Did Einstein really prove that Newton was wrong?

It is widely believed that Einstein proved that Newton's classical mechanics was wrong. But, was it really wrong? If it was really wrong, how could scientists believe in a wrong theory for over two hundred years? If it was really wrong, are the claims that Newton successfully explained many phenomena sheer lies?

In a strict sense, it is true that Newton's classical mechanics was wrong. Nevertheless, it would be fair to say that Newton's classical mechanics was a very good theory, which successfully explained many phenomena not only qualitatively but also quantitatively.

It may be hard to explain exactly how Einstein's theory replaced Newton's classical mechanics at laymen's level. But, let me put it this way. From the days of Adam and Eve, every human being knows that every object feels a force downward. However, is this true? No. We now know that objects near the earth feel a force not downward, but toward the center of the earth. Moreover, "downward" is not a well-defined word considering that the earth is round.

Nevertheless, the theory that every object feels a force downward is very convenient and successful theory, if you confine yourself to a small region. In a small region, you can forget about the fact that the earth is actually round, and the downward direction is very well-defined notion. However, if you travel around the world you will see that the downward direction is not well-defined as it is not a unique direction and the theory that every object feels a force downward is not a good theory.

Same goes for Newton's classical mechanics. It is very useful, convenient and successful theory within its domain of validity. When the objects move with speeds far less than the speed of light, and gravitational force is not strong, it is a good theory. However, when the objects move very fast or gravity is strong, Newton's classical mechanics is wrong.

Nevertheless, the lesson we have learned in Newton's classical mechanics is never discarded. In a lecture, loop quantum gravity physicist Carlo Rovelli said,

"We don't unlearn what we have done. [...] Of course, it's hard to pinpoint exactly what is the key thing that remains with us, but science is about adding knowledge and interpreting previous knowledge, but it's not about discarding previous knowledge."

In my article "the mathematical beauty of physics," I already explained that "every new theory in physics must be able to explain new phenomena in addition to describing old phenomena that an old theory has already explained adequately." This is applied to our cases as well. The theory that object near the earth feels a force toward the center of the earth can explain that every object seems to feel a force downward. Similarly, Einstein's theory of relativity can explain why Newton's classical mechanics seems to be so successful; when objects move with speeds far less than the speed of light, and gravitational force is not strong, Einstein's theory of relativity reduces to Newton's classical mechanics. In such cases, Newton's classical mechanics is as good as Einstein's theory of relativity. Indeed, the Nobel laureate Max Born said "The continuity of our science has not been affected by all these turbulent happenings, as the older theories have always been included as limiting cases in the new ones."

On the other hand, we now know that the theory that object near the earth feels a force toward the center of the earth is in turn neither the final nor precise theory. We know that this theory is due to Newton's universal law of gravitation that every object attracts one another. Similarly, we now know that Einstein's theory of relativity is in turn neither the final nor precise theory either. We know that Einstein's theory of relativity needs to be formulated in a language that is consistent with quantum mechanics. Loop quantum gravity and string theory do this job. Of course, it is also possible that they are not also the final theories themselves but mere approximations of more fundamental theories.

I

So far, we have seen that old theories which are right in their own domains are wrong in more extended domains. As explained in my article "the mathematical beauty of physics," despite being "wrong" they are still important in formulating new theories that are right in more extended domains.

On the other hand, it sometimes happens that theories which are wrong even in their own potential, proper domain of validity serves themselves as stepping stones for more right theory. For example, Rayleigh derived the blackbody radiation spectrum in May, 1905. Jeans found a mistake in Rayleigh's derivation in June; it was off by a factor of 8. Even though Rayleigh was wrong, Jeans would not have been able to derive what is now called ``Rayleigh-Jeans law" without the wrong calculation by Rayleigh.[1]

A similar remark can be made about my role in loop quantum gravity. According to loop quantum gravity, there are minimum units for area. Traditional loop quantum gravity can calculate the values for the minimum units of area. However, I showed that their calculation was wrong. I showed that they should be given by the square root of the values they have calculated. However, without the wrong, old loop quantum gravity, I would have never succeeded in calculating the correct values

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[1]Actually, Rayleigh-Jeans law is satisfied only for long wavelength, and Planck's law is correct for all wavelength range. But, that is a different story. Here, I mean that Jean's calculation was wrong even in its proper, potential domain which is long wavelength range.

for the minimum units of area.