

Unified Field Theory: basics

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Present textbooks on Einstein's Relativity deal solely with relativity, but there was a time when these textbooks took the next step from relativity which was to unified field theory. I look at what James A Coleman had to say on unified field theory in the 1950s and make comments. Of course, unified field theory should have progressed much further from the 1950s in the interval to our present time (2008), but unfortunately due to very little mention, it has not been made aware to many people, hence there has been only a few working on it since then.

- James A Coleman in his book on relativity, after discussing relativity, then starts on unified field theory:

Now that the discussion of the theory of relativity has been completed, it may look as if the story has been told and that there is nothing more that can be said. Nothing could be farther from the truth. The theory of relativity was only an introduction to the much bigger and even more tantalizing problem with which Einstein grappled for the last twenty five years of his life. This is called the unified field theory.

The problem is easy to understand but difficult to solve. We will remember that one of the basic phenomena in our universe is that of gravitational attraction, i.e., every object in the universe attracts every other object. We saw that this could be expressed mathematically by Newton's approximate law-

- I omit this reference to finding Newton's gravitational law as an approximation. In my descriptive of physics, we have mathematical models and the equation which follows is valid within the idealisations and conditions of a certain mathematical model.

Coleman writes: $F = Gmm'/d^2$

where m is the mass of one object, m' that of the other, d the distance between them, and G the gravitational constant.

- What Coleman omits is that its best to deal with idealisation of mass-points. And I want to write this equation as instead:

$$F_g = Gmm'/d_g^2$$

where F_g = gravitational force, G , m and m' are as he describes, and the distance between them is now d_g .

Coleman continues:

But we also know of other types of forces which are similar to gravitational attraction. Two unlike electric charges (a negative charge and a positive charge) will also attract each other with a force given by:

$$F = Cqq'/d^2$$

where q is the amount of the negative charge, q' is that of the positive charge, d the distance between them, and C a constant.

- In this scenario we have the idealisation of point-charges. And I want to emphasise that the force in the second equation is not the same as in the first, so I rewrite as:

$$F_e = Cqq'/d_e^2$$
 might have been better

where it should hopefully be obvious what this means.

Coleman continues:

This particular formula is called Coulomb's law, after its discoverer. And we also have a similar formula giving the force of attraction between two unlike magnetic poles (a north magnetic pole and a south magnetic pole), equation

- And I rewrite his equation as:

$$F_M = KMM'/d_M^2$$

- Coleman with this notation says:

where, similar to the other two formulas, M is the pole strength of the north magnetic pole, M' the pole strength of the south magnetic pole, d_M the distance between them, and K is constant, different from the previous G and C .

Comparing these three equations, there are two important conclusions. First, the three equations which mathematically express three different and entirely unrelated phenomena are identical in form. The second important conclusion to be drawn is that the difference between the gravitational force of two masses, on the other hand, and the electric and magnetic forces, on the other. Gravitational forces are forces of attraction only, but two like charges (two negative charges or two positive charges) will repel each other. Similarly, two unlike magnetic poles will attract each other, but

two like poles (two north poles or two south poles) will repel each other. The three types of forces are similar in respect but dissimilar in another.

Historically, these equations were evolved empirically by different people working entirely independent of one another. But the similarity between the three types of forces (gravitational, electric, and magnetic) is so striking that it seems as if all three must be branches of a more fundamental or basic phenomenon of nature. The attempt to derive these equations from more fundamental theory comprises one particular aspect of the unified field theory.

- Actually, researchers were not working independently from one another, they were following similar ideas from a general descriptive theory namely Newton's theory and this theory extended further by the likes of Boscovich; making that the fundamental theory of which he speaks.

The general purpose of the unified field theory is a much broader one than this, however. For it is an attempt to deduce all the physical phenomena we know of from a few simple fundamental principles. Up to the present time, the laws of physics have been developed in separate sections or branches in a generally unrelated way. The laws of thermodynamics comprise one branch, those of optics another, etc. As we have matured scientifically through the years, and our store of knowledge of the physical world has increased from an infinitesimally small amount to an infinitesimally larger amount, we have seen interrelations between the branches. These amalgamations, when they occur, have enabled us to gain scientific knowledge at a much faster rate. If, through the unified field theory, the fundamental laws of the universe can be stated for all time, then the laws of all various branches should flow as an effortless consequence.

Although a unified field theory sounds highly desirable, how do we develop such a theory in actual practice? As the name implies, the theory concerns itself with fields. When two gravitational masses (or electric charges or magnetic poles) attract each other, the interaction takes place in the region, or field, between the [[point-particles]]*.

- Coleman says "masses" but "point-particles" is better.

