Chapter 7: Motion

7.1 Introduction

Kant's concept of motion is found in his works of transcendental philosophy, that is, *Critique of Pure Reason* (1781), *Prolegomena to Any Future Metaphysics* (1783), and his laws of mechanics in *Metaphysical Foundations of Natural Science* (1786). Kant's views on motion are related to his views on *a prior* space-time, categories and principles.

Kant's quest for synthetic *a priori* propositions (judgments) in physics, mathematics, and metaphysics and the scientific explanations in his philosophical works make him out to be a philosopher of science[103]. Michael Friedman considers his work on Mechanics to be Newtonian in many ways. Newtonian science has made remarkable contributions to the historical development of modern science. There are some similarities to Newton in Kant's concept of motion and the formulation of his three laws of motion (mechanics) in the MFNS. For example, both the Newtonian and Kantian laws are founded on

[103]According to Moti Bir Rai, Kant can be considered as a philosopher of science and this can be known only by comparing him with other philosophers of science. Kant writes that categories like substance, cause, interaction, etc. are indispensable for both science and everyday life. Philosophically minded scientists like Plank, Einstein, Wyle, Heisenberg, Bohm and others have extensively written on these topics. All these writers refer to Kant. For details, see his 'Kant as a Philosopher of Science', *Journal of the Department of Philosophy*, Vol.II, University of Calcutta, 1976-77, pp.87-97.

specific concepts and principles, and both the laws are meant to be applied to the objects of experience. Hence, after arguing for Newton's three laws of motion as judgments of experience from Kantian points of view, I critically illustrate some significant differences between the two and also argue that Kant's three laws of mechanics form an integral part of Kant's philosophy of physics.

Watkins and Friedman think that Kant was somewhat influenced by Newtonian Science. But it does not mean that Kant was a thoroughbred Newtonian in his take on science. Like contemporary scientists, he was in search of a consistent scientific theory to give a philosophical foundation. In his time, the Newtonian mechanics was thought to be a consistent scientific theory. Kant's formulation of the three laws of motion was intended to give a metaphysical foundation to Newtonian science, which he thought to be a requirement to make it more certain. Kant has mentioned that Newton's laws of motion (except the third law of motion) are not synthetic *a priori* judgments. This has given birth to a perpetual confusion in understanding the laws of motion of both Newton and Kant. I explain and defend Kant's reasons behind considering Newton's Third Law of Motion as a synthetic *a prior* judgment, in § 7.4.1 of this chapter.

How are Newton's three laws of motion[104]equivalent to the judgments of experience in the Kantian case? To answer this question, we need to proceed from understanding the empirical employment and role of categories in the formulation of principles and laws and differences between judgments of

[104]Chandrasekhar, S., *Newton's Principia for the Common Reader,* Kolkata, Oxford University Press, 2012, pp. 22-31.

perception and judgments of experience. We get the transcendental principles of natural science (pure physics[105]) in the CPR and the metaphysical laws as the laws of mechanics[106] in the MFNS and the differences between 'Judgments of Perception' and 'Judgments of Experience' in the PFM. After exploring Kant's concept of motion and critically examining the pure (*a priori*) and empirical concept of motion, I move forward to argue for Kant's judgments of experience and their possibility in physics.

In this chapter, I explicate Newton's three laws of motion as judgments of experience. I begin the journey by explaining the role of pure concepts and pure understanding, which give rise to principles and laws of physics. I explore Kant's definitions of judgments of perception and judgment of experience and illustrate a difference between the two with examples (in the form of a table). I argue for Kant's objective validity (valid for everybody) as one of the criteria of judgments of experience, and this objective validity is not the validity of the objects of experience but of the uniformity of the human mind. I argue that the judgment of experience is made by the acts of synthesis. I also explain how we should understand Newton's three laws of motion in the sense of Kant's transcendental (critical) philosophy.

[105]Kant's philosophy of physics does not include all the parts of physics but only the pure parts of physics.

[106]Kant, I. *Metaphysical Foundations of Natural Science*, M. Friedman (Tr. & Ed.), New York, Cambridge University Press, 2004, pp.80, 82 and 84.

7.2 Kant's Concept of Motion

Kant's early views on motion in his essay 'A New Doctrine of Motion and Rest' (1758) are found to be relativist. In this essay, Kant even rejects Newton's ideas of absolute motion and space by noting "I should never use (the terms 'motion' and 'rest') in an absolute sense, rather always relatively"[107]. However, Kant has used the term 'absolute motion' as an idea of reason in a quite different referential framework. Robert Palter makes it more intelligible in his 'Kant's Formation of the Laws of Motion':

> For Kant, every description of motion requires a (materially defined) kinematic framework or *relative space*. Some kinematic problems may require for their solution the introduction of several such relative spaces. In every problem, however, there will be one relative space whose state of motion is left unspecified and this is, for the problem in question, the 'immovable' relative space, or *absolute space*. Thus, Kant's absolute space is, unlike Newton's, an indeterminate framework which may be thought of as shifting from problem to problem; absolute space functions, in Kant's view, as a mere regulative idea of reason. (p.101)

Kant's views on motion are related to his views on space and time and on some categories and principles. Motion is not free from experience and at the same time, it is not possible without the presupposition of space and time. Hence, the concept of motion is not itself a pure concept like a category. Mohanty has correctly noted this point in his *Lectures on Critique of Pure Reason*: "We might have concepts which can be derived from several pure concepts. Kant wanted

[107] ibid, p.xiii.

that the elements must be original or simple. For example, the notion of motion can be derived from various other notions put together; that it is not one of the fundamental concepts of understanding" (p.107). Motion is in our outer intuition so it cannot be included in the pure (*a priori*) part of physics but succession and determination are *a priori* due to the category of causality. In other words, the Kantian laws of mechanics are *a priori* because they correspond to the categories of substance, causality, and communication.

