

Chapter 2: *A priori*

2.1 Introduction

Pure physics consists of principles that are *a priori* (obtained from reason). They constitute the principles of empirical physics. The principles of empirical physics are identical to the principles of empirical knowledge. The *a priori* aspects of empirical knowledge constitute the formal basis of physics. The formal basis is founded on *a priori* intuitions (space and time), pure concepts (categories) and principles (propositions and judgments). This is made possible by the *a priori* by establishing a necessary connection between ‘necessity’ and ‘universality’ and bearing ‘objective validity’.

Kant’s philosophy of physics includes the general question of the possibility of synthetic *a priori* judgments in physics. The enquiries concerning the possibility of such judgments in physics demand a clear understanding of Kant’s concept of ‘*A priori*’. In this chapter, I explore Kant’s criteria of *a priori* and the distinction between subjective and objective necessity and thereby explain the importance of objective necessity in understanding the possibility of synthetic *a priori* judgments in physics.

I begin the journey by explaining the reason for Kant’s quest for *a priori* in physics. For Kant, physics (both pure and empirical) is grounded on principles

which are *a priori*²⁶. *A priori* knowledge, for him, was a search for the knowledge that is universal, necessary and independent of experience. He tried to show how this knowledge is obtained from our reason without taking any assistance of experience. This view was a reversal of Hume's view that necessary ideas (concepts) were obtained from impressions and impressions from sensibility and sensibility from experience. Hume had accepted the principle of causality to be synthetic but denied its source to be *a priori* which prompted Kant to find out the possibility of synthetic *a priori*.

Human knowledge as such requires both sensibility and understanding. Our knowledge begins from experience but does not end in the experience itself. There are necessary and universal propositions and judgments in pure physics which are independent of experiences. Those kinds of judgments which are true and valid of an object of experience are instances of knowledge. They involve space, time and categories. The necessary and universal judgments are synthetic *a priori*. A judgment without objective validity is not *a priori* in Kant's case. The objective validity equated to universality and necessity is related to the object of experience and reality²⁷. Thus, it is important to be clear about Kant's concept of

²⁶The *a priori* principles constitute the principles of empirical physics. In other words, the principles of physics (as a science) are identical to the principles of empirical knowledge. As per Kant's 'Architectonic Plan', empirical knowledge (obtained from experience) is at the bottom of the transcendental philosophy of physics.

²⁷Necessity, universality and objective validity are the three essential characteristics of a synthetic *a priori* judgment. They are closely related to one another. (Kant, I., *Kant's Critical Philosophy (Prolegomena to Any Future Metaphysics)*, Vol.III, J. P. Mahaffy (Tr.), London, Longmans, Green, and Co., 1872, p.70)

a priori at the very beginning of understanding Kant's philosophy of physics. His hope with '*A priori*' was to acquire the knowledge which is not derived from experience but applicable to experience. It should also be borne in mind that Kant's philosophy of physics, in the sense of transcendental philosophy, is not the knowledge of objects but the *a priori*. It presupposes both *a priori* and empirical knowledge²⁸.

2.2 Kant's Concept of *A priori*

Kant notes that all of our knowledge begins with experience but does not simply arise out of it (CPR, B1, p.41). All of our knowledge begins with experience because unless the senses stimulate the faculty of knowledge into action, knowledge in the sense of knowledge of objects cannot arise. That is why experience is the occasioning cause of all our knowledge. It does not follow, however, that it provides the principle of the possibility of all our knowledge. Albert Einstein seems to agree with Kant on this point when he writes the following in his *Ideas and Opinions*:

It seems that the human mind has first to construct forms independently before we can find them in things. Kepler's marvellous achievement is a particularly fine example of the truth that knowledge cannot spring from experience alone but only from the comparison of the invention of the intellect with observed facts²⁹. (p.266)

²⁸In the same way, *a priori* principles presuppose empirical principles at the relational level of acquiring the knowledge of nature.

²⁹Einstein, A., *Ideas and Opinions*, C. Seeling (Ed.), New Delhi, Rupa & Co., 2002, p.66.

