

A Plane World

By Charles H. Hinton

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WHERE the sun's rays grazing the earth in January pass off and merge into darkness lies a strange world.

'Tis a vast bubble blown in a substance something like glass, but harder far and untransparent.

And just as a bubble blown by us consists of a distended film, so this bubble, vast beyond comparison, consists of a film distended and coherent.

On its surface in the course of ages has fallen a thin layer of space dust, and so smooth is this surface that the dust slips over it to and fro and forms densities and clusters as its own attractions and movements determine.

The dust is kept on the polished surface by the attraction of the vast film; but, except for that, it moves on it freely in every direction.

And here and there are condensations wherein have fallen together numbers of these floating masses, and where the dust condensing for ages has formed vast disks.

And these disks are glowing hot--yet no light comes from them into our universe.

For this world lies beyond the aether--far beyond. And however hot or glowing the masses are, if there is no medium to transmit the vibrations of heat the influence cannot travel.

Thus the only directions in which the heat can travel are on the film. From each of these glowing disks the luminous influence streams forth carried by the vibrations of the film which supports everything. For the heat and intense agitation of these glowing disks shakes and disturbs the bubble, and just as a thin soap bubble quivers and shakes, so this film quivers and shakes. And so elastic is it, and so rigid, that it carries the light and heat to all surrounding regions. Yet so vast is the bubble, so tremendous in its dimensions, that the agitation from these glowing disks travels almost in straight lines till, spreading out on every side, it merges into darkness--like the ripples in the center of a vast calm lake gradually become indistinguishable.

And round these central orbs of fire--for orbs of fire they are, though they only transmit their fire along the film of the bubble round these orbs pass in due order and succession other disks, which, cold or warm, have not that energy of light and heat which the central orbs possess.

These disks, though large, are so immeasurably small compared with the vast surface of the all-supporting bubble, that their movements seem to lie on a plane flat surface; the curving of the

film on which they rest is so slight compared to their magnitude, that they sail round and round their central fires as on a perfect level surface.

And one of these orbs is fitted by nature to be the habitation and home of living beings. For it is neither so hot as it was for long ages after it had condensed from the film of dust wherefrom all orbs are made, nor has it so cooled down as to render life unsupportable.

And, moreover, it is full of vast crevices and channels, for in many places the interior in cooling after the rim had set from its molten condition has left long caverns and passages, not only in one layer, but in many.

And on the rim and in these passages and caverns live the inhabitants of whom I speak.

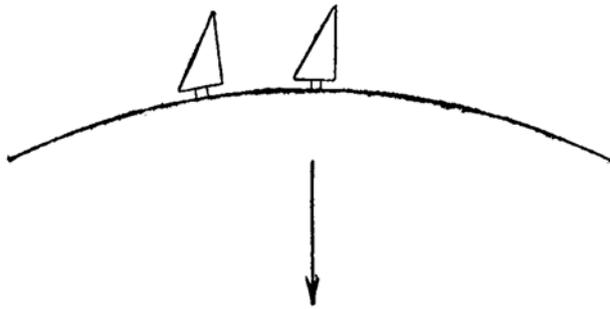


FIGURE 5. Two beings walking round.

They do not rise from the surface of the film, but as all matter lies on the smooth surface but one particle deep, so their bodies formed out of matter lie, as we should say, on this smooth surface.

Yet of this they know nothing. They say that they stand and walk.

For this orb has an attractive force.

By that very same impulse of coming together whereby it gathered its particles out of the dust on the bubble, by that very same force it draws towards its center all that is near it or on it. Thus "up" is to these inhabitants a movement from the center of the disk on the rim of which they live and away from it. "Down" is a movement from the rim towards the center. The thin layer which forms the mass of the disk is their solid matter. They are not able even in thought to rise away from the surface of the bubble, and look from space upon their mode of existence. They ever pass to and fro upon a line, upon a rim; and no two can walk except after one another. If you look at the rude picture you will see that the two beings represented by two triangles cannot pass one another if they are unable to lift themselves up from lying on the surface of the paper. The surface of the paper represents the surface of the bubble, and sliding freely on it, but unable to lift up from it, are tenuous shapes that are the inhabitants, and that thin layer of particles that is to them solid matter.

Now were it not for the fact that the orb is reft into these chasms and passages, the only movement that these beings would have would be of passing round and round on the rim of their world.