The alteration consists of inner and outer intuition because it is dependent on the outer intuition of motion in space. Motion is a matter of outer intuition, and this intuition is possible just because of space, and this space alone is determined as permanent. In comparison to it, time and all other things of inner sense (all the things of inner sense are not considered empirical) are in constant flux because the things of inner sense are not permanent like the things of outer intuition.

Motion as the alteration in space is always connected with the concept of causality. The intuition of alteration is not possible only by pure understanding[108]. We also require the help of sensibility. Further, alterations take place in time because they presuppose successions of units of time. The notion of the alteration as an example of motion is made possible by the transcendental exposition of the concept of time.

[108]Kant clearly tells us that the proposition, "every alteration has its cause" or "every event has a cause" is the concept which can be derived only from experience. See Kant's *Critique of Pure Reason* (B3), London, Macmillan & Co. Ltd., 1963, p.43.

The Kantian conception of motion is both transcendental and geometrical. It is transcendental in the sense that it does not directly deal with empirical or phenomenal motion but with the pure concept of motion, which is objectively possible in experience. And it is geometrical in the sense that it can be constructed and demonstrated. That is why Konstantin Pollok has disagreed with Thomas Soren Hoffmann's definition of motion as "the predicable of experience as such" because it does not distinguish between the empirical and pure concept of motion[109]. According to Pollok, if we understand the pure concept and the empirical concept of motion as identical, then we will be misconstruing the Kantian concept of motion. The two concepts of motion cannot be thought to be single. Pollok points out that Kant did not accept Christian Gottfried Schutz's view printed in the *Critical Review* of 1781. Schutz writes that we cannot represent a line in an *a priori* intuition without drawing it in thought. Drawing however is a kind of motion, and it is an empirical concept. According to Schutz, even the lines and conic figures need empirical help in order to be represented. Pollok thinks that this kind of mistaking Kant's concepts of motion is due to the notion of the subject being ambiguous since it can be understood both in a geometrical and transcendental case. The movement of a point in imagination is an example of pure motion (transcendental), and the movement of a ball or something in experience is an example of empirical motion. However, Kant says that the pure concept of motion should not be confused with that of the empirical motion. These two types of concepts of motion cannot be collapsed into a single concept. The pure concept of motion presupposes the same objective validity of possible experience.

[109]Palter, R., Kant's Formulation of the Laws of Motion', *Syntheses*, Vol.21, 1972, p.101.

Kant's concepts of pure, empirical, and relative motion and the idea of absolute motion in relation to similar types of space are discussed in his MFNS under the four broad chapters: Phoronomy, Dynamics, Mechanics, and Phenomenology. He did not discuss the idea of absolute motion and space in the CPR. Rather, he denied the substantiality and absoluteness of space. He discusses motion extensively in the MFNS with the ideas of absolute motion and space. The ideas of absolute space and motion are just ideas of the reason for understanding the other different kinds of space and motion. He begins with "absolute is rigid and very hard to find" in the CPR and ends with "absolute as an idea of reason" in the MFNS (p.16) but remains static to a view of space and time as formal conditions for all kinds of human knowledge. Motion being possible due to space and time presupposes something empirical because it is possible to find something movable only through experience. Similarly, time itself does not alter, but it is something which is in time that alters. The concept of alteration presupposes both space and time as existing. Whenever philosophers of science and scholars of Kantian philosophy discuss the concept of motion, they interpret it through Newtonian and Einsteinian frameworks. They compare Newtonian laws of motion with Kantian laws of motion and thereby give empirical justification. They even fail to understand the differences between the pure concept of motion and the empirical concepts of motion. It is important to understand the difference and similarity between Newton and Einstein's mechanics, to understand Kant's pure concept of motion.

The classical mechanics of Newton differs from the mechanics of Albert Einstein. Newton's laws of motion are dependent on his theory of mechanics and

these laws together with his law of gravitation give us an explanation of the motion of macroscopic objects under everyday conditions; but when applied to extremely small objects of high speeds (in the equation to the speed of light), his laws are not satisfactory. Only the theory of relativity can explain motion at a speed approaching the speed of light. When the motion of extremely small objects is taken into consideration the wavelike properties[110] of matter must be taken into account. When the Newtonian Laws of Motion speak of an object as being in motion, such motion is usually in reference to another object which is considered to be at rest. In the case of Einstein's theory, the motion of an object in the universe is relative. Einstein's view of relativity is also not against Kant. Despite his time regulation in Relativity (synchronization), Einstein has not gone completely against Classical Mechanics. This is clarified by Harald Hordenson's interpretation of Einstein's concept of motion in the *Relativity, Time and Reality: A Critical Investigation of the Einstein Theory of Relativity from a Logical Point of View*. Hordenson writes:

> Since the fundamental propositions which lead Einstein to the Relativity problem turn out to be meaningless when classical time is rejected, the derivatives of the time concept will also fail to make sense. Take for instance 'movement'. In the context of the physical phenomenon discussed here, the word 'movement' means the change of position with the flow of time'. But the flow of time implies 'before', 'simultaneous' and 'after' which

[110]Reyna Ruth's *The Philosophy of Matter in the Atomic Era: A New Approach to the Philosophy of Science*, Bombay (Asia Publishing House, 1962, p.21), where he writes that the 'wavelike particle' in the wave mechanics has been introduced by Schrodinger as a duality between waves and particles, according to which an electron or a photon (quanta of light) is experimentally viewed as both particle and wave and must be described in this dual and seemingly antithetical way.

