In Defence of a Partial Facticity View

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According to Nancy Cartwright, the laws of nature do not describe true facts about reality. She details the considerations of how this must be so in her book, *How the Laws of Physics Lie*. Here I will focus on the chapter "Do the Laws of Physics State the Facts?", where she explicitly denies that a facticity view of laws is defensible. While Cartwright's titles directly implicate the laws of physics, she means to include all laws of nature that purport to be fundamental and explanatory in her attack of the facticity doctrine.

I seek to show that Cartwright's conclusion, that the facts described by a law do not obtain, is based on an unsatisfactory argument that demands too much of laws, or goes beyond the scope of their explanatory and descriptive power. Her understanding of laws requires them to both possess the most fundamental explanatory power and provide a complete description of facts resulting from instances of these laws; this she requires equally under *ceteris paribus* conditions as well as complex interactions with multiple laws in reality. I will examine how such constraints on laws would indeed render them as incomplete descriptions of facts about reality, but more importantly, why approaching laws in this manner is unreasonable and undermines a practical judgment of laws.

Cartwright's position on fundamental laws, in her own words, is that they "do not describe true facts about reality. Rendered as descriptions of facts, they are false; amended to be true, they lose their fundamental, explanatory force" (Cartwright, 1998, p. 865). She calls this assumption, that laws are true descriptions of facts, the facticity view of laws. As evidenced in the above statement, her main issue is the trade-off between the descriptive truth of laws and their explanatory power. Her classic example is the attempt to describe how two massive, charged bodies behave. The two relevant laws which, taken together, ought to provide a true description of the bodies are the law of universal gravitation and the law of force between two charges – Coulomb's law. The behaviour of the bodies cannot be correctly described by either law by itself; we are in agreement on this point.

However, Cartwright then asserts that neither law is even approximately true because "[n]o charged objects will behave just as the law of universal gravitation says; and any massive objects will constitute a counterexample to Coulomb's law" (Cartwright, 1998, p. 868). Beyond stating the obvious facts that charged bodies are not described solely by the law of universal gravitation and conversely that massive bodies are not described solely by Coulomb's law, Cartwright purports that neither law is true because the consequent gravitational force, after interacting with the force between two charges, is very different from the one described by the law of universal gravitation. Likewise, the consequent force between two charged bodies is affected, in theory, by interacting with the gravitational force between the bodies, and the consequent phenomena of the charged force is not exactly described by Coulomb's law. Cartwright contends that neither law can truly describe the portion of the 'resultant' force for which it is responsible; that is, the law of universal gravitation is expected to explain the gravitational force, even when modulated by the interaction of charges. In fact, she argues that the resultant force is not divisible into partial forces, such as gravitational and that of charges, thereby making it impossible for the relevant laws to describe the complete consequent phenomena.

There appears to be a noteworthy flaw in Cartwright's philosophical methodology in the above position. A fundamental law, on her view, should possess the ability to describe the consequent facts that occur due to interactions between it and other fundamental laws. In the case of the massive (having a mass, not necessarily 'gigantic') and charged bodies, she expects the law of universal gravitation to truly describe the consequent facts of all possible instances where the law would be applicable, even when these instances involve other laws that affect the influence of the gravitational force. The law of universal gravitation in its most basic formulation,

$$1.\ F = G\frac{m_1 m_2}{r^2}$$

provides a fundamental explanation of what factors comprise the total gravitational force between two bodies and describes the magnitude of the force. What the law does not do, and what Cartwright requires of a law, is account for variations in the magnitude of the gravitational force when other laws, describing the extent other forces, are applicable. In the above case with two charged bodies, we accept the following as a (simplified) representation of the consequent force:

$$2.\ F = G\frac{m_1 m_2}{r^2} + k^c\frac{q_1 q_2}{r^2}$$

This second formulation is acceptable as an explanation of the forces at work. But does it truly describe the consequent facts of the resultant force in the two charged bodies example? As Cartwright notes, "In the interaction between the electrons and the protons of an atom … the Coulomb effect swamps the gravitational one, and the force which actually occurs is very different from that described by the law of gravity" (Cartwright, 1998, p. 868). So, the law of universal gravitation in (1) cannot truly, or even accurately, describe the force that occurs.

I see no difficulty with this limitation of (1). It is taken as obvious that a law explaining and describing gravitation under ideal, uninfluenced conditions will not be sufficient to describe the effect of gravity under conditions influenced by other forces described by other laws. Even with (2), a true description of the resultant force is not provided, says Cartwright, because the phenomena of the resultant force is so different from the independent descriptions given by the law of universal gravitation and Coulomb's law. But for her, the descriptions of facts in reality offered by the two laws are not merely insufficient; on her view, they are "simply false" (Cartwright, 1998, p. 866). This is where my view diverges with Cartwright's. The descriptions of real facts put forward by fundamental laws are incomplete, not false. Cartwright attempts to counter such a view by showing how vector addition of forces, as outlined above, introduces 'causal powers', which she believes are inadequate for revealing what laws of nature actually do.

