# Physics: A Roman Catholic Perspective

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**November 27, 2013**

***Beatae Mariae Semper Virgini,***
***Mediatrici, Coredemptrici, et Advocatae***

# I. The Nature of Physical Science

## A. Truth, Opinion, Science, and Faith

Before commencing the study of any subject matter, one ought to know its definition, scope, and methods. We must therefore examine the nature of physics, both in itself, and in relation to other branches of study. Let us attempt to understand it by first defining what we mean by "science."

Physics is one among many different sciences. Today, when we say "science," we usually mean one of the physical sciences. But that is simply a prejudice of the modern mind. "Science" is derived from the Latin "*scientia*," which means "knowledge." This clearly distinguishes it from technology, which is an application of this knowledge to the practical needs of life. Truth is the correspondence between our judgments and reality. Truth does not lie in our ideas, but in the affirmations and denials we make with those ideas. If our judgment about the world accurately reflects reality, then we call it a true judgment; otherwise, we call it a false judgment. Opinion can therefore in some sense be called "knowledge," inasmuch as some opinions are indeed true. So what distinguishes science from true opinion?

We are often correct in our assertions about the world, but cannot say why. We cannot give a reasoned account of our knowledge. We merely have true opinions. Science, then, to distinguish it from true opinion, is defined as "knowledge through causes." That is to say, if we know the causes (or reasons) for something, then we understand what it is and how it behaves in varying circumstance. If we remove the causes, then we necessarily remove these behaviors, and perhaps even the thing itself. In this way we have added to our true opinion a reasoned account of our knowledge. Naturally, some events cannot even in principle be the subject of human science. Any contingent event, that is, any event that may or may not occur in a fixed set of circumstances, cannot be the subject of a science. For instance, since human will is free to choose, one cannot prove or predict its acts. For if the will were determined by the circumstance in which it must choose, it would cease to be free. One consequence then of "rationalism" (the false opinion that all reality is subject to human science) is that free will is denied. God, by way of comparison, does have knowledge of these "future contingents," for it is God Who moves our wills directly. In like manner, history cannot be a human science, because its course is not governed solely by material factors, but by human beings acting freely. In general, if the causes of anything are inaccessible to our human intellects, that thing cannot be the subject of a human science.

A question that will naturally occur to students concerns the place of the Catholic Faith: Is their act of faith merely true opinion, science, or something else entirely? For the theological modernist, faith is an opinion that answers to nothing objective, but to the subjective needs of men. In other words, it is even less than true opinion. It is opinion that corresponds not to a single reality, but to the desires of many different believers, which can be and usually are contradictory. This modernist conception of faith is utterly false, but before we examine the true nature of faith, we ought to consider why the modern world has taken refuge in this empty notion. It is clear that faith cannot be the same as science, because we do not

know the causes of much that is comprehended under faith. There are two reasons for this. First, many articles of the Faith concern contingent events: the fall of man, the Incarnation, the Redemption, and many others. These belong properly to the study of salvation history, and depend upon not only the free choices of creatures, but the absolute freedom of the Creator. Second, some of the articles of faith transcend our human capacities of rational demonstration. Examples here must include the doctrine of the Trinity and the miracles performed by Christ. At this point the modernist goes wrong, because he is really a rationalist. Logically speaking, if the whole universe is knowable by human science, and human science has no way of evaluating the articles of faith, these articles must not correspond to anything in reality. These false friends of religion therefore seek some substitute for objective reality. All that remains to them is their subjective consciousness, so they set up a correspondence between faith and subjective feeling instead. Faith for the modernist is not about the world "out there" (reality), but about the world "in here" (feeling). Consequently authentic religion is for the modernist not a life in conformity with the Divine Will, but one in conformity with personal longings.

If, however, we are honest about the limits of human reason, our humility will lead us to a better account of the act of faith and, through this act of faith, to a more profound understanding of God and the universe of beings created by God. The Catholic Faith, which makes dogmatic claims about reality that can and often do conflict with faulty claims of human science, is most certainly true in every respect. Such claims as conflict with the Catholic Faith are not really science at all, or even true opinion. They are falsehoods. But what allows us to profess the Faith with this absolute certainty? What character does it have beyond true opinion? An act of faith is an act of trust in the authority of a revealer. It is an entirely reasonable and rational act if we can ascertain that the revealer both has the knowledge in question and will not deceive us.