> for distant points become meaningless to an observer when classical *a priori* time relations are negated. (p.75)

Ian Hinckfuss points out in his *The Existence of Space and Time* that the word 'flow' as "flow of time" in the meaning of 'movement' and the phrase "time flows like a river" has some problem. However, it is not necessary to discuss the problem and nature of time here (I have already discussed this in Chapter Six). Alteration takes place in time, presupposing a succession of units of time. Again, there is the regulation of time and inclusion of time in the dimension of space in the theory of relativity. The two theories are not against each other but like a paradigm shift in the language of Thomas Kuhn. The above view becomes clearer when we refer to Werner Heisenberg on the relationship between certain principles of general relativity and classical mechanics in his *Physics and Philosophy.* According to him, Newtonian mechanics and Einstein's relativity have a certain relationship, even with the application of a law of quantum mechanics. This was resolved by the experiment carried out by Michelson, Morley and Miller in response to the question raised by Heisenberg: "What happens if the matter is set into motion? Does the ether participate in this motion and—if this is the case—how is a light wave propagated in the moving ether?" Heisenberg writes in his *Physics and Philosophy*:

> In Newton's mechanics a certain 'principle of relativity' is fulfilled that can be described in the following terms: If in a certain system of reference the mechanical motion of bodies fulfills the laws of Newtonian mechanics, then this is also true for any other frame of reference which is in uniform non-rotating motion with respect to the first system. Or, in other words, uniform translational motion of a system does not produce any mechanical effects at all and can therefore not be observed by such effects.

> Such a principle of relativity—so it seemed to the physicists—could not be true in optics or electrodynamics. If the first system is at rest with respect to the ether, the other systems are not, and therefore their motion with respect to the ether should be recognized by effects of the type considered by Michelson. The negative result of the experiment of Morley and Miller in 1904 revived the idea that such a principle of relativity could be true in electrodynamics as well as Newtonian mechanics. (p.69)

In a similar way, there are many connections between Newtonian and Kantian concepts of motion. Kant's project of formulating the laws of motion as laws of mechanics was different from that of Newton and his contemporaries. Kant has tried to develop the '*a priorion'* concept of motion and the possibility of synthetic *a priori* propositions and judgments in physics and mathematics.

7.3 Newton's Three Laws of Motion as Judgments of Experience

A category like 'causality' makes experience possible and the community of objects of experience is comprehensible only because we perceive them in space, that is, in outer intuition. Hence, this space creates the possibility of the relationship between communities of objects. When these categories like substance, causality, community, reciprocal and relation are applied to the reality they become principles and all these principles can become laws so far as they hold to be objectively valid of actual experience or possible experience.

The categories like substantiality, causality, and community have a role in our ways of acquiring knowledge of things. The things have to be discovered through

perception, but their relations have to be determined by employing these categories. The categories as fundamental concepts enable us to anticipate the experience. The categories as having material necessity and universality (*a priori*) are concerned with the determination of objects of experience and give rise to laws of nature. On this understanding, Newton's three laws of motion as judgments of experience incorporate categories. However, the only consideration of the formal side of the laws of nature would be an interpretation of *a priori* aspects of nature in the narrower sense. Kant holds that we do not derive or directly learn from nature her laws.

Kant did not directly say that Newton's Third Law of Motion is a judgment of experience. He shows that action and reaction depend upon a category and when this category is applied to reality it becomes a principle and if it is valid of actual experience or possible experience it becomes a law. The laws of physics are not possible without the presupposition of space and time. From this point, we can easily understand that Kant cannot be proved to be wrong for considering Newton's Three Laws of Motion as judgments of experience. He has done it with the condition that if a principle is not valid of experience, it can never be a law and at the same time synthetic *a priori* judgment. According to Kant, motion is not pure, but an empirical concept, and it is linked to space and time. Space and time are pure forms of intuition and condition for all our perceptions. Motion depends on space and time, and the laws which depend on fundamental concepts (categories) and objective validity (universality) are synthetic *a priori* judgments. But if any law fails to be objectively valid or valid of possible objects, then it is not to be regarded as a synthetic *a priori* judgment. On this point, even Newton's

three laws of motion are not exceptional. Besides this, there are some significant differences between Kant and Newton's three laws of motion. The consistent, relevant and objectively valid laws are *a priori* judgments of experience. An *a priori* judgment that fails to be objectively valid in experience is vacuous. If a law of physics lacks its objective validity, then it becomes a pseudo law (purely speculative and possibly metaphysical). Moreover, the science of nature with such kinds of laws would become hyperphysical. Kant's main concern in physics is with the concepts of nature that refer to the objects and not to the mere creatures of thoughts. The concepts of the mere creature of thoughts (imaginary or thought objects) cannot be determined and become hyperphysical.

