Motion

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Abstract: An extension of the currently prevailing concept of "motion." The widely separated galaxies are all moving radially outward from each other. This motion therefore has no specific direction; it is *scalar motion*. The properties of this type of motion are deduced, and it is shown that these are identical with the properties of gravitation and the corresponding electrical and magnetic effects. These phenomena are thus identified as scalar motions, a conclusion that has some significant implications for basic physical theory.

> *I do not define time, space, place, and motion, as being well known to all.* (Isaac Newton)

In the three centuries that have elapsed since Newton wrote these words there has been a great deal of discussion and controversy about the nature and properties of space and time, but the concept of motion remains essentially the same as in his day. To scientist and layman alike, motion is a change of spatial position relative to some identifiable point or object. For scientific purposes it is assumed that space can be represented in three-dimensional coordinates. Motion is therefore seen as taking place in a system of coordinates, a *spatial reference system*. The change of position in the reference system produced by the motion is called a displacement, and is a vector quantity; that is, it has both magnitude and direction. Thus motion, as customarily defined, is *vectorial motion*.

Meanwhile an enormous amount of additional empirical information has been accumulated, and it has become evident that there are observable motions which do not conform to this definition. The circumstances under which these motions are encountered are such that attention is directed primarily to the origins of the phenomena that are involved, and the peculiarities of the motions themselves have been passed over with little attention. However, motion is one of the most basic concepts of physics, and anything that throws more light on its nature is a significant and potentially far-reaching addition to scientific knowledge. A thorough and critical examination of these deviant types of motion is therefore definitely in order.

Let us look first at the motions of the galaxies. Observations show that all of the distant galaxies are moving away from our location at high speeds. Various hypotheses have been advanced as to the origin of these speeds. For several decades the favored explanation was the Big Bang, a hypothetical event at some singular point in the past in which a gigantic explosion ejected the galaxies (or the matter from which the galaxies were subsequently formed) in all directions at the speeds now being observed. More recently, the original hypothesis has fallen into disfavor, and has been largely replaced by a hypothesis which asserts that the Big Bang was not necessarily an explosion, but was merely the beginning of a general expansion of the universe that is now carrying the galaxies outward in space. All of these ideas as to the origin of the observed motions are purely speculative, and provide no *factual* basis for an investigation of the motions that are involved. For such a base we will have to look at what is *actually known* about the galactic motions.

Each of the distant galaxies is observed to be moving radially outward from our Milky Way galaxy. In itself, this observation does not seem to involve anything unusual from a motion standpoint. However, if we turn our attention to the motion of our own galaxy we do encounter something out of the ordinary.

Unless we make the assumption that our galaxy is the only stationary object in the universe, an assumption that was repudiated by science long ago, the fact that the other galaxies are all moving away from us implies that we are also moving away from all of the others; that is, we are moving outward in all directions. Since it is conceded that our galaxy is not unique, it follows that all galaxies are moving outward in all directions. Thus the galactic motion has no specific, or inherent, direction. It is a motion with magnitude only, a *scalar motion*.

Here, then, is a type of motion that does not conform to the definition of "motion" that is currently accepted for scientific purposes. Its *existence* is conceded, but its unusual features have not heretofore been subjected to any critical examination because the galactic motion has been viewed as a special case, a unique phenomenon. Of course, this is pure assumption. Indeed it is specifically contradicted by the existence of small scale examples of the same kind of motion. Typical of these is the motion of spots on the surface of an expanding balloon, often used as an analogy to explain the nature of the galactic motion. But the physics of expanding balloons are of little interest to the theorists, and no significant amount of attention has been paid to this motion either. In fact, most investigators have simply ignored the evidence indicating that, in the instances cited, we are dealing with an alternate type of motion.

As a result of this policy, the present-day physical theories that purport to deal with motion in general are actually dealing only with *one particular kind of motion*. This is a serious error. One of its most unfortunate results is that some of the important types of motion that participate in physical activity *are not recognized as motions*, and are not treated as motions, because they do not meet the vectorial criterion of motion; that is, they do not necessarily cause change of position in the spatial reference system. As can readily be seen when we examine the situation more closely, there is an entire class of scalar motions that do not qualify as motions on the basis of the vectorial definition.