Modern scientists ask for just such an act of faith from their pupils. The student has no way of verifying the immense number of observations and inferences that have been incorporated into modern science. He must depend upon the knowledge and veracity of his instructor, who himself depended upon another. Thus, there develops a scientific tradition (handing down) of previous observation and inference. The student, for his part, has good reason to have faith in his instructor. The instructor is likely to have credentials indicating his proficiency in the subject matter. He may have accrued many years of service at a prestigious university or scientific institution. Moreover, he would be severely penalized for deviating in essentials from that tradition. Peer reviews and academic evaluations continually guarantee that the scientist conforms to the generally accepted views of the scientific community. The instructor has few credible incentives to misrepresent physical theories to the student and will suffer serious consequences if he systematically does so. It is therefore entirely reasonable for the student to submit his mind to that of his teacher, so long as the scientist remains within the boundaries of his competence.

The act of faith that the Catholic makes is similar, but more certain and absolute, depending also upon the gift of God. First he determines, either by his own reason, by his common sense, or by following the reasoning of another, that there is a God, Who has every perfection of Being, including Truth and

Goodness. These truths are sometimes called the "Preambles of the Faith," because they are the reasonable foundation on which our act of faith depends. Now God has intervened in human history, initially by sending the prophets, but finally by sending His Eternally-Begotten Son, Jesus Christ, born into time of the Blessed Virgin Mary. By His public miracles and especially by His Resurrection from the dead, He has proven His Divinity. We may therefore conclude two things: First, as perfect Truth, Christ has knowledge of all things created and uncreated. Second, as perfect Goodness, He can have no desire to deceive us and wills only the good. His Doctrine is therefore true in all details and best calculated for the good of those who will receive it. We cannot pick and choose which doctrines to believe, but are obliged to assent to Revelation in its entirety because of the Authority of the Revealer. To assure that the Tradition (handing down) of the Faith is maintained until the end of time, He established a visible Church that is One, Holy, Catholic, and Apostolic.

Faith and science can never be in contradiction, for all truth has its ultimate source in God. But we must be careful to distinguish their relative certainties. It is science that cannot contradict Faith, and not vice-versa, for the Divine Revealer is more perfect in truth and goodness than any creature, and Christ has demonstrated His Divinity with unshakable proofs. We must reject, therefore, whatsoever we find in human doctrines that either contradicts or yields a conclusion contradicting Divine Revelation, bearing in mind always the *Magisterium* (Teaching Authority) of the Catholic Church.

**B. Three Orders of Scientific Abstraction**

Since science is "knowledge through causes," we naturally seek to understand what is meant by causes, for we cannot use these as instruments of understanding unless we can accurately recognize and classify them. But it is important to first distinguish clearly between the three principal sciences applied to the material world: metaphysics, mathematics, and physics. In the classical and medieval traditions, these sciences study real beings, but each studies beings under a different aspect. Metaphysics is the highest of these, for it is "the science of being as being." In saying that it is a "*science of being*," we simply mean that we are studying *real beings*. In saying that metaphysics is "the science of being *as being*," we indicate that the particular aspect under which we are studying beings is precisely their *being*. The first is materially what we are studying, the second is the formal aspect under which it is studied. In other words, we are studying beings just insofar as they are beings and no further. We are not interested in their particular nature, whether they are living or inert, but only what can be inferred about them from their existence. This definition will become clearer if we compare metaphysics to mathematics. Mathematics likewise studies real beings, but under the aspect of quantity. So mathematics can be defined as "the science of being as *quantified*." It is concerned with beings only insofar as they can be measured. Finally, the classical and medieval traditions understand physics as "the science of being *as movable*." In other words, physics considers *ens mobile*, which is Latin for "mobile being."