We make empirical judgments and these judgments are of two types: (1) Judgments of Experience and (2) Judgments of Perception. These two kinds of judgments are differentiated on the ground of their subjective and objective validity. Empirical judgments having objective validity are termed as "Judgment of Experience" and those which are subjectively valid are to be regarded as "Judgment of Perception"[111]. The latter types of judgments do not require *a priori* concepts of understanding (i.e. the requisite relation between necessity and strict universality) but only the logical connection of perception in thinking. Here, the concern is with the former types of judgments because they are concerned about the application of categories (pure concepts) and principles to empirical judgments. This application produces an objective validity. According to Kant, the *a priori* conditions of the possible experience make the derivation of

[111]Kant, I., *Kant's Prolegomena to Any Future Metaphysics* (*Kant's Critical Philosophy*, Vol.III), J. P. Mahaffy (Tr.), London, Longmans, Green, And Co., 1872, p.69.

the universal laws of nature possible[112]. The table[113] below makes the judgment of perception and judgment experience more explicit:

S/No.	Particulars	Judgment of Perception	Judgment of Experience
1.	Judgment	Yes	Yes
2.	Subjective Judgment	Yes	No
3.	Objective Judgment	No	Yes
4.	Immediate cognition of the objects	Yes	No
5.	Mediate cognition of the objects	No	Yes
6.	Involves the pure concepts of understanding (i.e., categories)	No	Yes
7.	Signifies necessary and universal	No	Yes
8.	Conjoining and comparing of perception in the consciousness of a particular state	Yes	No
9.	Conjoining and comparing of perception in consciousness generally	No	Yes
10.	Subjective validity	Yes	No
11.	Objective validity	No	Yes

[112]ibid, p.68.

[113]Table mine.

In the first stage, all judgments are mere perceptive judgments. It is not enough for perceptual judgments to be objectively valid. For this, they need to signify necessary and universal application[114]. The judgments of other men agreeing with each other are not mandatory if they really agree to the same unity of the object. In this sense, the objective validity of the judgment of experience is equivalent to the notion of necessity and universality. The judgment of experience takes its objective validity from the condition of universal validity in empirical judgment but not from the immediate cognition of the object, and this objective validity rests upon category. This determines the objective validity of the judgment. Kant gives us two examples in favour of the distinction in the PFM and they are as below:

1. The room is warm, sugar is sweet, and cinchona is bitter (subjectively valid judgments).
2. Air is elastic (objectively valid judgments).

The judgments of perception are subjective and particular and do not refer to objective validity but the judgments of experience are necessarily universal and objectively valid. In the Kantian case, understanding the significance of objective validity is very important. This validity creates a difference as illustrated in the above two examples. From the first example, we understand that the warmness of the room, the sweetness of sugar, and the bitterness of cinchona are subjective

[114]How the experience of an individual transforms into concept, propositions and ultimately into judgments is explained in detail by Kant in 'Transcendental Deduction' of *Critique of Pure Reason* and in *Prolegomena to Any Future Metaphysics*.

and particular. They hold good only for the subject. The mere perceptive judgments are particular and differ from person to person. They do not hold good for all of us and are not similar to everybody else. The second example "Air is elastic" is a judgment of experience. This judgment signifies a necessary and universal application. The judgment holds good for all. When we consider a judgment necessarily as universal, we have to consider it as objectively valid. This means that what it states is not only in reference to the perception of a subject but the quality of the object. In this judgment, everybody agrees with one another on the unity of the object to which they all refer and with which they accord. In this case, objective validity, necessity and universality have equal implication. But how is this perceiving of experience itself possible? Conscious intuition involves sensibility (perception) and understanding (judgment). This judging is also in two stages:

1. I merely compare perceptions and merely connect them in the consciousness of my (particular) state.
2. I conjoin them in consciousness generally.

From the above examples, we understand that a judgment of perception is valid for a particular person and hence, subjectively valid. This judgment does not involve the pure concept of understanding. In the beginning, an immediate cognition as consciousness, in particular, is perceptive judgment but when that is given to pure concepts of understanding to make a universally valid cognition as conscious in general it changes into a judgment of experience. This is clear by another example: when I feel and say that this room is warm, it might not be

warm enough for my friend who has just arrived in Darjeeling from Singapore; but when I say to him that the temperature of my room at this particular time and condition is 22°C, and then he would agree with me. The former judgment is perceptive and subjectively valid, and the latter judgment is the judgment of experience (comparatively universalized) and objectively valid. This kind of judgment of experience requires pure concepts of understanding to become objectively valid and objective validity requires necessity and universality. The so-called 'objective validity' is possible because we human beings experience and judge in a similar way (here, the judgment is validated from a scientific instrument of measuring of temperature but this instrument is universally accepted).