Despite the use of equations above, I do not hold the view that resultant forces are completely quantified or described by simply adding all the relevant forces (explained by their respective laws) together. However, they offered a visualisation of the explanatory and descriptive power of individual fundamental laws that I dealt with in the preceding paragraph. Cartwright does not permit the idea of 'component' and resultant forces beyond a metaphorical reading. She asserts that component forces, derived from laws, do not actually describe what bodies do for various reasons: the forces due to gravitation and due to charges "are not real, occurrent forces"; the resultant force "is neither the force due to gravity nor the electric force"; and finally, "neither [force] exists", despite the claim of vector addition that the force due to gravitation and charge are both produced (Cartwright, 1998, p. 870).

These are bold declarations that are not adequately defended by Cartwright. The existence of component forces and the indescribability of the joint resultant force are not mutually exclusive. The force due to gravity and the force due to electric charges both exist, but they interact in a way such that the laws describing the component forces cannot fully describe the consequent phenomena. This is no fault of the laws or the forces they stipulate. Laws cannot provide complete accounts of the facts that result from any number of interactions with other forces. This does not make them false descriptions of facts about reality. Laws can provide complete descriptions of facts under ideal conditions and incomplete descriptions under complex, real-world conditions.

Cartwright considers John Stuart Mill's opposing view that component forces do exist. He thinks that the distinct effects of each component force do exist in the resultant force. But Cartwright denounces this as merely unlikely, and she cites the example of pulling a body equally in two opposite directions. For example, let us attach two strings to a ball on opposite hemispheres, and both strings are pulled with an equal magnitude of force; the ball does not move in any direction, unlike Mill's example of a northeast movement due to northward and eastward forces on a body. The tension on the body, however, could in theory be detected and measured, identifying the individual component forces. Hoping to provide a clearer example where "there is no possibility for seeing the separate effects of the composed causes as part of the effect which actually occurs", she offers examination of the five energy levels of the ground state of a carbon atom (Cartwright, 1998, p. 870).

Without delving into the detailed process for determining the five distinct energy levels (Cartwright, 1998, pp. 871-873), I will note that Cartwright acknowledges that the five levels result from a combination of a Coulomb potential and a spin-orbit coupling potential – this is considered the correct explanation. If we consider the effect of the Coulomb potential alone, we identify only three energy levels. But a spin-orbit coupling potential also occurs because each electron's spin "couples with its orbital angular momentum to create an additional potential" that results from the spinning electron's "intrinsic magnetic moment" (Cartwright, 1998, p. 872). Indeed, this is a complex interaction of forces, but this does not imply that the law governing the Coulomb effect is false. When the Coulomb potential combines with the spin-orbit coupling potential, the third of the original three energy levels splits into three other very different levels. The first two energy levels persist, but the third no longer exists; instead, three new levels are identified, totaling five energy levels for the carbon atom's ground state.

The Coulomb effect, and the law that stipulates it, cannot independently describe the result of the intricate interaction of electric and magnetic forces (caused by spin). While it is not possible to make a completely true factual statement about the Coulomb potential's effect in the carbon atom without taking into consideration other forces at work in determining energy levels, that does not make Coulomb's law false with regard to descriptions of fact. The law only describes a specific tendency, or potential in this case, whose effects are actually recognisable – the first two energy levels in this example persist! Perhaps there are other atoms where the energy levels described by Coulomb potential do not exist because of spin-orbit coupling potentials interacting at all levels; but the point remains that Cartwright's example is insufficient for her remit, and moreover each law "focus[es] on one or another of various aspects of the situation" (Chalmers, 1993, p. 203). These forces, aspects, or features are real factors that exist, whether or not they are distinguishable in the consequent phenomena.

To reiterate Cartwright's position, she believes that it is implausible to take component forces "literally as parts of the actually occurring force" (Cartwright, 1998, p. 871). What, then, is causing the resultant force? The causes of phenomena are the real forces stipulated by laws, which describe facts under ideal conditions. Although *ceteris paribus* conditions never occur outside experimental settings, Cartwright's position is flawed because she expects the law of universal gravitation to take into account the effects of electric charges on gravitational force, when the law of universal gravitation deals with gravity only. The law of universal gravitation would provide at least an approximate description of the trajectory of a leaf falling from a tree, even when combined with laws describing other interacting factors, such as aerodynamics. Additionally, she supposes that laws' challenge to provide true descriptions of facts could be alleviated by deeming laws to be descriptions of causal powers that bodies possess, not facts about reality. In her essay she is reluctant to admit causal powers into the understanding of what laws do, although she and Alan Chalmers later do accept them in similar forms (Cartwright, 1989; Chalmers, 1993).

Without having appealed to causal powers or 'nature's capacities', I hope to have clarified where in Cartwright's case for the rejection of the facticity view of laws there is room for reasonable doubt. Expecting fundamental laws to provide complete descriptions of facts resulting from complex interactions between various laws is too demanding, considering the intricacy of reality. As Chalmers eloquently writes, "any situation in the world will involve the interplay of a number of nature's capacities. An accurate and exhaustive description of the outcome of that interplay is one thing. An accurate description of how one or other of those capacities function is another. Fundamental laws perform the latter task" (Chalmers, 1993, p. 203). The employment of capacities is beyond the scope of this essay, but acknowledging that laws do provide explanations of phenomena in reality also affirms that fundamental laws are at least "strong candidates for true statements" about reality, if not complete ones, and that they certainly do not offer only false descriptions as Cartwright alleges (Chalmers, 1993, p. 203).

References

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