These three sciences are traditionally understood to form a hierarchy, with metaphysics at the top, followed by mathematics, and then physics. This hierarchy corresponds to differing orders of abstraction,

with physics being the least abstract, mathematics more abstract, and metaphysics the most abstract. When we say that one is more abstract than another, we do not necessarily mean that one is more complicated than another, or even more difficult, but rather that as we progress upwards, we leave out certain aspects of real beings. Let us consider a concrete example. Real material beings possess *individual* matter that makes each thing to be *this thing* and no other. For example, Socrates is individuated (made an individual) by this *particular* matter (*these* hands, *this* snub nose). But the human intellect can only apprehend things abstractly; there can be no science of individuals. The first abstraction is to leave out the individuality (or *thisness*) of the matter. What is left is matter insofar as it is sensible (able to be perceived by the senses). The study of beings under this aspect is called "physics." Physics studies Socrates not insofar as he is Socrates, but insofar as he is a man. It pertains to a man to have matter, indeed, but not any *particular* matter.

When objects are studied mathematically, they are studied only insofar as their matter is intelligible, for the intellect leaves out of consideration their sensibility. When we imagine a mathematical triangle, we consider it extended in two dimensions, but this extension is only intelligible to the understanding, not perceptible to the five senses. Likewise, when we study Socrates mathematically, we consider him only insofar as he has a measurable body. (*e.g.* He is 68 inches tall. He weighs 160 pounds.) Finally, metaphysics abstracts from matter entirely, for it considers only the existence of the object and any other attributes that accrue to it from that existence alone. So we consider Socrates insofar as he has being and the unity, truth, and goodness, that necessarily accompany being.

| **Science:** | **Studies:** | **Example:** | **Leaves Out:** | **Supplies Principles To:** |
|---|---|---|---|---|
| metaphysics | "being as being" | Socrates as being | all matter | mathematics, physics |
| mathematics | "being as measurable" | Socrates as body | sensible matter | physics |
| physics | "being as movable" | Socrates as man | individual matter | |

*Table I.A: The Hierarchy of Abstraction in the Sciences*

This hierarchy of abstraction among metaphysics, mathematics, and the physical sciences, is also a hierarchy of principles. A superior (more abstract) science is able to supply principles of study to its subordinate sciences. The definition of motion in physics must be taken from metaphysics, for physics cannot define its own subject matter. Likewise, physical science depends upon mathematics for its understanding of quantity, which is absolutely crucial to the study of bodies in motion. The lower science cannot supply the higher examples with principles for study, but only concrete material for the higher science to study. So physical science provides bodies to be studied mathematically, and both physical science and mathematics provide beings to be investigated by metaphysics. The principles of study descend downward from higher science to lower, while the matter to be studied ascends from lower science to higher. Before we proceed to a study of physical science, then, it is necessary to discover in metaphysics some basic principles to guide us.

## C. Motion and the Four Causes

We know from experience that there is change or motion. It is inescapably part of this world. There are also many different kinds of motions. So we would do well to define motion first.

A little thought will convince the student that the task is no easy one. It is one thing to recognize motion when we see it, but to define it requires a good deal of genius, such as that possessed by Aristotle. He recognized that to define motion, we need to say something about the terms of motion, that is, the before and after of every change. Aristotle saw clearly that change is only possible when something actual is also potentially something else. For example, a piece of bronze may *actually* be a bust of Julius Caesar, but it is *potentially* a bust of Marcus Brutus, that is, if it were melted down and recast in a different shape. Before any such change takes place, there must be these two principles in a thing: First, the matter (bronze), which can potentially be given a different form. Second, the form itself (Caesar), which determines it to be this thing and no other. The bronze can potentially become many different things; we say that this matter has a potency to become all of them, but can be actually only one of them at a time. Perhaps now we can understand what is meant when it is said that "being is divided into act and potency." These are two principles that all created beings possess, and it is in terms of them that we must define motion.

