WHAT IS GRAVITY?

by Nick Thomas

Gravity is most interesting, for it cannot be perceived directly but its effects are very obvious. We incarnate into the realm of gravity and grow up with it, so that by the time we begin to think for ourselves it is so natural that it took the genius of Sir Isaac Newton to recognise it, name it, and describe it in a scientific way in the 17th century. But that is all he did, for he did not know how it 'works'. This worried him for he was deeply suspicious of force 'acting at a distance' without any obvious intermediate 'links' or other means through which it acts. The concept of touch had become so important for science that it seemed all forces and influences should act through direct contact, such as when one ball hits another. This we can readily visualise, and think about materialistically. The loss, even the spurning of spiritual causes arose perhaps particularly through Newton, although he was deeply religious. Kepler before him, who discovered the laws of planetary motion, still thought that angels pushed the planets round their orbits. Such an approach was anathema to Newton, who sought clearly visualisable influences of a material kind. It was he who proposed that even light should be made up of tiny particles flying through space. To be the discoverer of a force that acted without any clear material intermediary worried him to the end of his life.

The philosophical standpoint called materialism seeks to understand all things in terms of matter, in contrast say to spiritism which is also one-sided and sees everything as spirit. Gravity – a major law obeyed by matter – defies a materialistic description and appears to belong more to the philosophical standpoint known as mathematism, which seeks the most fundamental ground of all things in mathematics. This remained the same with Albert Einstein, who found a geometrical approach in his famous General Theory of Relativity, where he treated the movements of all material objects as governed by the 'shape' or 'curvature' of space itself. An analogy, although a bad one, is to picture a curved bowl and a marble 'orbiting' round the bowl after being thrown into it: the shape of the bowl controls the path. The transition from geometry to physics comes when forces have to be explained, because 'force' is not a geometrical concept. In the case of the bowl we cannot ignore the momentum of the marble without which the shape of the bowl would be ineffective: both factors determine the motion.

picture: John Dalton

Apple falling... or reacting to stress?

It is easily imagined that forces are active everywhere in Nature, a philosophical viewpoint known as dynamism. But how do we know that? The only forces we know of are those we directly experience, switching now to phenomenalism! If I observe a falling apple as Newton did, what I actually observe is movement, and acceleration if I am careful. I do *not* observe force unless I intervene. But we can suspend the apple from a spring which measures force because the amount by which the spring is extended is directly related to the force, so here surely we observe the force of gravity! True enough, but we do not observe force, we measure a change in length of a spring. We relate this to our experience of force because *we* would have to exert a perceptible force to extend the spring by the same amount. It is then easy to suppose that gravity via the apple exerts a similar force on the spring, and then to explain every change in length, shape or movement as caused by force and so arrive at dynamism. One-sided phenomenalism would say there are no forces unless we are experiencing them directly. Which is right?

The phenomenon we can start with is to note that we ourselves only experience force if we try to change the movement of an object. Thus if we push a stationary car, or hold an apple in our hand to prevent it falling, we experience force. This way we can steer between dynamism and phenomenalism. We can conclude from this that force arises when the state of movement of an object is interfered with. The car is initially at rest, and we try to change that; the fall of the apple is interfered with. The same applies to gravity as is clear in the case of the apple, for a force arises when we try to *prevent* its action. Thus we might suspect that gravity is not a force at all, but a cause of motion. Force arises when we oppose it. This is the reverse of Newton's view that gravity exerts a force which then causes movement. It is more in line with Einstein's view that gravity has a geometrical basis, and if we try to prevent an object following the geometry then we find we have to exert a force. In our normal experience the shortest distance between two points is a straight line, but in a space that is curved the shortest distance need not be a straight line and may in fact be a curve known as a geodesic. An analogy is to think about the shortest distance between two points on the surface of a sphere such as the Earth (i.e. what curve *on the surface* is shortest). It is a great circle, which is the circle in which a plane through the two points and the centre cuts the surface. Einstein's idea was that all objects will naturally follow such curves or geodesics in space unless they are interfered with although they need not be circles in the more general case. This is simply a generalisation of the obvious fact that a ball rolling on a flat table will naturally follow a straight line unless something gets in the way.

It is more consistent and accords with phenomena to regard

gravity in this way. We do not need to be one-sided and say there are no forces in Nature, but a careful attention to phenomena does seem to indicate that it is easy to put the cart before the horse! Force arises, rather than always being the cause as one-sided dynamism asserts. We are not saying that force is never a cause of change, we are only disputing the idea that it always is, particularly in the case of gravity.