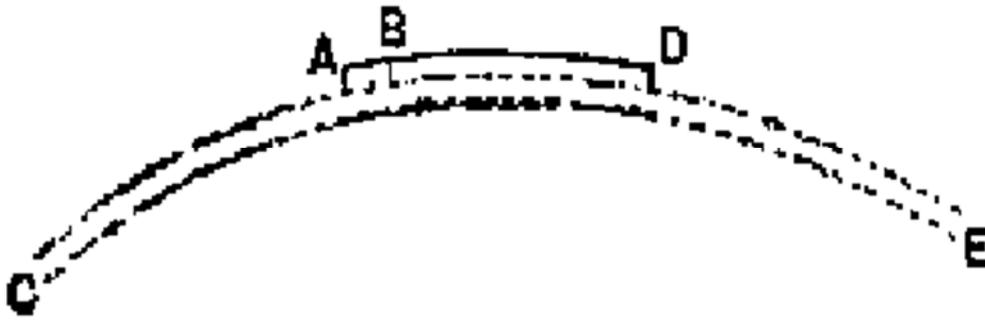


FIGURE 6. A Section of the film of the bubble showing a disk BD lying on it, and a creature AB on the rim of the disk. CE is a section of the film, BD is a section of the disk, AB is a section of the creature. The thickness is enormously magnified and also the height AB of the creature compared with the diameter BD of the disk. The attraction which AB feels keeps him to BD; both AB and BD, the being and the disk, slide freely on the film CE without knowing of its existence.

Many words that we have, to them could bear no meaning. Thus "right and left" is to them unknown. For consider their faces bent in one direction along the rim. In following this direction, they go forward, in retracting from it they go backward. If they go away from the center they go up, towards the center is down. And by no means can they turn, raising themselves from the surface whereon they are. They do not even know that they have two sides; their movements, thoughts, and imaginations are all confined to that surface on which they are. This they call their space, their universe; nor does aught that lies beyond it, towards the interior of the bubble or away from it, directed outwards, come into their thoughts, even as an imaginary possibility of existence.

Life is extremely limited on such a world. To take a single instance, in order for two beings to pass each other, a complicated arrangement is necessary, shown in figure 7.

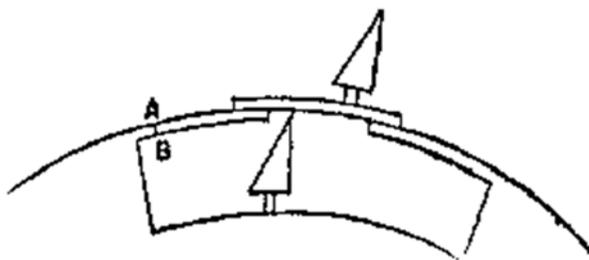


FIGURE 7. Two beings passing.

At intervals along the rim recesses and chambers are constructed. Near the openings of these chambers lay movable plates or rods. When two beings wish to pass, one of them descends into the recess the other one pushes the rod so as to form a bridge over the opening, walks across it, and then removes the plate so that the one who has descended can get up and go on his way.

If by any chance, while a being is in the recess, the plate or rod which acts as a bridge gets fixed, he is in a dangerous predicament. For suppose a being confined as shown. If he, suffering from want of air, cuts through the roof at AB, the whole part to the right of AB comes tumbling down. For its only support is severed when AB is cut through. It is impossible to make a hole which is not the whole width of matter as it lies on the surface. And with regard to this all constructions have to be made. There cannot be two openings in a wall of a house, unless when the one is open the other is so fashioned as closing to act as a rigid support to the wall, which now depends for its upholding entirely on it.

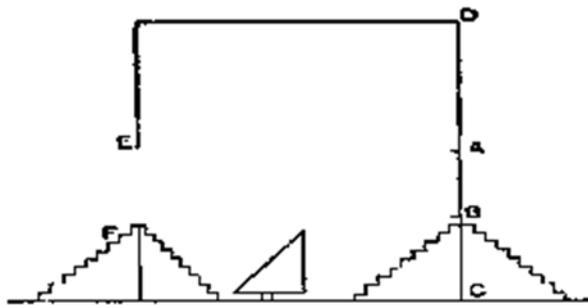


FIGURE 8. A house.

Thus, in the diagram (fig. 8), the house is held up entirely by the side opposite to the doorway EF, which is now open. The roof is supported by the side CD. If an opening AB be made in the wall CD before the doorway EF is closed, the roof will fall in. So, in order to pass through the house, EF must be firmly shut up before AB is opened. The houses are always built in the interior passages so as to leave the rim of the disk free for locomotion.

And there are many things to be said of the inhabitants on this disk with respect to their social and political life. It is hardly necessary for me to put down much about it here, for any one by using the method of the historian Buckle, and deducing the character of a people from their geographical influences and physical surroundings, could declare what the main features of their life and history must be.

But one or two remarks may be made here. First of all they are characterized by what I may venture to call a crude kind of polarity.

In dwellers in our world this polarity, which shows itself amongst other ways in the distinction of sexes, is tempered and modified.

In every man there is something of a woman, and in every woman there are some of the best qualities of a man.

But in the world of which we speak there is no physical possibility for such interfusion. In a linear existence there would be no consciousness of polarity. It makes its appearance first in the plane, and in a hard and unmitigated form.

It is impossible to do otherwise than caricature these beings when we write of them thus in brief. So let us accept the matter frankly, and, without scruple, look at them in the broadest possible manner.