We might be tempted to say that "motion is a change from potency to act," and we would be correct, but we would have failed to define "motion." Why? Because we would then be required to define "change," which, as a little thought will make clear, is really nothing more than the "motion" we set out to define. This is an example of a logical fallacy called "*petitio principii*," or "begging the principle." Motion cannot be defined as a particular kind of motion! Aristotle, on the other hand, saw that in every continuous motion the object is in varying degrees of reaching its final actuality. To return to our example, as the molten bronze is poured into the cast, it gradually assumes the form of the bust of Brutus. At each moment it is actually some particular shape on its way to becoming Brutus. Aristotle saw that something like this was happening in every continuous motion. He therefore defined "motion" as "the entelechy of a being in potency insofar as it is in potency." This term, "entelechy," means something close to "act," but it also includes the idea of reaching its end. As it has come down to us through the medieval Latin tradition, motion is defined simply as "the act of a being in potency insofar as it is in potency." In our example, the motion from Caesar to Brutus would be "the shape of the bust of Caesar which is potentially Brutus, insofar as the bust is potentially Brutus." The potency of being Brutus lies in the bronze, not in the current shape of Caesar. In other words, it is not "the shape of the bust of Caesar which is potentially Brutus insofar as it is actually Caesar." This shape would be its present form, the shape of Caesar's bust. Motion is something's act precisely in its ability to be something else, that is, just insofar as it is in potency. Philosophers may legitimately debate the merits and difficulties of such a definition, but a better one has yet to be proposed.

We are half way to understanding Aristotle's four causes in material substances. We have already discussed two kinds of cause: the material cause and the formal cause. In our example, the material

cause is the bronze which can potentially become many different shapes, and the formal cause is the shape of Caesar's bust. These two causes, matter and form, are called "intrinsic causes" because they lie within the material substance. Both the bronze and its present shape are included in the bust itself, but two other causes do lie outside of the bust. The latter causes are therefore called "extrinsic causes." The first of these, called the "efficient cause," is the working of a sculptor. A bust of Caesar cannot become a bust of Brutus without an external agent (one acting) to impress upon it a new form. This agent is the efficient cause. The second, or "final cause," is the end to which the sculpture must conform. In forming the bust of Brutus from the bronze in the bust of Caesar, there must be some standard toward which the bronze is directed. This is the ideal shape which the sculptor holds in his mind. The sculptor strives to bring the shape of the bronze into conformity with his idea. Without any one of these four causes we are unable to explain why things change.

There is another way to view these four causes. We have seen that the bust is in act insofar as it has a determined shape. The shape (form) in some sense acts upon the bronze (matter) to determine it to this one thing and no other. The form is active in relation to the matter; the matter is passive in relation to the form. Or, in other words, the form acts upon matter; the matter is acted upon by form. Now the efficient cause operates through form because it imparts form to matter. That is, it causes form to act upon matter. The final cause operates through matter because it directs the matter to its new form. That is, it causes the matter to be acted upon by form. The difference is subtle, but the efficient and final causes can be likened respectively to pushing and pulling. Whereas the efficient cause moves by action from a beginning, the final cause moves by attraction to an end.

| **Cause:** | **Location:** | **Example:** | **Causal Character:** |
|---|---|---|---|
| Formal | intrinsic | shape of bust | acts upon matter |
| material | intrinsic | Bronze | is acted upon by form |
| efficient | extrinsic | action of the sculptor | causes form to act upon matter |
| Final | extrinsic | sculptor's idea of the bust | causes matter to be acted upon by form |

*Table I.C: The Four Causes*

## D. Science and Method

Clearly, the methods of each science will differ. Physical science, because it abstracts from particular matter, but not from sensible matter, can make extensive use of the senses in its demonstrations (experiments). Mathematics, having abstracted from sensible matter, cannot use sensible objects in its demonstrations (proofs). It can only use the ideal properties of bodies in intelligible matter. This does not mean that the mathematician cannot use drawings or diagrams to help him remember. It only means that the diagram, which in fact always departs from the ideal, cannot supply the principles of his demonstration. Metaphysics, having abstracted from matter entirely, cannot use either sensible objects or ideal bodies. It must use principles of pure intellect and judgment alone.

We have said already that the superior science supplies principles to the lower sciences. Metaphysics studies beings only insofar as they have being. One principle of metaphysics is the principle of non-contradiction: a thing cannot be and not be at the same time under the same aspect. Clearly, both mathematics and physical science make ample use of this metaphysical principle. But mathematics adds new principles, for instance, the postulates of Euclidean geometry, without which it would not be possible to reason about figure. Physical science, the least abstract of the three, borrows from mathematics as well as metaphysics, for without the conclusions of mathematics, the physical sciences would be unable to measure change. But it also must seek additional principles from the senses.