Obviously, a system of scalar motions, such as the motions of the galaxies, in which all individuals are moving outward in all directions, cannot be represented in a spatial reference system in its true character. In order to make representation of the galactic system of motions possible, we assume that our galaxy is motionless (although we know that this is not true). By means of this assumption, the moving galactic system is coupled to the stationary reference system at one specific point, the reference point, we may call it. The galactic situation is typical of scalar systems in general, and we can therefore generalize our findings in the following statement, the first of a series of general principles that will summarize the properties of scalar motion:

I. A system of objects moving radially outward from each other (a system of scalar motions) can be represented in a stationary spatial reference system only by coupling the moving system to the reference system at a reference point.

It can easily be seen, in the case of the galaxies, that the direction attributed to the motion of any specific galaxy is entirely dependent on the point that is arbitrarily assumed to be stationary, the reference point. If we designate our galaxy as A, the direction of movement of galaxy X, as we see it, is AX. But observers in galaxy B, if they exist, see the direction as BX, those in galaxy C see it as CX, and so on. In general,

II. The direction of a scalar motion, in the context of the reference system, is a property of the coupling to the reference system, not an inherent property of the motion.

Because of the way in which scalar motion has to be represented in the reference system, the reference point or object is seen as motionless, or moving vectorially. All other points, or objects in the scalar system appear to be moving radially outward from the reference point. The nature of our view of the reference object, the member of the scalar system located at the reference point, is particularly relevant to the question as to the existence of hitherto unrecognized scalar motions. We therefore note this fact:

III. The scalar motion of the reference point or object does not result in any change of position in the spatial reference system.

Another feature of scalar motion that needs to be noted is that because the reference object is arbitrarily assumed to be stationary, from the scalar standpoint, whereas it is, in fact, moving, the motion of this object has to be attributed to the objects from which it is receding. For example, when galaxy X is moving away from us at speed a, our galaxy is simultaneously moving away from galaxy X at some speed b. The recession of galaxy X, the magnitude that we observe, is then a+b, rather than the true speed a. By coupling the location of our galaxy to the spatial reference system we have transferred its motion to the galaxies with which it is apparently interacting. It can easily be seen that this, too, is a general proposition.

IV. The motion of the reference object of a scalar system appears, in the context of the reference system, as an additional component of the motion of each of the other objects in that scalar system.

In the case of the galactic recession, the reference point for the scalar motion, the location of our Milky Way galaxy, is the point from which the motion is being observed, However, it is the assumption that our galaxy occupies a specific position in the spatial reference system that makes it the reference object, not the fact that it is the location of the observer. This is brought out clearly in the case of the expanding balloon. For instance, if the balloon is resting on the floor of a room, the reference point is the point at which the balloon touches the floor, and is thereby immobilized in the spatial reference system. The location from which the motion is being observed is irrelevant.

The point in the reference system to which the reference point of a scalar motion is coupled may move vectorially in the same manner as any component of the vectorial system of motions. The expanding balloon, for example, may be resting on the floor of a moving vehicle, rather than on a surface that is stationary in the reference system. The general principle may be stated as follows:

V. The reference point of a scalar motion may be in motion vectorially.

In order to simplify the presentation, the foregoing discussion has been limited to positive (outward in the reference system) scalar motions. We will now want to note that scalar motion may be negative (inward) as well as positive. For example, the motion of spots on the surface of a contracting balloon is identical with that of the spots on an expanding balloon that we have been considering, except that it is reversed.

VI. Scalar motion may be either positive (outward in the reference system) or negative (inward in the reference system).

The foregoing six numbered statements describe the principal properties of scalar motions. In looking for evidence of hitherto unrecognized motions of this type, what we need to do is to identify phenomena that have these properties. As noted in item III, these motions do not necessarily cause changes of position in the spatial reference system. But we can deduce from item IV that the existence of *forces* will be evident. Some consideration of the relation between force and motion is therefore required at this point.

