

MODERN SCIENCE

Threshold & Philosophical Problems

By:

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Foreword: Msgr. Theophilus Okere

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CHAPTER 3

THE CLASSIFICATION OF SCIENCE

When we talk of the classification of science, we are talking “of the practice of narrow concentration on a particular physical problem” by scientists. This means “the division of labour over the whole of science in an institutional context.”¹ This results in detailed and thorough investigation of a small physical problem, and in numerous specialties or disciplines in science. Each discipline/specialty investigates a particular problem. The Latin adage *scientia non-duplicanda est* – sciences are not duplicated arbitrarily – should be re-called here.

In the ancient and medieval times, there wasn't much of a classification: philosophy and science and knowledge coalesced. Writing on this issue, S.E Stumpf notes:

...it is a fact of the history of thought that science and philosophy were the same thing in the beginning and only later did various specific disciplines separate themselves from the field of philosophy; medicine being the first to do so.²

In actual fact it was only as late as the modern period that some kind of classification of science began to appear. Since then, there have been various classifications by individual pioneer scientists like Galilei Galileo (1564-16420); the rationalist philosopher Christian Wolff (1679-1754); and the positivist philosopher Auguste Comte (1798-1857). The classification made by the French Academy of science, however, has remained decisive and dominant in modern times. Thus for modern classification of science, we have to fall back on the French Academy more than on any other group or individual. The rival Royal Society did not have definitive claim to science till about 1834 and it lacked official backing which the French Academy enjoyed.

The organogram, the organizational structure, of the French Academy resulted in the classification of science. The Academy in 1699 was divided into sections (a bureaucratic device originally designed for official control, a kind of ministerial control); a device to share out work and responsibility and perhaps to increase productivity. This marked the end of Bacon's Salomon's House (a research institute composed of cooperating but unspecialized mass of researchers with common interest in natural philosophy). The Academy, on the other hand, became a federation of subject groups. That is, it embraced the whole range of

mathematical and natural sciences but still encouraged specialization. In later years, knowledge continued to grow and the need for specialization became inevitable; the Academy permitted and encouraged this. The Academy at the beginning had the following sections: ³

Mathematics

Mechanics

Astronomy

Physics

Chemistry

Botany

Agriculture

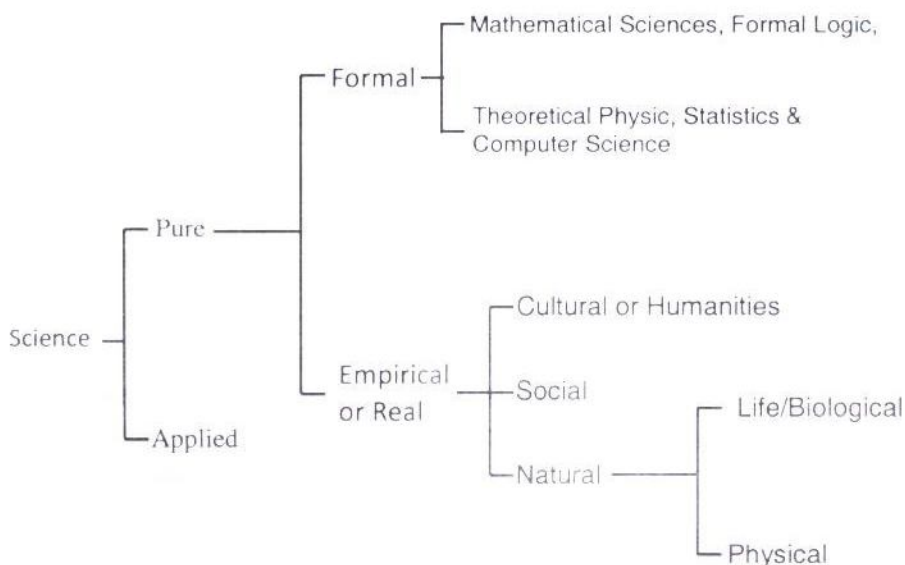
Anatomy/Zoology

Medicine/Surgery.