The modern mind calls a science only that which can be studied experimentally, that is to say, through the experience of the senses. Mathematics, abstracting from sensible matter as it does, has consequently become today an exercise in logic having no necessary connection to reality. Indeed, the attempt has been repeatedly made to resolve all of mathematics into merely *logical* relationships, without any recourse to imagination and its intelligible matter. Naturally, metaphysics is rejected outright by those who do not understand the orders of abstraction proper to each science, and who therefore exclude whatever does not invoke a material cause. This scientific demand is nonsense, especially where the science of revealed theology is concerned. For the various elements of Divine Revelation can serve as principles (causes) of demonstration no less than those of geometry or physics. Moreover, such theological demonstrations are more dignified inasmuch as the principles of demonstration often transcend what can be obtained by any human science.

Leaving these higher sciences aside, the experience of the senses should be an important part of method in the physical sciences. The "scientific method" is usually presented as a clear-cut, even mechanical, order of investigation. But this order does not always hold in practice. The investigations of physical science bring the whole man, with all his prejudices and experiences, inclinations and aversions, into a new relation with the physical world. Many physical discoveries have been the result of accident, blind trial and error, or sudden brilliant insight. Examining this method will, nevertheless, help the student understand an important part of the physical scientist's work.

| | |
|---|---|
| 1. | Define a problem that requires a solution. |
| 2. | Produce an hypothesis to explain the problem. |
| 3. | Predict new consequences of the hypothesis |
| 4. | Test the hypothesis experimentally. |
| 5. | Formulate a valid theory that yields new problems. |

*Figure I.D: The Steps of the "Scientific Method"*

First, the investigator must begin with something he wishes to explain. He produces an hypothesis (educated guess) about the causes responsible. He then predicts new consequences from the hypothesis that can be tested experimentally. The testing of these leads, in turn, to a more comprehensive theory that

produces new questions or problems for the scientist. Theories that have been thoroughly tested and have attained a high degree of certainty are sometimes called “scientific laws” or “laws of nature.” The third step is truly the great advance which the moderns have made upon classical Greek science. For the ancient Greeks were keen observers, profound thinkers, and quite imaginative in their hypotheses. Yet, each one having explained some physical phenomenon to his own satisfaction, they ceased to progress. It is really no wonder if an hypothesis accounts for all present observations. That is precisely why it was formed! If it did not, it could be easily discarded. But how can one determine which of the remaining hypotheses is the best? The modern method demands not only that the hypothesis account for prior observations, as did the ancient method, but also that it yield new predictions, which can then be tested. The linear method of the Greeks has been replaced by a circular one that, if followed diligently and with intelligence, will constantly check the accuracy of our physical theories. This modern scientific method has, for both better and worse, radically transformed the intellectual and material culture of the modern world.

There remains to say a few things about experiments. An experiment is not simply a *passive listening* to nature; it is an *active interrogation* of nature. Nature cannot be allowed to speak at random, but must be made to answer the questions we put to it, which means that an experiment must be carefully conceived and executed. Prior to the experiment, we should *already* have an hypothesis about the causes that are operating behind the appearances. The experiment must be designed to verify or reject that hypothesis with certainty. This is what Francis Bacon called an *experimentum crucis* (critical experiment). The physical circumstance of the experiment will typically be an uncommon or contrived one in which the presence or absence of the these causes will be easily seen. It will very often require a physical apparatus to put nature into such a condition and scientific instruments to amplify and record the results of the experiment.

The classic example of the *experimentum crucis* is Sir Isaac Newton’s experiment validating his theory of color mixture. It was well known from ancient times that some transparent materials, such as raindrops and some glasses, have the power to produce all the colors of the rainbow from an initial beam of white light. Some investigators were of the opinion that white light is *modified* to produce these colors. Newton, on the other hand, thought white light a composition of all of the colors, and that the prism is just *separating* white light into its colored components. He performed a simple experiment to decide which of the hypotheses was true. He first used a glass prism to produce the whole rainbow (the visible spectrum of light) from a single beam of white light. But then he cleverly positioned another prism to take in all of the colored beams and reunite them into a single beam. If the material of the prism were really modifying the light, the second prism would either further modify the light or have no more effect on the already modified light. On the other hand, if his own hypothesis were true, the various colors would be gathered back together to form white light again. The experiment proved him correct. He could separate white light into colored components and then mix them back together again to form white light. The competing theory of color was overturned.