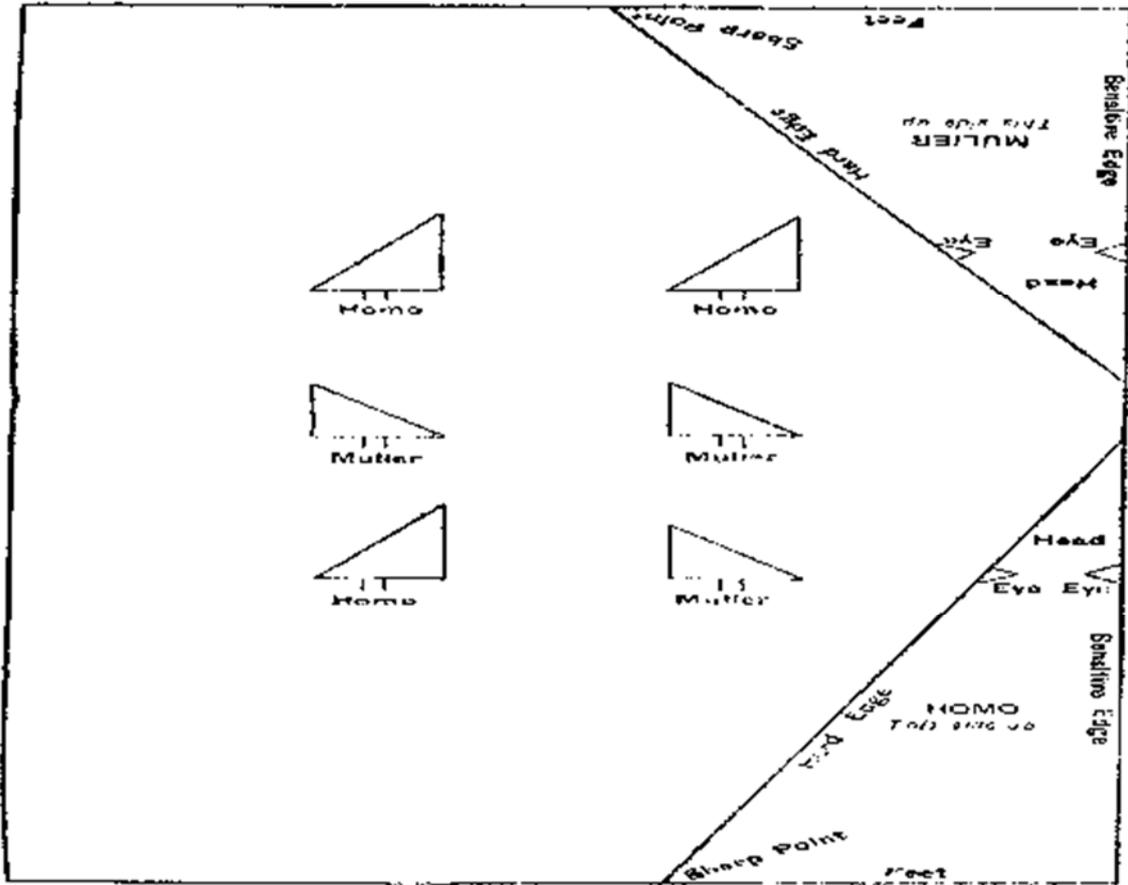


Figure 9

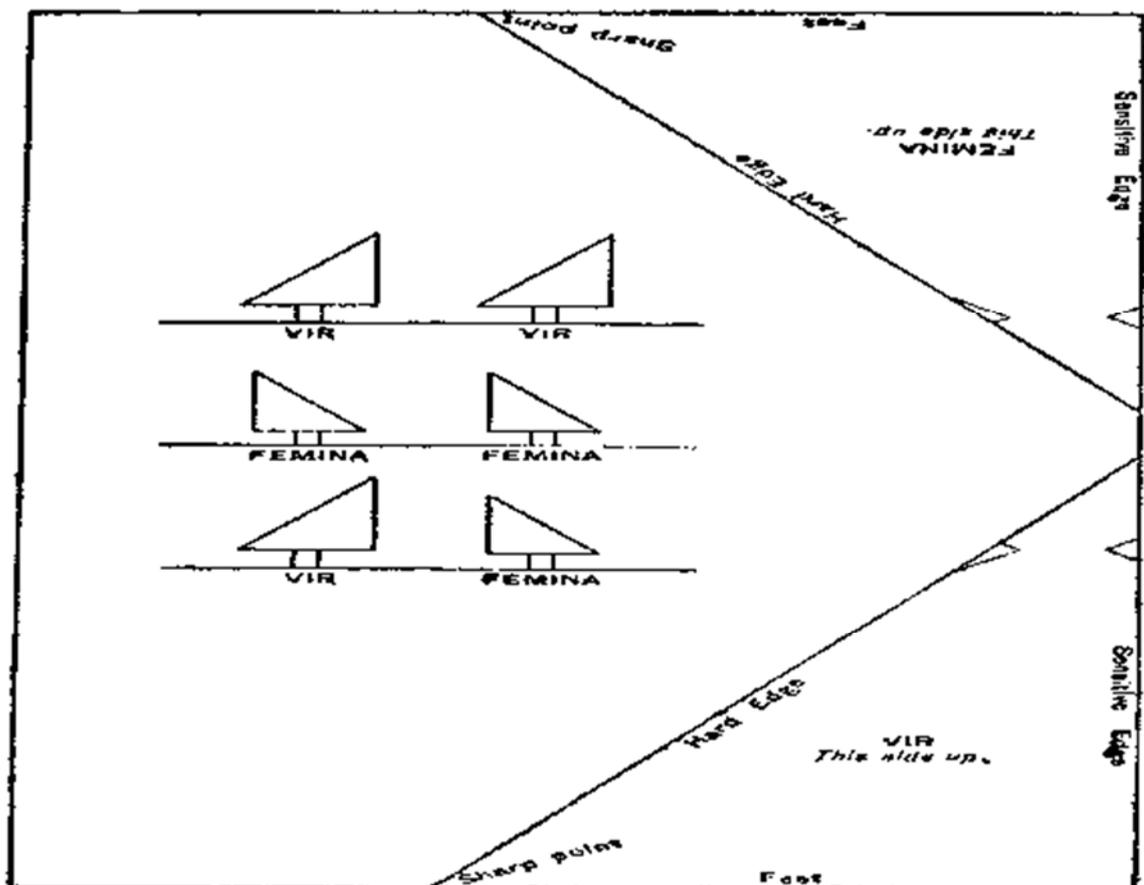


Figure 10

If the reader will trace and cut out the triangles in the corners of figures 9 and 10, he will obtain four plane beings, two of which are men, two of which are women. The lines down which the cutting is to be made are marked with a black line. Now having cut out two men, whom we will call Homo and Vir, draw a line on a piece of paper to represent the rim of the world on which they stand, and, remembering that they cannot slide over each other, move them about. It must be remembered that the figures cannot leave the plane on which they are put. They must not be turned over. The only way in which they can pass each other is by one climbing over the other's head. They can go forwards or backwards. Much can be noticed from an inspection of these figures. Of course it is only symbolical in the rudest way, but in their whole life the facts which can be noticed in these simple figures are built up and organized into complicated arrangements.

It is evident that the sharp point of one man is always running into another man's sensitive or soft edge. Each man is in continual apprehension of every other man: not only does each fear each, but their sensitive edges--those on which they are receptive of all except the roughest impressions--are turned away from each other.

On the sensitive edge is the face and all the means of expression of feeling. The other edge is covered with a horny thickening of the skin which at the sharp point becomes very dense and as hard as iron. It will be evident, on moving the figures about that no two men could naturally come face to face with each other.

In this land no such thing as friendship or familiar intercourse between man and man is possible. The very name of it is ridiculous to them. For the only way in which one man can turn his sensitive edge to another man is if one of them will consent to stand on his head. Fathers hold their male children in this way when little, but the first symptom of manhood is connected with a resentment against this treatment.

If now two women, Mulier and Femina, be looked at, the same relation will be seen to hold good between them. By their nature they are predisposed, by accident, to injure one another, and their impressionable sides are, by the very conditions of their being, turned away from each other.