The sciences continued to develop and categorize and in the academy scientists were elected into sections that correspond to their specialist competence. In this way the sciences were gradually being classified.

Today classification is increasing minutely. Science is becoming more narrowly departmentalized. Any small physical problem demands a special treatment and as such constitutes a discipline of its own. The following classification schematically presented is more or less the generally accepted classification today:

Broad Classification: Pure and Applied



Based upon curiosity and practical need (the two central impetuses that drive science), we observe that there are two major classifications of science: Pure and Applied.

Pure Science is the systematic body of knowledge descriptive of reality or the operation of general laws. It satisfies man's natural desire to know. Though pure science might have implications for application, knowledge for its sake rather than application is its primary motive. Applied science, on the other hand, is the systematic application of scientific knowledge to serve mankind in a practical way. Applied science is that kind of scientific research primarily focused on the development of technology, new products and processes that are practically useful to man.

Formal And Empirical/Real Sciences: Pure science is further classified into Formal and Empirical/Real Sciences. Formal sciences study abstract, logical or mental forms or processes. Their objects and approach are *a-priori* not empirical (sensory). Examples include mathematics and logic.

Mathematics

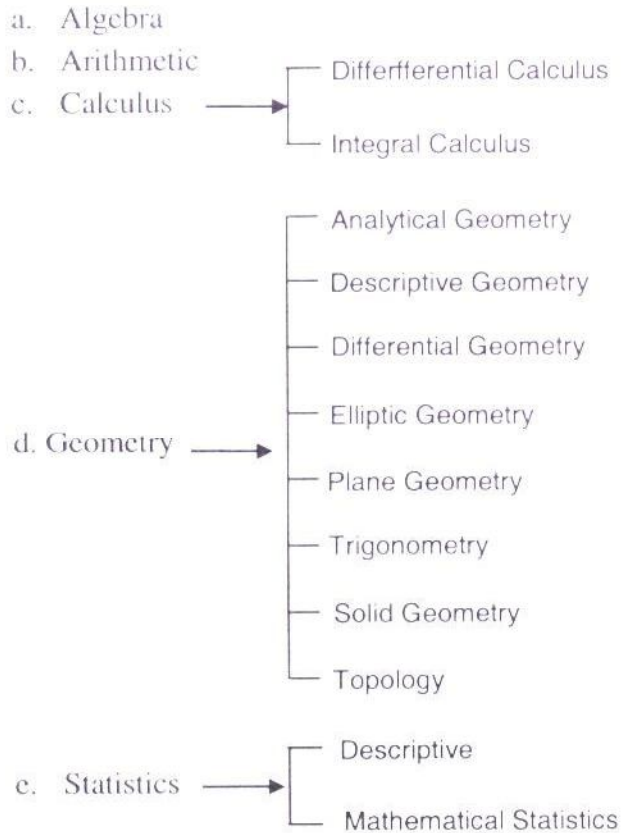
Mathematics is perhaps the oldest of the sciences but the word did not enter the English language till the late 16th century. The word Mathematics is a transliteration from the Greek *Mathesis* which means *Learning*. *Mathematikos* means fond of *learning*. *Mathetes* means *disciple*. Relating mathematics to numbers was, according to Aristotle, first made by the disciples of Pythagoras, the Pythagoreans, in the 6th century B.C. They were devotees of mathematics which they advanced. They believed that the principles of mathematics, the elements of numbers [the odd (limited) and the even (unlimited)] were the principles of everything. Everything that exists is reducible to the principles of mathematics and expressible in numbers.⁴

The origin of the idea of mathematics, however, predates the devotion to it by the Pythagorean society. The Egyptian Rhind Mathematical Papyrus (RMP) also called the Ahmes or Ahmose Papyrus and also known as Papyrus British Museum 10057, which dates to around 1650 B.C; is much earlier than the time of the Pythagoreans. The Moscow Papyrus, which dates to about 1850, another major source of African mathematics, even predates the popular Rhind Papyrus. We have no less authority than that of Aristotle to support that mathematics first began in Egypt when he affirmed that: "...the mathematical arts were founded in

Egypt....”⁵ Even the Plimpton 322, the Babylonian Mathematics of the people of Mesopotamia, which dates to about 1900 B.C., predates the Pythagoreans.