Sense experience provides us with the raw material of sensible impression (intuitions) to our sensibility and understanding (faculty of knowledge) to produce empirical knowledge³⁰. This experience gives us contingent knowledge³¹ but not necessary and universal knowledge. A universal mode of knowledge must possess the character of inner necessity. It must be independent of experience, even free of all impressions of the senses in itself, clear and certain. Such knowledge, therefore, is entitled ‘*A priori*’ and that which is acquired solely from experience is ‘*A posteriori*’. In a strict sense, *a priori* knowledge is independent of all experiences. In this connection, Kant introduces his famous distinction between *a priori* knowledge and empirical knowledge. I discuss them separately in the following two § 2.2.1 and § 2.2.2.

2.2.1 Empirical Knowledge

Empirical knowledge is co-relate of *a priori* knowledge and based on experience. Human knowledge is incomplete without it³². Kant never doubted the possibility and validity of such knowledge. We can agree with the empiricist’s view that our knowledge of objects depends on experience, but this never means that all of our knowledge is dependent upon sense impressions. This is because empiricism identified with sensationalism is a weak philosophical position. In a scientific

³⁰It is to be noted that empirical knowledge is pre-scientific and the stock of it consists of items which do not form a system.

³¹‘Contingent Knowledge’ is knowledge which is derived from experience.

³²This is because the so-called ‘Human World’ is full of empirical objects.

system, all its concepts and principles are not necessarily acquired (derived) from experience but from both pure reason³³ and experience.

To Kant, human knowledge is not only dependent on sense impressions but also upon our faculty of thought, as understanding subsumes the object under a concept. In other words, empirical knowledge is the knowledge of empirical objects. We get such knowledge from empirical judgments, and these judgments do not depend only on sensation and intuition but also on pure concepts. These pure concepts or fundamental concepts as categories are ‘forms’ of the knowledge. How these pure concepts as categories are necessary for knowing objects of the world would be discussed in Chapter Three, i.e., ‘Categories’.

Kant understands science as the refinement of common-sense knowledge and systematization of empirical knowledge³⁴. The principles of physics are nothing without the existence of empirical objects of the world. Reason gives us *a priori* knowledge in the form of *a priori* principles and laws in physics. The pure aspects of empirical knowledge are distinguished and separated by the faculty of understanding (pure reason)³⁵. Kant adds that if we eliminate everything which

³³The *a priori* concepts and principles are not directly derived from pure reason but through understanding.

³⁴Kant and Einstein had similar ideas about the concepts of science and role of intellectual insights in a subject like theoretical physics. (Lenzen, V. F., ‘Einstein’s Theory of Knowledge’, P. A. Schilpp (Ed.) *Albert-Einstein-philosopher-scientist*, Vol.II, New York, Harper & Brothers Publishers, 1959, p.362)

³⁵For Kant, there are broadly three faculties of knowledge and they are reason, understanding and sensibility.

belongs to senses, there remain certain original concepts (CPR, B6, p.45). The judgments derived from such concepts are completely *a priori*. These judgments bearing true universality and strict necessity cannot be supplied from mere empirical knowledge.

2.2.2 *A priori* Knowledge

According to Kant, human knowledge requires reconciliation of understanding and sensibility. Human knowledge depends on both experience and rules of understanding. '*A priori*' knowledge is not derived from experience. It is prior to experience as opposed to '*A posteriori*' or empirical knowledge which has its ultimate source in experience. The priority of *a priori* knowledge is not temporal but logical because in case of time no knowledge is prior to time. The *a priori* knowledge is prior to experience in the sense that its principles of possibility are independent of experience. David Hume made a mistake by considering the *a priori* knowledge to be derivable from experience and the mathematical propositions (judgments) as contingent. If the axioms, formulae and propositions of mathematics are derived from experience then we cannot be sure about their certainty. Albert Einstein (1959, p.218) expresses a similar view: "As far as the propositions of mathematics refer to reality, they are not certain; and as they are certain, they do not refer to reality"³⁶. And in pure physics, we have fundamental concepts and principles which are also not derived from experience. Philosophy of physics, as being a part of the philosophy of science includes *a priori* concepts

³⁶Einstein, A., 'Geometry and Experience', *Reading in the Philosophy of Science*, H. Feigl and M. Brodbeck (Eds.), New York, Appleton Century Crofts, 1953, p.189.