If now, however, Homo and Mulier be placed together, a very different relationship manifests itself. They cannot injure one another and each is framed for the most delightful converse with the other. Nothing can be more secure from the outside world than a pair of approximately the same height; each protects the sensitive edge of each, and their armoured edges and means of offence are turned against all comers, either in one direction or the other. But, if the pair, through a mutual misunderstanding, happen to be disadjusted, and, their feet on the rim, turn their sharpnesses against one another, they are absolutely exposed to the harms and arrows of the world.

Still, even in this case they cannot wound one another--a happy immunity.

In the annals of this race which I have by me I find a curious history, which, unintelligible for ages to them, admits by us of a simple explanation.

It is said that two beings, the most ideally perfect Vir and Mulier, were once living in a state of most perfect happiness, when owing to certain abstruse studies of the Mulier, she was suddenly, in all outward respects, turned irremediably into a man. Vir recognized her as the same true Mulier. But she occupied the same position with regard to him which any other man would. It was only by standing on his head that he could, with his sensitive edge, approach her sensitive edge. She refused to explain how it was, or impart her secret to any one, but she had, she said, undergone a great peril. She manifested a strange knowledge of the internal anatomy of the race, and most of their medical knowledge dates from her. But no persuasion would induce her to reveal her secret; all the privacy of existence would be gone, she said, if she revealed it. She was supposed to have acquired some magical knowledge.

This possession, however, did not make either of them happy, and one day, with fear, she said that she would either die or be restored to the outward semblance of her sex.

She disappeared--absolutely; although she was surrounded by her friends, she absolutely vanished. And had it not been that some days afterwards, cutting through the solid rock for the purposes of some excavations, they accidentally came on a chasm, they would never have found her alive again. For she was found in a cavity in the living rock, warm and beautiful--her old self again.

Her secret died with her.