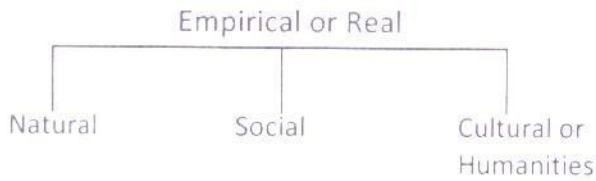
Today mathematics is known as the most precise and exact of the sciences so much so that the other sciences attempt to approximate its exactness. For this mathematics has become the language of science. Mathematics has pure and applied aspects. These are outlined in the following scheme:

Pure Mathematics:



Applied mathematics

- Actuary studies
- Auditing
- Engineering
- Statistics



Empirical or Real sciences have as their objects empirical (sensory) realities. They proceed by way of empirical verification. Following the positivists influence in the definition and classification of science (positivists hold that the only authentic knowledge is that acquired using the scientific method, which has the verification principle as its corner-stone; that is, knowledge of physical phenomena justified by experience based on sensory observation). The terms science and empirical science have come to be considered synonyms.⁶

But there exists, among scientists and philosophers of science, disagreement as to what exactly constitutes the scientific method even in the natural sciences. Consequently, the term science is also used to designate the study of human social phenomena. Cultural studies (classics, languages, and art) are known as humanities. Thus empirical sciences are distinguished from formal sciences and categorized into natural, social and cultural sciences. Natural sciences are distinguished from the social sciences and the cultural sciences and categorized into the Physical Sciences and the Life/Biological Sciences.

There are no clear lines of distinction between the natural sciences. They are not mutually exclusive. There are areas of mutual cross-sharing of information. Consequently you have cross-disciplines. When physics for instance is dominant you have, astrophysics, geophysics, chemical physics and biophysics. When chemistry is dominant, you have biochemistry, geochemistry and astrochemistry. There are multiple disciplinary sciences such as Environmental Science, Oceanography, Physical Oceanography and Marine Biology

Physical and Biological Sciences are the branches of natural science. The physical sciences study the non-living aspects of man's environment. They include physics, chemistry, astronomy and the geosciences. Biological sciences study life, all living organisms, and how they interact with each other and their environment.

Physics is the study of the forms of energy such as heat, sound, and light. It tries to understand the nature and sources of energy and the ways in which one form of energy could be changed to another.

Astronomy is the study of the heavens. It investigates the relationships, movements, composition, sizes and distances of celestial bodies, within and beyond the solar system.

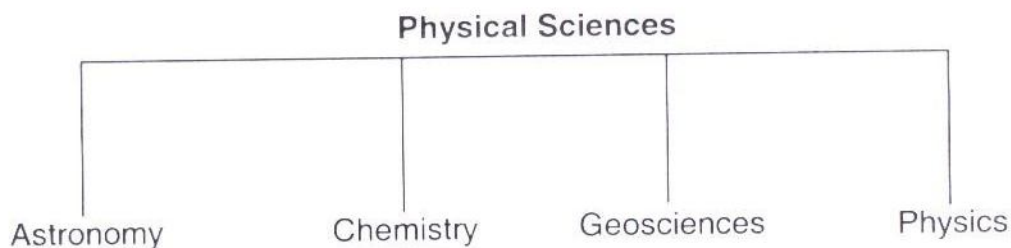
Chemistry is the study of matter and its behavior when combined with other materials. Matter is studied to find out its composition and how it changes and what happens when integrated or disintegrated. Taking substances apart (analysis) helps chemists know its composition. Combining (synthesis) helps them produce completely new substance or improve similar substance. The knowledge of chemistry is important in other areas such as medicine, agriculture and engineering to mention only these.