of physics and when we apply them, we get the principles of physics. Some *a priori* principles taken from the *Critique of Pure Reason* are quoted below:

1. "All intuitions are extensive magnitude.³⁷" (Axiom of Intuition)
2. "In all appearances, the real that is an object of sensation has intensive magnitude, that is, a degree.³⁸" (Anticipation of Perception)
3. "Experience is possible only through the representation of a necessary connection of perception.³⁹" (Principle of Analogy)
4. "In all change of appearances substance is permanent; its quantum in nature is neither increased nor diminished.⁴⁰" (Principle of Permanence of Substance)
5. "All alterations take place in conformity with the law of the connection of cause and effect.⁴¹" (Principle of Succession in Time, in Accordance with the Law of Causality)
6. "All substances, insofar as they can be perceived to coexist in space, are in thoroughgoing reciprocity.⁴²" (Principle of Coexistence, in accordance with the Law of Reciprocity or Community)

And some *a priori* laws of mechanics from the *Metaphysical Foundations of Natural Sciences* are quoted below:

1. "With regard to all changes of corporal nature the quantity of matter taken as a whole remains the same and is neither increased nor decreased.⁴³" (First Law of Mechanics)

³⁷Kant, I., *Critique of Pure Reason*, N. K. Smith (Tr.), London, Macmillan & Co Ltd, 1963, p197..

³⁸ibid., p.201.

³⁹ibid., p.208.

⁴⁰ibid., p.212.

⁴¹ibid., p.218.

⁴²ibid., p.233.

2. “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).⁴⁴” (Second Law of Mechanics)

3. “In all communication of motion, action and reaction are always equal to one another.⁴⁵” (Third Law of Mechanics)

There is a distinction between relatively *a priori* and absolutely *a priori* knowledge. According to Kant, relatively *a priori* knowledge is not *a priori* proper, being ultimately empirical. For example, the judgment “this building will fall down if its support is withdrawn” is relatively *a priori* although it is not based on the observation of the actual house. This judgment is ultimately empirical since it is deducible from the empirical general rule “all material bodies fall down when their supports are withdrawn” coupled with the statement that this building is a material body. Absolute *a priori* knowledge is absolutely independent of experience, in the sense that it is neither immediately based on sense observation nor immediately based on experience by way of being either an empirical generalization or deducible conclusion from an empirical generalization.

Kant sometimes distinguishes between pure and non-pure *a priori* knowledge. A *a priori* knowledge is pure if it does not contain any empirical admixture. That is to say, an *a priori* judgment is pure if the judgment as a whole is *a priori* and all the constituent concepts are *a priori*. Let us take an example from pure

⁴³Kant. I., *Metaphysical Foundations of Natural Science*, M. Friedman (Tr.) New York, Cambridge University Press, 2004, p.80.

⁴⁴*ibid.*, p.82.

⁴⁵*ibid.*, p.84.

mathematics: the judgment “ $7+5=12$ ”. When at least one of the constituent concepts of a whole *a priori* is empirical then it is non-pure *a priori* judgment, e.g. “Every event has a cause”. The *a priori* judgments as instances of *a priori* knowledge depend on the two criteria of *a priori*: necessity and strict universality.

Kant characterizes broadly two types of universality: (1) Strict universality as a mark of the *a priori* and (2) Empirical universality is merely assumed and compared and given through induction (generalization). Kant never meant that *a priori* knowledge does not require any experience at all. In fact, he has explicitly mentioned that all *a priori* propositions are incomplete without their applicability to objects of experience or possible experience. Experience is at the foundational level (base) of Kant’s ‘Architectonic Plan’. William Harper rightly suggests, “Kant’s characterization of *a priori* knowledge as “absolutely independent of experience” should not be taken to rule out knowledge that requires some experience to appropriately awaken the faculty”⁴⁶. But Harper is wrong if he considers Kant’s material necessity to be a consequence of empirical universality⁴⁷ and the proposition “every alteration has a cause” as pure *a priori* (Harper, 1986, pp.250-2). The material necessity is not derived from experience but the concept ‘alteration’ can be derived only from experience. I will be

⁴⁶Harper, W., ‘Kant on the *A priori* and Material Necessity’, *Kant’s Philosophy of Physical Science*, R. E. Butt (Ed.), D. Reidel Publishing Company, 1986, p.250.