From our point of view it is easy to see what had happened. If the figure Mulier be taken up and turned over it will be easy to see that, though still a woman, her configuration has become that of a man. To all intents and purposes she is a man. She is rendered incapable of that attitude which is the natural one between the men and women in this land, and the happy relationship

between her and Vir is necessarily and entirely broken off. Move about as you will, keeping her figure turned thus on the plane, you will not be able to make her a fitting helpmate for her unfortunate Vir. She must have discovered the secret of raising herself off the surface, and by some accident been turned over. Perhaps she had used this new position to study anatomy--for to an observer thus situated the interior of every body would lie perfectly open--and in prosecuting her studies had over-balanced herself.

I have only mentioned this anecdote, however, for the sake of a curious observation which was made at the time. It was found that when she was in this transformed condition she was absolutely without atmosphere. To explain: ordinarily, apart from anything she said or did, there was a kind of influence proceeding from her which made her presence agreeable to Vir. When she was turned over she lost this. Now the explanation of this is obvious. To these people light is the agitation of the surface of the bubble; transparent objects are those which do not hinder this agitation in its course. But most bodies and the physical frame of the inhabitants amongst them were not transparent, but stopped and reflected these agitations of the film, thus sending off from their outer edge those vibrations which excited sight in their fellows. But besides these vibrations of light there were finer ones still which were not damped or deflected by the outer edge of the body, but came through the greater part of their frame as if it was transparent. In the interior, however, of their organizations there were certain regions which did arrest these subtler vibrations, and which had (as the eye of light) the power of appreciating them. In connection with these regions there were certain structures, extremely minute, which had the converse power of agitating the film, and so sending forth through the periphery of the body these same minute vibrations. These organs were not of any use, but they formed a sort of means of sympathetic communication between the inhabitants, acting in no very defined way, but certainly producing a sensation of a vague kind. Now when Mulier was turned in the way described, the relation of her frame to the film of the bubble was disarranged, and it was no wonder that this "atmosphere" disappeared

In many respects the inhabitants of this world are far more advanced than we are, having a simpler problem--how to deal with matter in one plane they have advanced more nearly to a complete knowledge of its properties. Yet great as their knowledge is, their performance is small. If you but reflect on one single fact, you will see how limited all their efforts must be. They cannot fix the center of a wheel, so that it rotates round an axis. For consider a wheel--a small disk lying on their plane. The center on every part of it touches the surface of the bubble on which all things slide freely. To fix this point they would have to drive down into the film--a thing which they cannot do, and which they are far from even imagining.

If they make an opening in the disk they can arrive at the center of it. But then the rod of matter which they put in will prevent the disk from revolving.

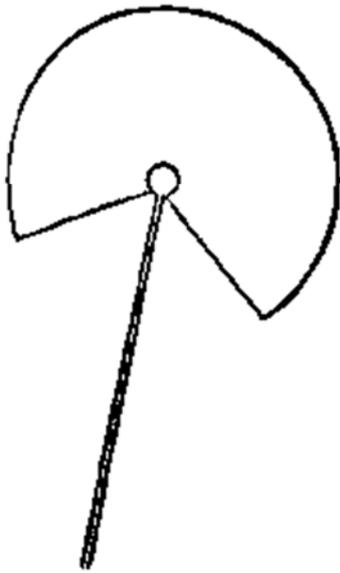


FIGURE 11. 'The nearest approach to a wheel'

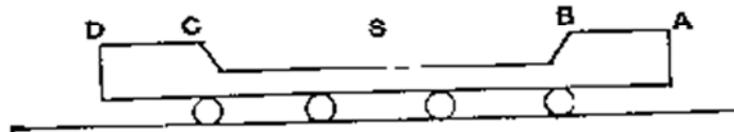


FIGURE 12. A cart.

The nearest approach to a wheel with a fixed center which they can attain is shown in figure 11, a portion of a circular disk which oscillates about the smooth end of a rod built into the substance of the cut-away disk. Their carts are shown in figure 12. They are simply rods placed on rollers: as the rod is pulled along, the rollers turn, and the rod slides along--just as a boat does on the rollers whereby sailors help themselves in hauling it up the beach. As soon as these rollers roll from under the rod, as it goes on in its forward motion, they have to be secured, and then lifted over the cart and put down in front. Thus there are to each cart a set of little disks or rollers, and, as the cart goes on, these rollers have to be lifted over the cart from the back to the front.

There is no means by which this can be made a continuous action. Each roller has to be waited for, lifted separately, and carried over separately. And to put it down in front, the rope by which the cart is dragged along has to be unfastened and fastened up again.

Looking at the figure 12 it will be seen that there is a hollow in the body of the cart. On the part AB the driver sits. In the hollow from B to C is put the load. The load cannot then slip out over the ends of the cart. There is nothing in the cart to prevent it from falling out sideways.

But the contents, as the whole body of the cart, are kept to the smooth surface of the bubble, and are thus supported by it on the side remote from the reader's eye, and also are kept from rising away from this surface by the force of attraction exerted by the film.