For application in physics, force is defined by Newton's second law of motion. It is the product of mass and acceleration: F = ma. Motion is measured on an individual mass unit basis as velocity, or speed;

that is, *each* unit moves at this rate, or on a collective basis as momentum, the product of mass and velocity, or speed. Momentum was formerly called "quantity of motion," a term that more clearly expresses the true nature of the quantity. The time rate of change of motion is dv/dt (acceleration, a) in the case of the individual unit, and m dv/dt (force, ma) when measured collectively. Thus force is a property of a motion, in exactly the same manner as acceleration. It is the time rate of change of the total quantity of motion, the "quantity of acceleration," we could appropriately call it.

The significance of this point, in the present connection, is that a force cannot be autonomous. By definition, it is a property of a motion. Thus, wherever we find that a force exists, it follows that there must necessarily be an underlying motion of which the force is a property. This is a positive requirement, with no exceptions. On the other hand, there are physical phenomena in which forces are observed to originate at locations where there is no movement in the context of the spatial reference system. Physical science is thus confronted with a dilemma. The reaction of the theorists has been to ignore the contradiction, and in defiance of the definition of force that is universally accepted, to assume that the forces in question are autonomous.

Gravitational forces, for instance, are assumed to originate, in some unspecified manner, in all matter, and that matter may be motionless in the reference system. According to Einstein, gravitation is due to a distortion of space by reason of the presence of the matter. But this is not an explanation. It merely replaces one question by another. Instead of asking, "How does matter generate gravitation?", we now have to ask, "How does matter distort space?" The attitude of the theorists toward this question is expressed by Arthur Eddington. "We do not ask how mass gets a grip on space-time and causes the curvature which our theory postulates," he says. The basic dilemma due to the conflict between the definition of force and the assumption that gravitation is autonomous has not been resolved by this hypothesis. It has merely been pushed farther into the background where it can be more conveniently ignored.

Recognition of the existence of scalar motion and identification of its properties now provides the answer to the gravitational problem. Newton's law of universal gravitation states that each particle of matter exerts a force of attraction on all other particles. From this law we can deduce that if each particle were free to move, as the galaxies are, then all particles would move as the galaxies move, but in the inverse manner. Just as each galaxy moves outward away from all others, each particle of matter would move inward toward all others. Thus gravitation is a motion of the same nature as the recession of the distant galaxies. It is a motion without specific direction that has a negative scalar magnitude (inward in the context of the reference system) which causes a *decrease* in the distance between particles, whereas the galactic recession is a motion without specific direction that has a positive scalar magnitude (outward in the context of the reference system) which causes an *increase* in the distance between objects. We can identify gravitation as an *inward scalar motion*.

Einstein took a step toward this conclusion by formulating a "principle of equivalence," which asserts that gravitation is equivalent to a motion. But because he did not recognize the existence of scalar motion, his principle asserts that gravitation is equivalent to a *vectorial* motion. This assumption runs into immediate difficulties because the directional characteristics of gravitation are quite different from those of vectorial motion. Einstein's answer to this problem was to abandon Euclidean geometry, and to assume a distortion of space by matter. Once the existence and properties of scalar motion are recognized, we can take a step beyond Einstein, and say that gravitation is not only *equivalent to* motion, it *is* a motion. And since it is a scalar motion, the radial force field that we observe is automatically explained, without the necessity of making any arbitrary assumption such as that of a distortion of space.

The big obstacle that has hitherto stood in the way of recognizing that gravitation is a motion is that gravitational forces are observed to originate from physical bodies even when those bodies are at rest in the reference system. As long as *motion* is equated with *vectorial motion*, there is no motion of which these gravitational forces could be properties. But when gravitation is identified as a *scalar motion*, everything falls into line. A scalar motion originating at a gravitating object, with the characteristics defined in the preceding paragraphs, has exactly the properties that we observe in gravitation. As noted earlier, if this object is free to move, it does move in the scalar manner. If it is not free to move, its location becomes the reference point for its scalar motion. The magnitude of this motion then becomes an added component of the motion of each of the other objects in the scalar system, in accordance with the general property of scalar motions as defined above. The gravitational force exerted by massive object A is the force aspect of its scalar motion, transferred to the distant objects by reason of the immobilization of object A at the reference point.