Ludwig Wittgenstein has rightly said, "If language is to be a means of communication there must be agreement not only in definitions but also (queer as this may sound) in judgments..."[115] Communication would not be possible if different persons (human beings) behave differently under similar conditions. The communication of judgment presupposes uniformity in cognitive equipment consisting of sensibility and understanding. An agreement in judgment is not sufficient for it to become a case of knowledge but there must be uniformity in the judgment of experience of concerned objects. We are able to make objectively valid judgments about the objects of experience and reality with the help of space and time and categories. A true judgment about the object of experience involves both empirical concepts and pure concepts. The act of

[115]See Ludwig Wittgenstein's *Philosophical Investigations*, G. E. M. Anscombe (Tr.), London, Basil Blackwell Oxford, 1953, Para: 242.

involving both the empirical concept and the pure concept is also one of the acts of synthesis.

The uniformity of nature is uniformity of mind. This uniformity is possible as long as our sensibility and understanding remain the same and categories form the bedrock of human knowledge. Without consciousness in general, common agreement, inter-subjective-world and human knowledge as such are not possible. It is the experience that gives knowledge. The knowledge gained through experience as empirical knowledge contains both *a priori* and empirical factors. The former is the contribution of the subject and the latter is dependent on objects. Thus, space-time and categories are pure aspects of human knowledge. Kant never excluded objective validity and inter-subjective-world from a synthetic *a priori* judgment. The so-called inter-subjectivity is itself included in the meanings of objective validity.

According to Kant, the laws as judgments of experience incorporate certain principles including generalization. The incorporated principle makes the application of category (fundamental concept) possible. When the uniformity (universality) of the law is a part of the objective validity and generalization, then the law becomes a judgment of experience. The laws of empirical physics are not synthetic *a priori* judgments. Only the judgments of physics which include pure concepts, principles and objective validity are thought to be judgments of experience. Kant has clearly asserted in the CPR and PFM that the notion of motion is not completely independent of experience. Hence, motion is a part of our experience and dependent on our objects of experience. In this sense, Kant

connects ‘motion’ with ‘matter’. Matter without motion is unthinkable and physics without motion is incomplete. However, according to him, the concept of motion is of two types, that is, the pure concept of motion and empirical concept of motion. Further, nature is governed by certain principles which are synthetic *a priori* judgments. Kant reminds us in many places that pure physics and pure mathematics possess synthetic *a priori* judgments. His three laws of motion are without the inclusion of generalization. The ‘Generalization’ in physics means its dependence on induction. What is generalized from induction cannot be *a priori.* Thus, this might have led Kant to formulate the three laws of mechanics in the MFNS in his own way to establish the thesis of his life-long philosophical programme of proving the possibility of synthetic *a priori* judgments in pure physics and mathematics. Therefore, the laws of motion of Mechanics formulated in the MFNS are synthetic *a priori* judgments, and the three laws of motion formulated in *The Principia* as judgments of physics are judgments of experience because the application of universality in them is not derived from pure reason, but generalized from experience. Kant’s laws of motion cannot be properly justified without considering the abovementioned difference. For example, Friedman in his *Kant and the Exact Sciences* considers Kant’s justification of the laws of motion and the law of universal gravitation to be similar to the Newtonian justification.

Watkins does not completely agree with Friedman in his ‘The Laws of Motion from Newton to Kant’ (p.341). According to him, Friedman’s above interpretation makes Kant’s justification more empirical than the alternatives

(even if not empirical in any typical sense). It seems that Watkins agrees with the view that *a priori* judgments cannot be reduced to empirical judgments.

Universality generalized from experience as an arbitrary extension of strict universality has been termed by Kant as 'empirical universality' (CPR, A4, p.44). In this sense, an inductive generalization is not the strict universality (like we get in *a priori*) and cannot become synthetic *a priori* judgments. Hence, the judgments of experience are not synthetic *a priori* judgments. These judgments are made possible due to space and time, categories, principles and laws. Kant, in the end, ultimately comes to the conclusion that Newtonian science requires some '*a priori*' foundations.

Michael Friedman and Eric Watkins think that Kant's main purpose in the MFNS was to give metaphysical foundation to Newtonian physics. It should be kept in mind that when Kant says 'metaphysical', he is not taking it in the traditional sense of metaphysics of philosophy but in an improvised sense because he has termed it in the CPR as a new form of metaphysics[116] and deals only with pure concepts, principles and pure (*a priori*) aspects of empirical physics.

7.4 Kant's and Newton's Three Laws of Motion

Kant has taken many relevant ideas from Newton but it does not mean that his philosophy of science is Newtonian in character[117]. We have a reason to agree

[116]I have discussed this in § 1.1 of this thesis.

[117] The Newtonian laws of motion are more of axiomatic and mathematical nature.

with Gordon G. Britton when he expresses the following view in his *Kant's Theory of Science*:

> I take this to imply that a transcendental inquiry is not concerned with the correctness of, for instance, Newtonian physics, but rather with the philosophical interpretation to be placed upon it**.** To put it in a slightly different way, Kant's use of "transcendental" here is designed to make a sharp distinction perhaps for the first time in the history of thought, between scientific and philosophical questions. **(**p**.**130**)**

Philosophers dealing with Kant's philosophy of science relate him to Newtonian science. History tells us that it was Newtonian science that was thought to be consistent during the time of Kant. Apart from this notion, no one can ignore the concept of an object as impossible without the concept of motion in the Kantian philosophy of science[118]. We cannot directly relate (as Michael Friedman thinks) the Kantian concept and formulation of motion to that of the Newtonian formulation. Kant has something different to show from Newtonian mechanics keeping himself confined to the scope of his subject. A similar kind of view is also presented by Eric Watkins in his article 'The Laws of Motion from Newton to Kant' (pp.312-16). Watkins first mentions Newton's three laws of motion and thereafter compares it with the three laws of mechanics from Kant's MFNS (pp.80-84).