Thus the surface of the bubble and its attractive force supply the other two sides of the cart.

But of these two sides, the beings are ignorant, and it seems to them perfectly natural that loads of any kind, even of fluids, should be kept securely in a cart with two ends.

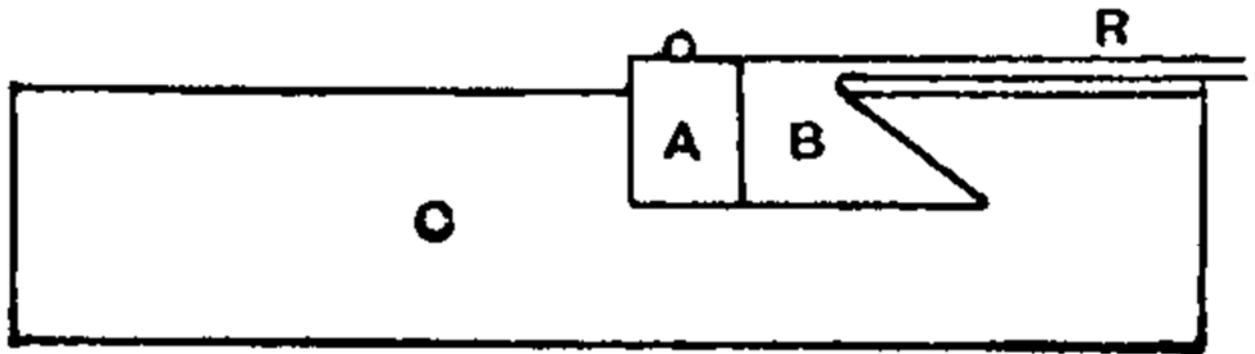


FIGURE 13. How a rope is fixed to a cart.

Figure 13 indicates the method by which the rope is fastened to the cart: C is the body of the cart; R is the rope ending in a wooden step B; A is an oblong piece of wood. When the rope has to be taken out, A is lifted out by its handle, B is slipped back and taken out of the recess in C, and then the rope is free from the cart. And in a similar way it is secured again.

One very ordinary way of driving machinery with us is by shafting. A long rod is driven round and carries wheels at different places along its length. Now with these inhabitants it was impossible to do this, because the twisting motion round a rod could not be imparted without going out of the thin layer in which they were. Their methods of transmitting motion were by long rods, by a succession of short rods, by pendulums attached to one another, or finally by wheels which drove one another, but which were held by smooth sockets fitting round the rim far enough to steady them, but not so far as to hinder them from touching each other.

As to their science, the best plan is to give a short account of its rise.

They discovered that they were on a disk rotating round an inner center, and also proceeding in a path round the source of light and heat.

They found that they were held in their path by a force of attraction. But this attractive force was not with them as it is with us. With us, since the effect which any particle has on the surrounding particles spreads out in our space if the distance is doubled from a center of attraction, the force it exercises becomes one-quarter of what it was when at the less distance.

With them, however, when the distance doubled, the force of attraction became only one-half of what it was at the less distance. For the light, or attraction, or force of any kind emanating from a particle, only spreads along the film, and does not pass out into the space above or beneath. If they had been on a thick globe instead of a bubble, the laws of attraction would have been the same as with us. But the bubble on which they were was thin compared with the paths along which the radiant forces spread forth. And thus every force being kept to one plane diminished as the distance from the center of its action (see appendix to this chapter).

Now it was a great problem with them how the light came from the central orb. Their atmosphere, they knew, extended but a small distance above the surface of their disk. And it was quite incapable, moreover, of conveying vibrations such as those of light and heat.

By studying the nature of light they became convinced that to transmit it there must be a medium of extreme rigidity between them and the great source of light.

It is easy enough to see that what they thought was a medium between them and their sun was in reality the rigid surface on which they rested. This elastic film vibrated in a direction transverse to the layer they called matter, and carried the particles of matter with it. But they, having no idea but that the surface on which they were was the whole of space, thought that space must be filled with a rigid medium. They found that the vibrations of the medium were at right angles to the direction in which a ray was propagated. But they did not conceive of a motion at right angles to their plane; they thought it must be in their plane.

It was a puzzle to them how their disk glided with so little friction through this medium. They concluded it was infinitely rare. They were still more puzzled when they had reason to believe it was an opaque substance; and yet that it could be anything else than a medium which filled their space was inconceivable to them. They could never get rid of it from a vacuum, however perfect. Indeed we see that in producing a vacuum they merely cleaned the surface on which they were.

In one respect it might have been advantageous if they had known, for, their law of attraction being what it was, their movement round their sun was not destined to go on for ever; but they were gradually falling nearer and nearer. Now, if only they had made the attempt, they might by some means have got a hold on the surface on which they were, and, by means of a keel which tended to furrow it, have guided their world and themselves in their path round their sun. Indeed, it is possible to imagine them navigating themselves whither they would through their universe--that is, on the surface of their bubble.