⁴⁷That is why Kant suggests that his readers and critics misunderstand the employment of *a priori* criteria, because there is an inseparable relation between necessity and universality and they do not have indistinct employment.

discussing material necessity in § 2.3.2 and the concept of alteration in Chapter Five, in detail.

2.3 Criteria of *A priori* Knowledge

For Kant, universality and necessity are two criteria of *a priori* knowledge. By universality, he means universal validity, i.e. validity under all possible circumstances. A true or strict universal proposition in this sense does not admit to the possibility of an exception. For example, in mathematics, we cannot conceive of the possibility of an exception to the truth expressed by the proposition “ $7+5=12$ ”. It suggests that, in Kant’s case, we should not confuse universality with universal quantification. In other words, a universally quantified universality of a proposition is not similar to the universality that is thought by Kant. Thus, “all swans are white” is a universally quantified proposition because it admits the possibility of an exception. On the contrary, a universal proposition in this sense may or may not contain a universal quantifier, take, for instance, the mathematical proposition “ $7+5=12$ ”. The universality of the proposition “seven plus five is equal to twelve” is different from the universality with respect to quantity and is universally valid for everyone. Although all propositions beginning with the words ‘all’ and ‘no’ are universal in quantity and all such propositions are not always necessarily true. For instance, “all men are mortal” is very weak and it is not known to be true because ‘men’ and ‘mortality’ are known only through experience. We get such a proposition as an inductive generalization from “some men have actually died”. On the other hand, a true universal proposition of mathematics like “ $7+5=12$ ”, which is

singular (in quantity), is universally valid for everyone or valid for consciousness in general. This means that for Kant, objective validity is the same as universality and necessity and both have an equivalent significance in his philosophy of science. Whenever we consider a judgment as universal and necessary, it must be objectively valid. Thus, the following views of Roderick M. Chisholm cannot be accommodated in Kantian views of *a priori*, Chisholm writes:

But when philosophers ask whether there are synthetic propositions that we know *a priori* to be true, they are not usually thinking of such propositions as these. They are thinking rather of propositions which can be expressed naturally in English in the form of "All S is P". Given what we have said about the nature of analytic proposition we may put the question, "Is there a synthetic *a priori*?" somewhat more exactly as follows: Are there any propositions which are such that (i) they are known by us *a priori*; (ii) they can be expressed in English in the form "Everything which is 'S is P'; and yet (iii) they are not such that in English their predicate-terms can be analyzed out of their subject terms?⁴⁸

In Kant's case, material truth is informative or non-vacuous. However, formal truth is vacuous and can never be used in actual and possible situations. It cannot be about the object given in experience. Material truth is not vacuous and may be treated as being about an object given in experience.

On the contrary, formal truths and semantic truths are *a priori* truths and not dependent on experience. For example, (a) " $p \supset p$ " is true because of the operation of ' \supset ', and (b) "My mother is older than me" is true because of the meanings of 'mother', 'son' and "older than". The negation of both is a

⁴⁸Chisholm, R. M., *Theory of Knowledge*, New Delhi, Brown University Inc., 1977, p.58.

contradiction (or self-contradiction). In Kant's terminology, a semantic truth is an analytic truth and a material truth is either analytic or synthetic.

For Kant, necessity consists in the impossibility of the opposite. He distinguishes the two senses of impossibility:

(a) Logical Impossibility

(b) Transcendental Impossibility

A proposition is logically impossible if it is self-contradictory. For example, the proposition, "all extended bodies are extended" is logically necessary because its opposite proposition "some bodies are not extended" is self-contradictory. Similarly, a logically possible proposition is transcendently impossible if the state of affairs projected by it is non-constructable, i.e., incapable of the exhibition in intuition (i.e. in space and time). Again, the proposition "two straight lines cannot enclose a space" is, though logically possible, yet transcendently impossible, insofar as the two-sided figure projected by it is not constructible, i.e., not in principle capable of the exhibition in the intuition of space.

For Kant, all logical judgments conforming to the principle of non-contradiction are analytic *a priori* and the judgments of pure mathematics and physics are synthetic *a priori*. This is because the judgments of mathematics and physics do not depend on the principle of non-contradiction. Nevertheless, analytic judgments are governed by this principle.