## E. Physics and the Physical Sciences

Were we to leave off our discussion of the physical sciences here, we would be greatly deceived about the scope of modern physics. For in early modern times a great change took place in the whole conception of the physical world.

The classical physics of Aristotle regards the world as filled with various natures. For instance, there is the nature of a stone, the nature of a tree, and the nature of a horse. The first is a mineral, the second a plant, and the third an animal. The Greek "*φύσις*," from which we derive the word "physics," and the Latin "*natura*," from which we derive the word "nature," have the same basic meaning. They refer to the essence of a thing insofar as it is a principle of operation and motion. In other words, having a particular nature implies having a particular kind of operation and motion. So the inert stone has its principles of motion, the living plant another set of principles, and the sensitive animal still another set of principles. These principles of operation are understood to be embodied in the highest form of the individual substance, which is called the substantial or essential form. When the substantial form is also a principle of the operations of life, it is called a soul. So a stone has the ability to act and be acted upon through contact. In addition to these operations of lifeless matter, a plant has operations proper to its own degree of being: It can transform inert matter into living matter through growth and reproduce to form new plants. An animal adds to these operations those of the senses: touch, taste, smell, vision, and hearing, or some combination of these. So it has a more perfect operation and a more perfect being than the plant. The study of these substances reveals a hierarchy of natures in the world, with man, whose soul is both the substantial form of the body and a spiritual (non-material) substance in its own right, at the pinnacle of the material creation.

A change in thinking is evident when we consider that we no longer understand physics to be the study of *natures*, but the study of *nature*. The mechanical philosophies of the early modern period had a leveling effect. The entire universe was conceived as one vast machine with interacting material parts, all essentially inert. The difference in *perfection* between a living being and an inert one was reduced to a mere difference in *complexity*. René Descartes, the first significant proponent of this philosophy, dispensed with the souls of animals and plants, but perceiving that man possesses spiritual operations (intellect and will) that do not involve matter, he retained the human soul. The human body was an "extended substance," the human soul a "spiritual substance." Man had become a body accidentally united to an angel. There is no way in his philosophy to rejoin the soul and body into a single human being. Later thinkers, taking Descartes to his logical conclusion, dispensed entirely with a soul that had ceased to have any relation to the physical world: Man is a machine, a marvelously intricate one to be sure, but just a machine.

So plants, animals, and men might exhibit extraordinary complexity of structure and behavior, but they can ultimately be reduced to the mechanical interaction of their material parts. This mechanical philosophy of nature is therefore called "reductionist." The idea of individual substance has disappeared altogether.

The operations of inert matter, now understood to be universal and, even more importantly, *complete* descriptions of all matter, have been stripped from substantial forms and turned into "laws of nature." Where then do these "laws" exist? In God? Scientists of the early modern period were commonly of this frame of mind, but later agnostic and atheistic thinkers could not avail themselves of this option. Form had become nothing but a particular arrangement of matter. The only remaining option was to identify these operations with matter itself. So the leveling of reality became an inversion: Matter is the basic reality; form and spirit, so-called, are but fleeting arrangements of matter. In this way were born the pernicious doctrines of Darwinism and Marxist materialism.

Since matter is understood to be the ultimate reality, and since mathematics is able to study the arrangements of matter in bodies, the application of mathematics is central to modern physics. Whatever cannot be reduced to quantity is dismissed as incapable of scientific study. There are indeed legitimate investigations corresponding to today's mathematical physics. In the middle ages, such sciences were called "*scientiae mediae*," or "intermediary sciences." St. Thomas Aquinas taught that these sciences have a physical subject (matter), and a mathematical aspect of study (form). Medieval examples are optics and astronomy. What is objectionable in modern physics is not that bodies should be studied mathematically, but that the philosophies and even the mathematical doctrines underlying modern physics make it *exclusively* mathematical. These doctrines contain a complete restructuring of the physical sciences. Modern physics considers the ultimate "laws" and material constituents of *inert* bodies. Other physical sciences, for their part, are considered legitimate only insofar as they are thought to be reducible to physics. In accordance with reductionist thinking, they cannot invoke principles superior to those that govern inert matter. Most striking of all, since physics now has regard only for lifeless matter, there is today neither in theory nor in practice a true science of biology! All that remains is the name.

