorption in the cases where we know those phenomena to occur. These mechanisms - in electrical shielding, for example - usually involve not an actual absorption of the primary agency against which the shield is provided, but rather a cancellation of the effects of that agency, by activities induced in the shield. In the electrical case, the dominant feature which renders the process possible is the existance of two kinds of electricity, opposite in nature in the sence implied in the terms positive and negative.

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The purpose of this essay is not to propose an absorbing shield for gravitation, but rather to examine the possibilities for realization of such a shield in the light of the present state of our knowledge in science.

The simple picture of absorption is one in which something travels onwards until it meets the absorbing material which, as it were, swallows it up. Thus, if moist air meets a porous screen which absorbs water by chemical action, the air passes through, but the water is left in the screen.

Again, think of light coming through the window, We draw the curtain and the light no longer enters the room. We say that the light has been "absorbed" by the curtain.

Our office is noisy. Every sound we make comes back to us, by reflection from the walls, so we cover the walls with absorbing curtains or felt and silence is secured.

We have a portable radio on the table, singing merrily. We put it in a metal container and it no longer operates. We think of the incoming radio waves as being absorbed by the container.

We are performing some delicate electrical experiments in our laboratory and people are walking about with rubber shoes. They become electrically charged and the charges disturb our

experiments, so we surround our apparatus with a metal case and the trouble disappears. We naturally think of the offensive electrical forse emanating from the charges generated here and there in the room as being absorbed by the enclosure.

In view of all these things, it is natural for us to ponder upon the earth attracting a falling body, causing it to increase its velocity continually. We cannot but wonder whether it would be possible to design, from some suitable material, an enclosure whose walls would "absorb" the gravitation pull of the earth so that the body inside would no longer fall.

Now, there has been a theory of gravitation which could, in principle, lend itself to absorptio slightly analogous to the chemical absorption to which we have referred, or perhaps more closely analogous to the absorption of dust from air passing through cotton wool. This theory of gravitation, put forth by Le Sage many years ago, postulated that all space was filled with small particles traveling in all directions with high speeds. Let us now consider two bodies A and B, Fig. 1.

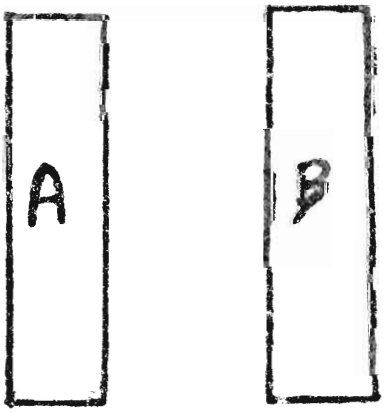

Fig 1.

If A were alone, it would be bombarded by particles from all sides and would show no tend- to move. This would be true whether the particles falling upon it were totally or only partially absorbed. Now when B is present, some of the part-

icles which would have come to A from the right are absorbed by B, so that A is bombarded more from the left than from the right and moves to theright. By analogous argument, A partially shields B against bombardment from the left, so that B tends to move to the left. The net result is that A andB move towards each other as though they attracted each other. If the bodies A andB were very thick in the left-right dimension, or if they were composed of some material very opaque to the particles, so that indeed no particles reached the space between them, a body placed between them would show very little or no tendency to move towards the left or right as a result of the presence of external bodies to the left or right of both A and B, and we should have a "shield" for gravitation.

A hendred years ago, we might have accepted such a speculation as is here involved as something not unreasonable. For we recall the fact that light radiation from the sky is stopped completely by a very thin sheet of metal foil, whereas it can penetrate with ease the whole atmosphere which, as far as mass is concerned, represents the equivalent of 14 pounds per square inch, and we might well wonder whether there might be some substance so opague to the flying particles that a relatively thin sheet of it would afford a shield. Alas for such speculations, however, we have learned so much about the structure of matter during the last century that we see no place for the existence of such a substance. Neither do we see any place for the flying particles. Our studies of cosmic rays have indeed introduced us to real particles of

enormous energy per unit mass flying through space in all directions. However, our critical faculties have become so sharpened in the studies of these rays that, today, much more than formerly, we must look with considerable scepticism on the existence of such particles as would have the properties necessary to account for gravitation in the foregoing sense.

Let us, however, turn to the crucial differences between electric forces, on the one hand, and gravitational forces on the other hand, which make it so easy to understand shielding in the former realm and so difficult to understand it in the latter.

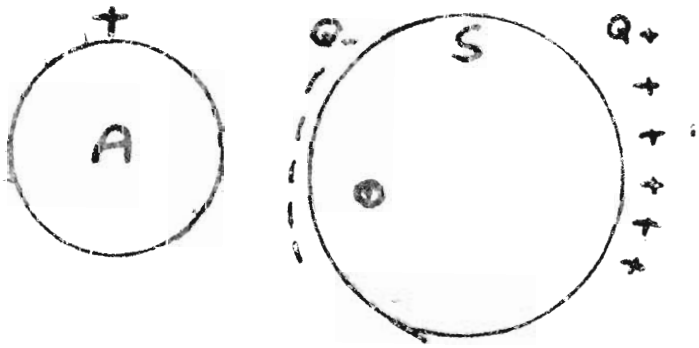

Fig 2

If A, Fig. 2, is a positively charged body, S a metallic shield, and O a point within it, we know that apparatus at O will be " shielded" from the influence of A. However, we do not visualize the shielding procedure as one in which the electrical forces emanting from A are somehow or other absorbed by S. We recognize the known fact of the existence of two opposite kinds of electricity, positive and negative. The shield contains both kinds in equal amount, so that it is neutral as a whole. The positive electricity is fixed in the atoms of the "matter" of the shield, but in an electrical conductor the negative electrons are free to move, and they do so move as far as they can, toward A which attracts them, thus leaving a positive charge on the part of the shield remote from A. Now if we should put a charge of positive electricity at O, the force due to A would push it to the right. However, the push due to the charge labelled Q_+

[illegible] the pull due to the charge [illegible] and Q combine to urge it to the left. It turns out that the push to the right resulting from A just balances the two pushes and pulls due to Q+ and Q- respectively, and so the charge at O is "shielded" from the external influence originating at A. We see that in this case the ultimate achievement of the shielding depends upon the existence of two opposite kinds of electricity. If there were two kinds of gravitational matter, one kind K_1 which repelled its kind, and another kind K_2 which repelled its kind, and if the kind K_1 attracted the kind K_2, then we might hope to realize shields for gravitation in the same manner as we realize shields for electrical forces.

Consider another rather more subtle case, where a beam of light waves or radio waves impinges upon a plate P, Fig. 3, with the result that nothing is observed to the right of P. The accepted way of regarding this phenomenon is not to suppose that the waves are somehow or other absorbed by P. We, indeed, say that nothing happens to the waves. They go on right through P, off to infinity. If we ask: "Why then do we not observe them?" the answer is that they set up electric currents in the plate P, which currents send out waves on their own to the right of P, but waves which are "out of step" with the original set in the sense that the "crests" of one set coincide with the "troughs" of the other. Thus, while there is "nothing" to the right of P, the nothing is, as it were, composed of equal and opposite halves. If P is what

Fig 3

we call a complete reflector, the electric currents set up in it send waves to the left as well as to the right and the nature of things is such that the waves which go to the right are out of step with the original set, and so cancel them, while the waves which go to the left cooperate with the original set to produce what we call reflection. If gravitational forces could be explained in terms of waves, and if matter were such that these waves, we might be able to realize a shield for gravitation in the same way that we shielded the radio, introduced at the beginning of this essay, against the waves from without by the metal container with which we surrounded it.