[118]Kant has connected matter with motion and vice-versa. Physics is incomplete without motion because whatever is movable in space is matter. (Kant, I., *Metaphysical Foundations of Natural Science*, M. Friedman (Tr. & Ed.), New York, Cambridge University Press, 2004, p.15)

In regard to Newton's three laws of motion, S. Chandrasekhar thinks that the consideration of the laws and their corollaries in totality was essential for understanding the laws of motion. This was well realized by Maxwell who reformulated Newton's first and second laws of motion to render more precise formulations of them[119]. The table[120] given below will help us to find out some differences in the formulation of Newton's three laws of motion and Kant's three laws of mechanics:

In the table below, we get the concept of inertia and momentum in Newton's first law of motion but in Kant's first law of mechanics, we get the law of conservation. Kant states that the quantity of matter must be conserved throughout the communication of motion but Newton does not. Kant's first law of motion as a statement of the conservation law is a consequence of his First Analogy of Experience. But Newton's first law of motion is about uniform motion in a straight line. It tells us that the velocity of everybody is constant unless changed by force. According to it, acceleration is produced by force. It assumes the existence of force and defines it as the only agent that can produce acceleration. The property that offers resisting force in opposition to anything that changes or tends to change its velocity is called inertia.

---

[119]S. Chandrasekhar starts by mentioning how Newton has proceeded to his second lesson to formulate the basis for his entire dynamics in the form of three laws of motion and five corollaries as an essential part of the laws, and he did this only after writing the introductory lesson on fundamental notions. (Chandrasekhar, S., *Newton's Principia for the Common Reader*, Kolkata, Oxford University Press, 2012, pp.22-31)

[120]Table mine.

Grade	Newton's Three Laws of Motion (from *The Principia*)	Kant's Three Laws of Motion (from MFNS)
The First Law	"Every body perseveres in its state of rest, or of uniform motion in a right line[121], unless it is compelled to change that state by forces impressed thereon."[122]	"With regard to all changes of a corporeal nature, the quantity of matter taken as a whole remains the same and is neither increased nor decreased."[123]
The Second Law	"The alteration of motion is ever proportional to the motive force impressed and is made in the direction of the right line in which that force is impressed."[124]	"Every change of matter has an external cause. (Everybody remains in its state of rest or motion in the same direction and with the same velocity unless it is compelled by an external cause to forsake this state)."[125]
The Third Law	"To every action there is always opposed an equal reaction: or the mutual action of two bodies upon each other is always equal, and directed to contrary parts."[126]	"In all communication of motion, action and reaction are always equal to one another."[127]

[121]It means in a straight line.

[122]Newton, Isaac, *The Principia*, Pmapublishing.com, 2017, p.19.

[123]Kant, I., *Metaphysical Foundations of Natural Science*, M. Friedman (Tr.) New York, Cambridge University Press, 2004, p.80.

[124]*The Principia*, 2017, p.19.

[125]*Metaphysical Foundations of Natural Science*, 2004, p.82

[126]*The Principia*, 2017, p.19.

[127]*Metaphysical Foundations of Natural Science*, 2004, p.84

Newton's second law is about a method of measuring force. Generally, a force is measured by balancing it by a known force as in the operation of weighing a body. For instance, a force '*f*' facing on a mass 'm' for 't' seconds and changing its velocity from μ to v. The momentum of a body at any instant is defined as the product of its mass and its velocity, M = mv. We do not get a mention of Newton's first law of motion in Kant's second law of mechanics. Kant provides a different formulation of Newton's law of inertia, citing a change of matter and external causality rather than a change of motion and forces. This second law of mechanics is also connected to his Second Analogy of Experience.

According to Watkins, Kant's third law of mechanics and Newton's third law of motion for all practical purposes are more or less identical. He further adds that Kant goes beyond Newton by providing an *a priori* proof of the truth of this law and a satisfactory ontological account of how action and reaction occur[128]. The ontological account provided for the communication of motion (action and reaction) can only be understood from Kant's rationalist metaphysical background. We may quote Moti Bir Rai from his 'Kant as a Philosopher of Science':

> When Kant deals with the community (action and reaction), he is dealing with the *a priori* conditions of empirical knowledge. To abandon the principle of community is equivalent to giving up belief in gravitation. If material bodies do not gravitate, then both Newton and Einstein must be credited with having solved a pseudo-problem.

[128]See Eric Watkins's 'Kant's Justification of the Laws of Mechanics', *Kant and the Sciences*, New York, 2001, p.146.

> Gravitation is a technical name for what Kant calls reciprocal action (interaction) between and among material bodies. (p.96)

That the views of Kant in his laws of mechanics are divergent from Newton's three laws of motion is also shown by Howard Duncan in his article 'Inertia, the Communication of Motion, and Kant's Third Law of Mechanics' published in *Philosophy of Science* (p.93-119). According to Duncan:

1. Kant's first law of mechanics is his version of the standard mechanical principle that matter is neither created nor destroyed in natural events. But Newton's view in his first law of motion is different from Kant's first law of mechanics because it is not about the conservation of mass (matter) in the communication of motion.