Necessity is of two types: subjective necessity as a logical necessity and objective necessity as a material necessity. This distinction is vital for understanding Kant’s answer to the question “how is it possible to have synthetic *a priori* propositions in physics?” The following table helps to explain the differences between the two⁴⁹:

S/No	Subjective Necessity	Objective Necessity
1.	Subjective	Objective
2.	Formal or logical	Factual or material
3.	Depends on the Principle of Contradiction	Does not depend on the Principle of Contradiction
4.	Analytic	Synthetic

2.3.1 Subjective Necessity

Subjective necessity is that necessity which is felt, thought and realized by the subject whereas objective necessity is that necessity which is concerned with the determination of the object. For instance, in the subjective necessity, we admit the truth of the conclusion which is drawn from premises. In this case, we refer to the principle of contradiction: admitting the truth of the conclusion and not admitting the truth of the premises is a violation of the principle of contradiction. Formal or logical necessity is a subjective necessity. That is why Kant’s use of

⁴⁹Table mine.

necessity is in the sense of material necessity as a criterion of the *a priori* in his transcendental philosophy of physics.

2.3.2 Objective Necessity

The necessity that we have in pure physics and mathematics is material and is opposite to contingent judgment of perception. This leads us to conclude that the principles of physics and mathematical propositions and formulae are not contingent. If they were contingent, their falsehood would be possible⁵⁰. However, mathematical judgments are always and everywhere true. The necessity of such propositions or judgments is material. The application of principle or rule such as that of contradiction results in self-contradiction but a violation of the rule like “ $7+5=12$ ” or principle of causality makes knowledge impossible. Thus, distinguishing between logical and material necessity has excluded the principle of contradiction from mathematics. Regarding this, Kant has tried to show the erroneous view of philosophers of mathematics that all mathematical inferences work following the principle of contradiction.

A judgment not conforming to the principle of non-contradiction is false, but when conforming, it does not need to be true⁵¹. This kind of disagreement comes up when we fail to distinguish between logical necessity and material necessity. Kant’s quest for necessity in pure physics and mathematics is not a subjective

⁵⁰According to Thomas Kuhn, Empirical Physics is progressive and fallible, which also means that there is no finality in empirical physics.

⁵¹ibid., p.84.

(logical) necessity but an objective (material) necessity. It has already been mentioned that in Kant's case, universality, necessity and objective validity have an equivalent notion. He has tried to make this point understood in many places in his CPR and PFM. If a person happens to consider his employment of necessity as criteria of *a priori* in physics and mathematics as an only subjective necessity, then he is sure to misunderstand Kant's distinction of necessity into the two kinds and their real employment. Hence, his necessity as one of the criteria of *a priori* is not a logical necessity. Logical necessity as formal is different from factual and material necessity.

Having a proper understanding of Kant's distinction between logical necessity and material necessity and his notion of objective validity helps us to understand the possibility of synthetic *a priori* propositions (principles) in physics. Why Kant considers the possibility of synthetic *a priori* propositions and judgments in physics and mathematics is due to this material necessity. This material necessity presupposes objective validity and this objective validity is impossible without the existence of empirical objects. This is also not about thing-in-itself (Noumenon) but the thing as it appears to us (Phenomenon). Kant's transcendental philosophy would not be possible without objective validity and empirical objects. In other words, the principles of physics are *a priori*, which means that the necessity and universality that they bear with them are to be applied to the objects of experience in reality. That is why Kant calls his philosophy of science as transcendental philosophy because without the objective validity and objects of experience the possibility of synthetic *a priori* judgments

would be out of the question. This has to be understood from his concept of *a priori* and material necessity.

One of the objectives of Kant in Transcendental Deduction was to provide his solution of Protagoras' problem—how can private and relative data give rise to a knowledge that is valid for everyone? The judgments equivalent to knowledge are valid for all humans and are interpersonal or inter-subjective. Kant has called them “objectively valid judgments” because he understands the word ‘objective’ as ‘determined by law’.