It was also unfortunate in another respect that they did not realize the fact of the supporting surface, for the feeling which they came to have of being suspended in space, absolutely isolated, was a very unsettling one, and tended to cause in them a certain lack of the feeling of solidarity with the rest of the universe.

We have seen that their laws of mechanics were very different from ours. But they had after all an experience of our mechanical principles, though in a curious way. In all motions of any magnitude moving bodies were confined to the surface of the plane. But where the small particles were concerned there was more liberty of motion. The small particles were free in their movement; although they could not go more than a very small distance away from the film on which they rested, still they were capable of motion perpendicular to it. Thus a long line of particles connected together could rotate as a whole, keeping straight like a twisting wire, and by means of many strings of particles thus connected, movements could be transmitted in a way which was totally unlike the mechanical movements to be seen in the case of large masses.

This motion of rotation round an axis lying in the plane was to them what electricity is to us. It was quite a mysterious force. But it was extremely useful in its applications. Having no idea of a rotation which in taking place went out of their surface, they could not conceive a reason for the results of such movements.

It can easily be seen how many kinds of forces they could have. There was the spinning motion of the small particles on the surface. This they were aware of it produced many appearances, but it was not fitted for transmission across great distances, as each particle was apt to be hindered in its rotation by its neighbor. Sometimes, however, when conditions were favorable, many of these rotations were harmonious, and waves were produced in their matter resembling the waves in our ocean.

There were only two other kinds of motion. One was an up and down vibration of the film carrying matter with it; the other was the twisting of strings of particles which were rigidly connected together. The up and down motion of the film was to them light. Those kinds of matter which did not hinder this motion were said to be transparent; those kinds which, lying on the film, hindered the motion or threw it back were said to be opaque.

The twisting motion round an axis was to them what electricity is to us. And when this twisting motion in one direction or another was conveyed to the particles of small masses which were free to move, many curious effects were produced analogous to the movements of electrified bodies. There are obviously no other rotations or vibrations possible; hence in that world there is nothing corresponding to magnetism. Their light was simple, and could not be split into two kinds as our light can be--into two kinds of polarized light.

Was there no sign, then, by which the inhabitants of this world could gain a knowledge of their own limitation? There was. There was both a sign and the interpretation of it lying before them. They knew that they could have two triangles precisely similar, anti yet such as could not be turned the one into the other by any movement in the plane. How two things could be so alike, and yet differ in some mysterious way, was to them a puzzle. As an instance of such triangles may be taken those used in figure 9 to represent the man and the woman. They may be exactly equal, yet the beings in a plane world cannot turn them so that one would coincide with the other.

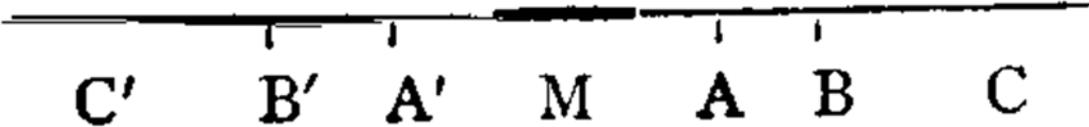


FIGURE 14

Yet had they but considered the case of a being lower in the scale of space existence than themselves, they would have seen the answer to their riddle. For consider a being confined altogether to a line (fig. 14). Let M be the being, and let him observe the three points ABC, and let him form an idea of them and their positions with regard to each other, which he measures by the distance he has to travel to reach one after passing the other.

Let him also become aware of the three points A'B'C', forming a precisely similar set on the other side of him.

It may be objected that the being in the line could not conceive any point lying beyond A, but that his experience would be limited to the points A and A'. If A and A' are material particles this would be the case, but we may suppose them to be places in the line marked out by cold and heat, or some such means. Then a being could conceive a series of positions in his space such as A, B and C; A', B', C'.

If now he remembers each set, and thinks about them, he finds that they are alike in every respect. But he cannot make them coincide with each other. For if he pushes the set ABC along the line, when AB and A'B' are together C is just where it ought not to be. It is not on C'. And if he gets C on C', then AB has gone far away.

He would neither be able to make them coincide nor to conceive their coincidence.

There would be no movement within the realm of his experience which would make them coincide.

Yet the dweller in a plane world could easily make these sets of points coincide, for he would bend the whole line round in his plane so that A coming on A', B should come on B', and C on C'. There would be no difficulty to him in doing this. And he does it in virtue of there being to him a movement possible which is not possible to the being in the line. He has a liberty of motion unknown to the linear being.

And now why should he not reason thus, "Something which to the linear being is inconceivable, to me is conceivable. Then may not things inconceivable to me be yet possible? May it not be possible that two triangles which are like one another, but yet which cannot be thought by me as coinciding--may not these triangles be able to be made coincident?"

In this simple fact of his perpetual observation was really the proof of the whole matter if he had but looked at it, the sign manual of his limitation, the promise of his liberation from it in thought, the key to the explanation of the mysterious minute actions by which he was surrounded, and perchance a help to the comprehension of a higher life.