The general acceptance of Einstein's gravitational theory, in spite of those of its features that strain credulity to the limit, has been due largely to the willingness of most scientists to go to almost any lengths to avoid conceding the existence of action at a distance, which seems to be implied in Newton's gravitational law (although Newton himself refused to speculate as to the nature of the gravitational effect). Recognition of gravitation as a scalar motion now solves this problem, as it reveals that the apparent action at a distance is merely an illusion resulting from the inability of the conventional spatial reference system to represent scalar motion in its true character.

The magnitude of a scalar motion, the amount of increase or decrease in separation between two moving points, is independent of direction, and therefore cannot be altered by the manner in which the motion is represented in the reference system. In the case of the expanding balloon, for instance, if we visualize the balloon as isolated in space, it is evident that point A on the balloon surface is moving away from point B, diametrically opposite, in the direction BA, and at some speed x, while point B is moving away from point A at the same speed in the opposite direction AB. If this balloon is placed in a reference system in such a manner that point B becomes the reference point—as by placing it on the floor of a room with point B touching the floor—the true magnitudes of the motions remain the same, but as seen in the context of the reference system they are drastically altered. Point B is now represented as motionless, and the entire rate of separation, 2x, has to be attributed to the motion of point A. There has not been any action by one point on the other, but because of the shortcomings of the reference system, the motion of point B, as seen in that system, has been transferred to point A.

The same considerations apply to gravitation. Gravitating object A is moving in the direction AB at speed x, while gravitating object B is moving in the direction BA at speed y. But because of the restrictions that apply to these objects by reason of their participation in *vectorial* motions, object B may be unable to change its position in the reference system. It then becomes the reference object for a system of scalar motions, and its speed y is transferred to the other objects in the system, in accordance with the general principles previously stated. Thus the speed of object A, which is actually x, is seen, in the context of the reference system, as x+y. In the usual case, the reference object B (for example, the earth) is much more massive than the distant object A (a falling body, perhaps). The transferred motion y is therefore much greater than the true motion x of object A, and the responsibility of object B for the greater part of the motion x+y is easily recognized. It thus appears that object B is exerting a force on object A causing it to accelerate—the action at a distance that is so repugnant to most scientists. As can be seen from the foregoing explanation, there is no such action. What we observe is merely an illusion due to viewing the motion in terms of a reference system that is incapable of representing it correctly. Each of the gravitating objects is actually pursuing its own course, independently of the others.

When gravitation is thus identified as a scalar motion, it becomes evident that the forces due to electric charges and the corresponding magnetostatic phenomena (magnetic charges, we may call them) are likewise properties of hitherto unrecognized scalar motions, Observationally, these forces differ from the gravitational force only in those respects in which scalar motions are variable; that is, in magnitude and in sign. Here again, the absence of observable motion at the point of origin of the force is due to the fact that the location of this motion (the location of the charge) is the reference point at which the motion is frozen by the coupling of the moving scalar system to the fixed reference system.

From the points brought out in the foregoing paragraphs, it can now be seen that Newton's assertion that motion is "well known to all" is very much in error. As it actually exists in the physical universe, motion is not the simple system of changes of position defined by vectors in a spatial reference system, as seen in current scientific theory. It is a complex system in which various types of scalar motion coexist with the vectorial motions, and interact with them. These scalar motions cannot be represented in their true character in a spatial coordinate system.

To many, perhaps most, scientists this is an unwelcome conclusion, because it obviously calls for a critical reappraisal of basic physical relations to take the role of scalar motion into account. But it is not theory or speculation; it is an inescapable result that necessarily follows when we correlate the observable facts. Both the currently accepted concept of "motion," and the prevailing view of the relation between motion and the reference system are clearly due for some radical reconstruction.

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