Since objects are influenced by other objects at a distance from them, Newton called such forces 'action at a distance.' What happened in the region between the objects was not known. Einstein's approach to the problem was to consider the field itself in an effort to understand the basic underlying properties of fields in general. Then gravitational, electric, and magnetic fields would follow as a special case and the General Theory of relativity (since it is a theory of gravitation) would be derivable from the unified field theory.

- Einstein has space-time warpage description of gravity. Baranski who was working with Einstein on unified field theory agreed with him on that theory, and has abandoning spacetime warpage and going back to Newton's descriptive of forces causing point-particles changing their trajectories as

easier to deal with than spacetime warpage. As far as I am concerned both descriptives for gravity work. However, what has clouded the issue is that when a scientist works in either Newtonian or Einsteinian descriptive of gravity they can be prone to making mathematical mistakes, and they then can mistake a mathematical model with mistakes in it as being an accurate mathematical representation of either of these descriptives. i.e. suppose we have an idealisation of a mathematical descriptive theory free of mathematical mistakes; what then happens is various scientists singularly or in groups mistake the math model they create with all its maths mistakes as being this error-free theory; when obviously it is not. Some of the many mistakes that can be made is dealt with in some of my papers on relativity at General Science journal.

Up to now, scientists have been concerned mainly with directly directly measurable quantities, such as temperature, pressure, force etc., and have evolved theories in terms of them so that they can measure these things experimentally in an almost mechanical aftermath. The emphasis has not been on the understanding of a phenomenon but on the physical proof of it, or as Einstein called it, the 'closeness to experience.' Admittedly, physical proof is desirable, but it should be emphasised that it is not necessarily the most important element. In all probability, the unified field theory will not be amenable to experimental proof as other physical theories have been, because of the more subtle nature of the phenomena with which it deals.

- Coleman looks at things the wrong way round, he looks at deriving a unified field theory from the three force equations he cites. When really things historically happened the other way around, ideas from unified field theory led to these three equations. Hence since unified field theory is the starting point for this scientific progress, it is confirmed with each step taken along this path. What of course clouds this is such issues as mathematical mistakes that can be made by people working on this tradition.

But the tremendous power of a unified field theory can be seen in that it produces much more fruitful results than does the mere repetitious derivation of formulas we already know. For if the underlying theory of fields is understood completely, we should then be able to understand other forces which also exist at the present time but about which we know very little.

An example is the powerful forces that hold nuclear particles together, i.e. nuclear forces. We know that these forces are much stronger than the coulomb forces, whereby like charges tend to repel each other – but beyond that we know little. It may very well be that there exist such a thing as nuclear fields, analogous to gravitational fields (but much stronger), which the unified field theory can predict.

- Coleman writes in 1954, and today 2008 we know more about these nuclear forces, which he in 1954 considers not much is known. The unified field theory is as per my claim - Boscovich's theory. And the Soviet Bloc reports that Boscovich's theory is in remarkable agreement with observed measurements of the nuclear forces. So, it is as Coleman thinks – unified field theory was able to deal with the forces he didn't know much about in 1954.

With a slight stretch of the imagination we can envisage an even broader usefulness for the unified field theory. We have seen that gravitational forces are forces of attraction only, while magnetic and electric forces are forces of attraction and repulsion. Is it not possible that a gravitational force of repulsion can exist in our universe and that this missing link only awaits our discovery of the general laws of fields before we create such a repulsive gravitational force?

- According to Boscovich's theory—Newton's gravitational equation has only a certain range of applicability and the gravitational force then switches from attractive to repulsive. That would then explain phenomenon we attribute at present to dark matter and dark energy. In that respect Boscovich's theory is what is called MOND – Modified Newtonian dynamics, because it is modifying Newton's gravitational equation to be something else on a different scale.

Such reasoning can be extended further. Perhaps a true understanding of fields will enable which are completely different from any that we know. Such scientific progress as this is rare in our civilization, but a brilliant example occurred when Maxwell in 1864 mathematically predicted the existence of radio waves from the most elementary knowledge of electricity and magnetism. The fact that these could not be produced experimentally for another twenty –odd years makes his achievement all the more notable. We may be on the verge of similar developments today through the unified field theory.

We see that we are living in exciting times. Not only is scientific progress being made at an ever-increasing rate, but every new scientific discovery predicts many more to come – each more enthralling than the last, and for many of these we will be indebted to the genius of Albert Einstein and to his theory of relativity.

- And that is where Coleman ends, and which I add – with this rapid rate of progress in exciting times, very little time has been spent on considering if we have understood things correctly, or whether we have things round the wrong way; hence why many mistakenly think unified field theory is something we work towards, rather than which we work from.

References

Relativity for the Layman, James A Coleman, Penguin books, UK 1954
Scientific Basis for World civilisation: Unitary Field Theory, Leo Baranski, 1960.

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