2.4 Non-Temporality of *A priori* Knowledge

According to Kant, the representation of succession and co-existence of all appearance contains substratum. The time in which all changes of appearance have to be thought do not change and remain still (CPR, A182, p.213). This means that all changes of appearances occur in time, but time itself does not change. Hence, time becomes a substrate of all temporal appearances and all appearances are temporal. However, what is beyond appearance is not in time and cannot be temporal.

A priori knowledge is not temporal in the sense that it does not occur in time. What Kant meant by “*a priori* knowledge is not temporal” is that it can be derived from something other than experience but not before time. Hence, *a priori* knowledge, though not derived from experience, cannot be thought to be before time. ‘*A priori*’ meaning ‘before time’ is out of the question, here. In the

same way, we cannot separate space and time by tearing them apart. We cannot say that there is an object but no space and time (space and time are original representations). The object which is in space is also in time. This means that what is in space is definitely in time. Further, a thing or an object is always in space and time. This also means that space and time is not a sort of substance in the Kantian sense. If it is a substance, then it will limit the substantiality of an object.

Even intellectual objects categories do not exist in real space and time. The knowledge of such kinds of objects cannot be said to be temporal. According to Kant, time is a pure form of intuition and a necessary condition for our empirical knowledge. We cannot logically separate knowledge from time. *A priori* knowledge does not mean that it is logically before time. It is independent of experience but not before or after this or that time. For Kant, there is only one space and time. *A priori* knowledge derived from reason is without spatiality and temporality.

Kant tells us that space and time are not derived from experience, but their conceptions are dependent on the mind. They are abstract and can be placed on anything. The existence of an object can be known through our intuition. An object has a certain shape-size, extension, weight, magnitude and qualities, occupies particular space and can be experienced in space and time. An empirical object exists in space and time. That is why to say that the empirical object does not exist would be equal to saying that it is not in time and not temporal. Hence, *a priori* knowledge is not temporal, and that is why Kant has suggested that we

cannot get rid of space and time even in our imagination. This means that we can have *a priori* knowledge but we cannot think that it is prior to time. Ilse Rosenthal-Schneider has expressed a relevant point, “Kant’s *a priori* is not temporal—previous to experience—it is logical *a priori*: independent of experience. For him, just as for Locke, they are only acquired, not innate ideas”⁵².

Kant did not completely follow his predecessor René Descartes’ views of innate ideas. We can say that his idea of ‘*a priori*’ is not that of ‘innate ideas’, though both of them are acquired without recourse to experience. It is an improvised version of Descartes’ innate ideas. Whatever is true of every human being is of *a priori* origin. Space and time at the level of intuition and categories at the level of concepts are *a priori*.

2.5 Conclusion

In this chapter, I have aimed to achieve a proper understanding of Kant’s concept of *a priori* which plays a very important role in our understanding of the origin of categories, principles, laws and space and time in his philosophy of physics (and philosophy of science as a whole). I started with the conception of *a priori* that it is not derived (or borrowed) from experience, explaining the differences between *a priori* knowledge and empirical knowledge and how the latter is

⁵²Rosenthal-Schneider, I., ‘Presuppositions and Anticipations in Einstein’s Physics’, *Albert Einstein: Philosopher-Scientist*, Vol.I, P. A. Schilpp (Ed.), New York, Harper & Brothers Publishers, 1959, p.135.

related to the former. I also explained the differences between subjective necessity and objective necessity. The former as formal, is different from factual or material necessity. The *a priori*, in Kant's transcendental (or critical) philosophy is guidance to the truth⁵³, and this provides us with the principles of connection, necessity and universality. Kant's philosophy of physics is deep-rooted in the concept of *a priori*. I have also shown how *a priori* is an advanced form of innate ideas and non-temporal. I argued against Harper's view that material necessity is the consequence of inductive generalization. I also argued in § 1.2 and § 2.3.2 that synthetic *a priori* judgments are incomplete without experience or possible experience. Experience is the basis of human knowledge as such. Kant has termed 'categories' as 'knowledge *a priori*' and pure forms of thought (without being derived from experience). These categories give rise to principles and constitute the laws of physics. I will be discussing them in my next chapter following Kant's application of categories to the objects of experience.

⁵³In the Kantian sense, this truth is not an eternal (or absolute) truth but the truth of propositions and judgments that are necessary and universal (objectively valid).