2. From a different perspective, Kant's second law of mechanics is the principle of the lifelessness of matter, a principle which Kant thought to be necessary for the possibility of a science of nature. In the second law, Kant rejects the Newtonian force of inertia which carries the connotation of a striving by a body to remain in a given condition. For Kant, inertia signifies merely the complete inefficacy of a body in itself. But Newton's first law does not follow from the lifelessness of matter alone, which means that any change in the state of a body is not self-caused. This divergent view of Kant from Newton has also been pointed out by Gorden G. Brittan in his *Kant's Theory of Science* that the so-called 'force of inertia' is for Kant the paradigm of a living force (p.161). According to him, Kant intended to eliminate the concept of 'inertial force' and this elimination has three aspects: (i) The inertial force precludes the possibility

of mathematical physics. (ii) The concept of inertial force is empty. (iii) Nothing but the opposite motion of another body can resist a motion, but the rest of other bodies cannot resist a motion.

3. Kant's view of reaction in his third law of mechanics is the motion of a body that is opposed to the motion of another body upon it. It expresses Kant's law of inertia (the lifelessness of matter): a body can have no causal effect upon another, and, therefore, cannot be reactive, unless it is in motion. Thus, drawing from his second law, a reactive, as well as an active body must be in motion; the reaction is the motion of a body and is measurable as moving force. Therefore, 'a reactive body can be such even if in a state of rest' in Kant's view is divergent[129] to Newton's view, 'inertial force is an essential and active property of bodies'.

7.4.1 Newton's and Kant's Third Law of Motion

> First, if Newton's third law is synthetic *a priori*, then why not the first and second laws? And if the three laws are synthetic *a priori*, and if we take them as adequate for the axiomatic development of Newton's theory, then in what way is an appeal to experience necessary to determine the truth value of the propositions of physics?
> (*Kant's Theory of Science*, p.132)

[129]Eric Watkins also states this in another way in his 'The Laws of Motion from Newton to Kant', *Perspective on Science* (Vol.5, No.3, 1997, p.314), "Kant does, parenthetically, restate a principle very similar to Newton's laws of inertia following his own formulation (so that one might think that the difference between the two is due to a looseness in translation from the Latin and is thus merely apparent), but such a principle could be simply an instance of his more general law rather than an equivalent formulation".

The above paragraph is Britton's charge against Kant's inconsistencies in the CPR and MFNS[130]. There are two questions in the above paragraph and the second question has been derived from the first question. The answer to the first question will itself provide an answer to the second question. In this section, my main attempt is to find out whether Kant's synthetic *a priori laws* of motion can be taken to be adequate for the axiomatic development of the Newtonian laws of motion[131]. I also aim to show a reason behind his consideration of Newton's third law of motion as synthetic *a priori*. By '*a priori*' Kant means it has to be necessary and universal and independent of empirical derivation and by 'synthesis' it has to involve an act of synthesis and also be informative.

Why did Kant consider only Newton's third law of motion as synthetic *a priori* judgment and why not the first and second laws? If the first and second laws are not synthetic *a prior* judgments then what are they? I have already discussed the answers to these questions in § 7.3. Newton's and Kant's third laws are:

> "To every action there is always opposed an equal reaction: or the mutual action of two bodies upon each other are always equal, and directed to contrary parts." (*The Principia*, p.19)

[130]Unfortunately, Kant is not always consistent in B17 of the Critique; Britton cites two such judgments "that in all changes of the material world the quantity of matter remains unchanged" and "that in all communication of motion action and reaction must always be equal". See Britton, G. G., Kant's *Theory of Science*, New Jersey, Princeton University Press, 1978, pp.132-3.

[131]According to Kant, Newton is a mathematical investigator of nature.

> "In all communication of motion, action and reaction are always equal to one another." (MFNS, p.84)

The following similarities can be drawn between the above two laws from a Kantian point of view.

1. Newton's third law of motion is similar to Kant's third law of motion because according to Kant, both laws involve a pure concept of understanding (or incorporate a category).

2. Both the laws satisfy the principle of communication as a base in its formulation (as attraction and repulsion) and stand for the possibility of social life.

3. Both the third laws can be related to the principle of conservation of substance and the principle of causality.

4. The law of attraction (or gravitation) can be derived from both the third laws.

There are many significant similarities and differences between Newton and Kant's three laws of motion. They are also important in understanding the acceptance of Newton's third law of motion by Kant. But I have mentioned above, my objective is only to explain Kant's reasons for considering Newton's

third law of motion as synthetic *a priori*. Kant's three analogies of experiences are inter-related to each other[132].

The categories like community and causality are related to the category 'substance' and vice-versa. To have judgments of the objects of experience or reality, it is necessary to have the application of categories like substance, causality and community. The third analogy is the 'Principle of Communication' expresses its inter-relationship with the first and second analogies of experience. All the three laws of motion formulated by Kant are based on analogies of experience. Kant's third law of motion is more similar to Newton's third law of motion in constitution and application. This similarity is evident in the derivation of the concept of attraction or law of attraction. Newton's third law of motion can also express the inclusion of inter-relation among the three principles (analogies of experience) and laws of motion.