The Catholic student must always be aware of this inversion in modern physics and cautious of its influence in his thinking. Contrary to what many Catholic apologists claim today, modern physics implies a philosophy that cannot be reconciled to the Catholic Faith, for it is false in its very principles. This is not to say that modern physics' mathematical predictions are inaccurate, for these conform well to reality. It is not experience that is faulty, but the formulation and interpretation of experience. There remains for orthodox Catholic scientists and philosophers a task of immense scope, severe intellectual discipline, and unremitting opportunity. The physical sciences, and indeed the various branches of mathematics, must be reconceived and reordered, all the while preserving the great multitude of legitimate modern discoveries and observations. No individual or small group of individuals will suffice; this project will demand the labor of legions of talented and dedicated philosophers, theorists, experimentalists, teachers, and popular expositors. Catholic Tradition affirms that "grace builds upon nature." With a sound philosophy of nature again in hand, the Church will find more fertile ground in which to plant the seeds of faith. Let us be sure that the credit for this is referred to God alone:

*Ad Majorem Dei Gloriam*.

**Chapter I.A Review Questions:**

1. What is meant by “truth”?
2. What is a “science”? How does it differ from “true opinion”?
3. What is meant by a “contingent” event? Why cannot these be the subject of a human science?
4. What does the theological modernist mean by “faith”?
5. What does the orthodox Catholic believer mean by an “act of faith”?
6. Does the scientist demand an act of faith from his student? Why?
7. Why is the Catholic’s act of faith in Jesus Christ entirely reasonable?
8. How must all conflicts between scientific theory and the Catholic Faith be resolved? Why?

**Chapter I.B Review Questions:**

1. How are the subject matters of physics, mathematics, and metaphysics defined?
2. What do we mean when we say that one science is more “abstract” than another?
3. In what way do physics, mathematics, and metaphysics abstract from individual beings?
4. Under what aspects would physics, mathematics, and metaphysics study a diamond?
5. In what way does the hierarchy of sciences yield also a hierarchy of principles?

**Chapter I.C Review Questions:**

1. What are meant by “act” and “potency”?
2. How is “motion” defined?
3. How does the act of motion differ from the act of form?
4. What is the difference between an intrinsic and extrinsic cause?
5. What are the four causes? Which are intrinsic and which extrinsic?
6. How should we understand the difference between an efficient cause and final cause?
7. Give an example of a motion not found in the text and identify its four causes.

**Chapter I.D Review Questions:**

1. In what way does the order of abstraction of each science determine its method?
2. Give examples of principles that physics borrows from metaphysics and mathematics.
3. What are the five steps of the modern “scientific method”?
4. How do the physical investigations of the modern scientists differ from those of the ancient Greeks?
5. Why cannot the “scientific method” of the physical sciences be applied to mathematics, metaphysics, and theology?
6. What is an *experimentum crucis*? What distinguishes it from mere observation of nature?

**Chapter I.E Review Questions:**

1. How does the classical science of Aristotle view the world?
2. What did the Greeks and Latins understand by the terms "*φύσις*" and "*natura*"?
3. What is a "substantial form"? What is a "soul"?
4. Describe the "mechanical philosophy" of nature.
5. Describe Descartes' philosophy of the body and soul. What is the great problem with it?
6. How did the notion of a "law of nature" come about?
7. In what way has modern science limited the idea of form?
8. How do Darwinism and Marxist materialism find their justification in modern physics?
9. Why has mathematics become so central to the modern study of the world?
10. What are "*scientiae mediae*"? Give some examples.
11. Why is there today no true science of biology?
12. Can modern physics in its present formulation be reconciled to the Catholic Faith? Why or why not?