But if gravity is not a force then what is it? Einstein's geometry? We must acknowledge the great success that Einstein's theory has had, but there exist serious physicists who dispute it nevertheless. From a spiritual perspective it reduces the cosmos, as did Newton but in a different way, to being a machine. An austerely beautiful mathematical edifice that is quite without soul, and which explains force no more than Newton did. Although it includes forces, it only does so in a descriptive manner, even though the mathematics are rigorous and testable. The mathematical entities relating to force *describe* but they do not *explain*. In the end there is no content, only structure. What causes space to be curved? What is matter? Science does not really know. Mass and force cannot be conjured forth from geometry like rabbits out of a hat, only movement can. Rudolf Steiner described how Alanus ab Insulis in the 12th century foresaw the coming of Copernicus and eventually our modern views, and taught his pupils that the future task would be (that is, now) to fill the beautiful empty structure once again with spirit.

Steiner spoke of gravity in what seems at first an extraordinary manner. If I lift my hand to touch my forehead, he said, I do not seriously imagine that there is a force attracting my hand to my head! I am well aware that behind the deed is a being, me, acting. It is similar, he claimed, when the apple falls to the ground. Of course this kind of reasoning is anathema to mainstream science, but we note that logically speaking it is entirely in accord with what we found about gravity and force, i.e. that there is some cause of motion in the case of gravity but force is secondary. It is just here that spirit belongs actually in science itself, for otherwise geometry or mathematics 'plaster over the cracks' by inserting descriptive elements that are not explanatory, leaving the vessel empty of content.

Can we approach gravity another way, to find an explanation? We will attempt to outline how this can be done, and see how it relates to Steiner's comment. Steiner described how we have a different kind of consciousness when we enter the spiritual world, one which looks inwards from the periphery of the cosmos towards an infinitely unreachable centre. This is the polar opposite to our normal consciousness, through which we experience ourselves as being at a centre looking out towards infinity. It is possible to characterise a space which fits this consciousness just as we find euclidean space fits our everyday consciousness. This is often called counter-space or Sun-space, with an infinite inwardness instead of an infinite outwardness. If indeed there is another space apart from the one we know, we can ask what it is like to be in both at once! What we would find is a kind of conflict or tension because the two spaces have different laws. If a body tries to keep its shape and size fixed in ordinary space while it moves then its analogous properties in counter-space must usually change, or vice versa. The result is a so-called stress, which in physics is an internal force resulting from a coerced change of shape (called strain). Thus if a piece of elastic is pulled to twice its original length it reacts with a force which is called an internal stress. Now when objects are in two spaces at once it is possible that they suffer a deformation (or strain) in one or other space, and as a result there is a stress. For example if a cube moves nearer to the counter-space infinite inwardness, then it appears to get bigger in counter-space even though it stays the same size in space. Now geometry cannot explain such a stress, it can only describe the change of shape or size. Thus geometry handles strain but the stress comes from somewhere else. We cross over from mathematics to physics when we try to go from strain to stress (or force). Thus we see two polar opposite yin-yang-like spaces, and stretched on the cross between them, as it were, beings suffering the stress we tend rather dispassionately to describe in scientific terms.

Now we can see that if a force exists which has no apparent spatial cause it might arise from such a stress, and the idea has been followed up in detail that gravity is related to a stress of this kind, a stress due to a strain in counter-space. Hence we are unaware of this cause with our ordinary consciousness, but its effects are apparent. The stress reduces if the two bodies move closer to each other, which is why they appear to 'attract' each other. A detailed mathematical analysis shows that the law is the same as the one Newton found, which indicates that this idea is feasible. Had it given the wrong law it would of course be nonsense, as that law has been very thoroughly tested. Of interest in the light of our earlier discussion is that the most essential factor is a strain between the spaces, which only gives rise to force if the resulting movement to relieve it is prevented. We cannot deduce from geometry why the strain gives rise to stress; that is for us a hard fact which we suggest arises from the suffering of the beings who must endure the strain. We have a beautiful form if we ignore the content, but when we fill that with content as Alanus ab Insulis suggested, we find the deeds and sufferings of beings, just as Goethe saw the beautiful world of colour as the deeds and sufferings of light. ■

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