Appendix

In our world a particle of matter which sends forth influence on the surrounding matter does not send its radiant energy off along a plane, but from the particle all the influence spreads out into space. And the most convenient instance in our world to consider is that of a luminous point from which rays spread out in every direction. Let M in figure 15 be such a point--a particle of matter sending forth luminous rays in our three-dimensional space.

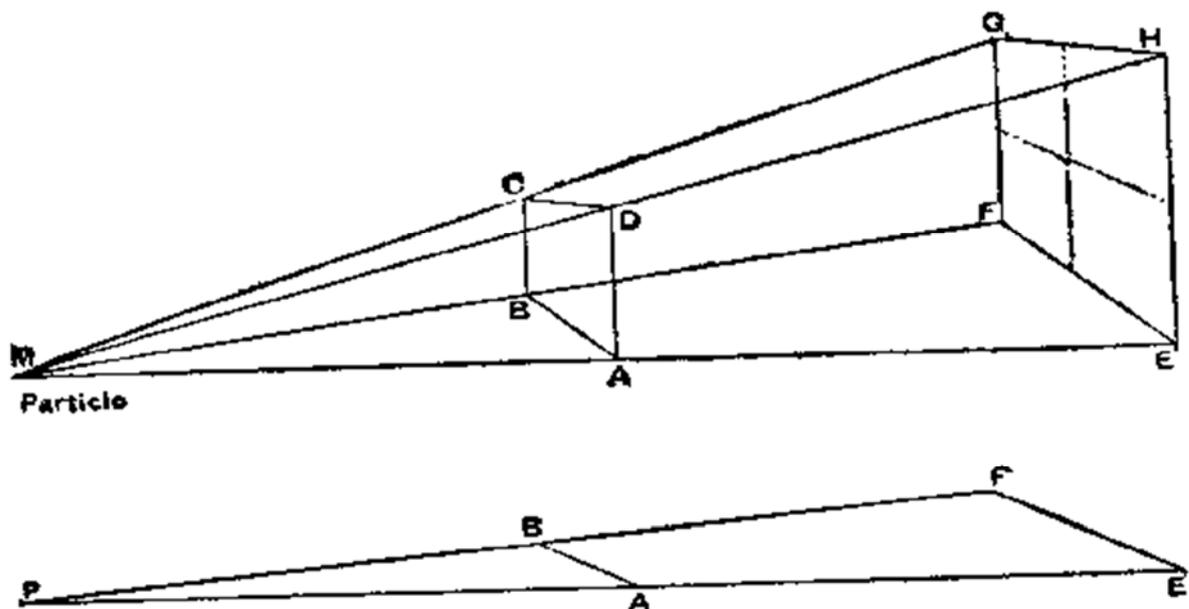


FIGURE 15. Particles in space and in a plane exerting force.

Instead of studying how these rays spread out in every way all around M, let us only consider those which, passing out from M, fall on the square ABCD. ABCD casts a shadow, and this

shadow extends, and is found to be bigger the further off from M it is measured. Suppose, at the distance from M, ME, we put a square in the path of the shadow so as just to receive the shadow on it exactly. Let EFGH be this square. As is shown by the dotted lines, this square will be four times as large as the square ABCD. So when the distance is doubled, the shadow becomes four times as big.

Now those rays of light which fall on ABCD would, if they were not interrupted by it, spread out so as to exactly cover EFGH. Thus the same amount of light which falls on the small square ABCD would, if it were taken away, fall on the large square EFCH.

Now since the large square is four times the size of the small square, and the same amount of rays fall on it--for it only receives those which would fall on the small square--there must be at any part of it an illumination one-quarter as strong as there would be at any point on the small square.

Thus the small square, if placed in its position, would seem four times as bright as the large square.

Thus, when the distance from the origin of light is doubled, the amount of light received by a surface of given area becomes one-fourth of what it was at the less distance.

This is what is meant by varying inversely as the square of the distance. When the distance is doubled the intensity of the light is not simply less, but is halved and halved, and becomes one-quarter of its previous intensity.

But in the case of a particle resting on a thin sheet of metal, and shaking the metal--as, for instance, a metal plate can be made to shake by a violin bow--then this law would not hold.

Take the second figure. Let P be the particle, and let the influence proceeding from it fall on the rod AB lying on the plane, and let us suppose the rod to stop the vibrations from going beyond it, to receive them and to turn them back just as a body does the light. Then the "shadow" of AB would spread out away from P; and if another rod EF were put in at the distance PE, which is double of PA, then, to exactly fit the shadow, it would have to be double the length of AB; and the vibrations which fell on AB would exactly fall on EF. Now since EF is twice as long as AB, the vibrations which fall on any part of it will be one-half as intense as the vibrations which fall on a portion of matter of the same size lying where AB lies.

Thus in a plane the influence or force sent out by any particle would diminish as the distance. It would not "vary inversely as the square of the distance," but would "vary inversely as the distance."