The action and reaction are a part of the communication of motion. The law of communication of motion is related to Kant's first and second laws of mechanics. Kant's three laws of motion are synthetic *a priori* judgments, but Newton's three laws of motion are not so because they are judgments of experience. Universality as a criterion of necessity is itself not a strict universality but an extension. This universality is derived from experience. These types of judgments which consist of generalized universality rather than strict universality cannot be of *a priori* nature. Newton's first and second laws do not satisfy Kant's criteria of *a priori* (necessity and strict universality). No doubt, the

[132]Kant, I., *Critique of Pure Reason,* N. K. Smith (Tr.), London, Macmillan, 1963, pp.212-233.

laws of both are synthetic judgments[133]. The only difference between the two is in their derivation of universality.

The Newtonian third law of motion is universal in a general sense. Whether it was a judgment that is universal and necessary or a judgment that is universal in quantity, for Kant, it satisfied both his criteria of *a priori*. In other words, Kant understood that the derivation of Newton's laws of motion is not similar to the derivation of his laws of motion except the third law of motion. We can agree with Watkins[134] when he considers Kant and Newton's third law of motion for all practical purposes to be more or less identical (it is valid when applied in reality). The difference between the two laws is that Kant provides *a priori* proof of the truth of this law and a satisfactory ontological account of how action and reaction occur[135]. This is possible because the communication of motion (action and reaction) and reciprocity (interaction) are mutually related to the first and second laws. The ontological account provided for the communication of motion can only be understood in Kant's transcendental background.

The important reason for considering both the third laws as similar to each other is that both the laws are about action and reaction and gravitation. We get the

---

[133]According to Kant, there are differences between analytic and synthetic judgment. All judgments of experience are synthetic. The phrase 'synthetic judgment' means informative and is applicable to experience or possible experience. Thus, a synthetic judgment may be both *a posteriori* and *a priori.*

[134]Watkins, E. 'Kant's Justification of the Laws of Mechanics', *Kant and the Sciences*, E. Watkins (Ed.), New York, Oxford University Press, 2001.

[135]ibid, p.146.

concept of inertia and momentum in Newton's first law of motion and a method of measuring force in his second law of motion. But when Kant deals with continuity of action and reaction, he is dealing with the systematization of empirical knowledge.

7.6 Conclusion

In § 7.2 of this chapter, I have critically explained the *a priori* concept of motion. Following Pollok's argument that the pure and empirical concept of motion cannot be thought to be identical, I have argued for Kant's concept of motion to be both transcendental and geometrical. This implies that Kant's concept of motion is a pure concept. The pure concept of motion presupposes the same objective validity of possible experience. The pure concept of motion and the empirical concept of motion should not be considered to be the same. Motion being possible due to space and time presupposes something empirical because it is possible to find something movable only through experience. The concepts of motion that we get in the mechanics of Newton and Einstein are empirical and discursive. Kant's concept of motion is not derived and developed from experience but from certain fundamental concepts and principles. This leads us to consider that Newton's laws of motion expressed in Kant's laws of mechanics are synthetic *a priori*.

In § 7.3, I have established arguments from the Kantian perspective for Newton's Three Laws of Motion as Judgments of Experience. The judgments of perception are subjective and particular and do not refer to objective validity, but the

judgments of experience are universal and objectively valid. The representations of the object are given to our sensibility by the connection of concepts of understanding. This relation determines the objective validity of the judgment. The Newtonian laws of motion are higher forms of judgments of experience on the ground that they involve both pure concepts of understanding and generalization. They are not synthetic *a priori* judgments because the universality that they bear in them is not of *a priori* origin or strictly free from empirical derivation. They are about the objects of experience involving both empirical concepts and pure concepts, but the synthetic *a priori* judgments are valid of objects of experience or possible experience. If a law ceases to be true, adequate and valid then it fails to be worthy of being called a 'Law'. Kant has clearly stated that with the development of human intelligence and the advancement of technology, new inventions and discoveries are happening continuously, as a result of which, there is no finality in empirical and theoretical science.

The categories like substance, causalities and communication, and analogies of experience and postulates of experiences make human knowledge as such possible. Empirical physics deals with 'Why' and 'How' of motion but Kant deals also with the question of "What is motion?" From this question, he moves on to show how the laws of mechanics are *a priori* synthetic judgments in the MFNS. In § 7.4, I have shown some comparative differences between Kant's formulation of three laws of mechanics and Newton's three laws of motion.

Kant was not directly concerned with any kind of experiment and generalization of the laws but with the consideration of laws of mechanics as synthetic *a priori* judgments. Kant's three laws of mechanics in the MFNS are related to the 'Analogies of Experience' in the CPR. The principles incorporate certain categories that are *a priori*, and the laws incorporate certain principles that are synthetic *a priori* propositions. When these principles are applied and are valid of the objects of experience or reality, then they become synthetic *a priori* judgments. His main goal in the formulation of the three laws of mechanics was to show a possibility of synthetic *a priori* judgments in physics. Thus, the main reason for the above differences between Kant's three laws of mechanics and Newton's three laws of motion was due to Kant's own programme of establishing the possibility of synthetic *a priori* judgments in physics.

In § 7.4.1, I have argued for a similarity between Newton's and Kant's third law of motion. I examined the reason behind his consideration of Newton's third law of motion as synthetic *a priori*. I also explained the reason behind Kant's indecision in the consideration of Newton's third law as a judgment of experience.