Chemistry helps man understand his world, how the universe is composed, and how he can change the substances in the universe to his advantage. Chemistry and Physics have greatly simplified the world. They have demonstrated that all things in the world can be reduced to matter or energy and that matter and energy can be converted from one to the other.

A further simplification shows that matter could be in the form of solids (elementary substances or elements), liquids (compounds), and gases (mixture).

Geosciences deal with the study of the earth, its atmosphere, surface, and internal structure. This includes the careful measurement of the earth's magnetism, gravity and size. Geosciences include aspects of physics and chemistry that relate to the study of the earth.

Zoology and Botany respectively study animals and plants.



1A. Astronomy:

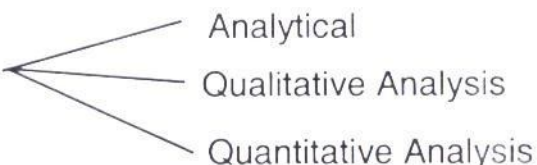
- Astronomy
- Astronautics
- Astrophysics
- Celestial Mechanics

- Cosmology
- Radar Astronomy
- Radio Astronomy

Applied Astronomy

- Celestial Navigation

IB Chemistry:

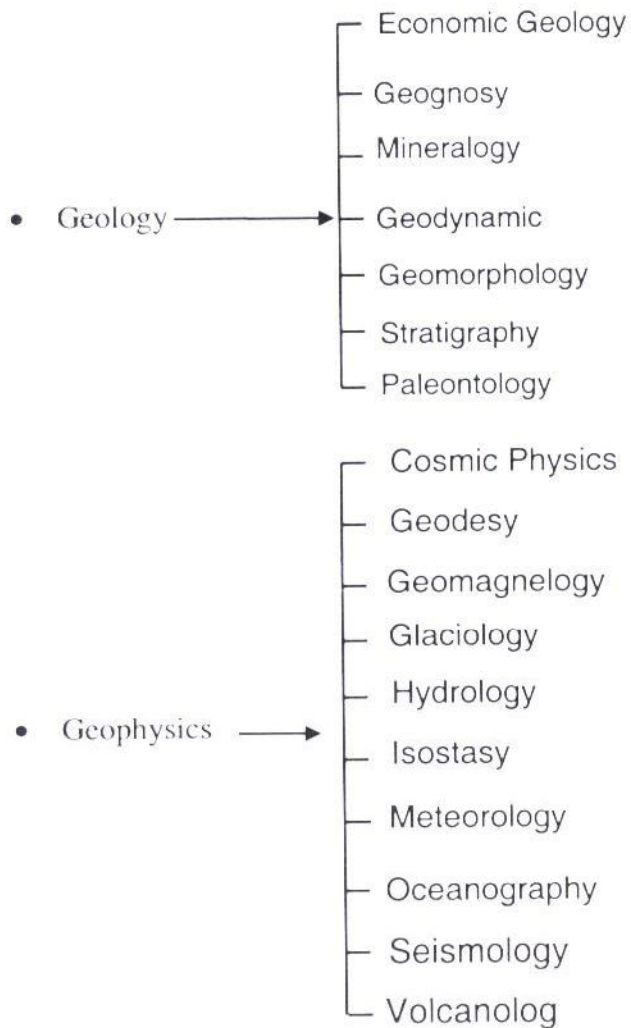
- Biochemistry
 - Inorganic Chemistry
 - Organic Chemistry
- 
- Physical Chemistry →
 - Electrochemistry
 - Nuclearchemistry
 - Photochemistry
 - Thermochemistry

Applied Chemistry

- Agricultural Chemistry
- Chemical Engineering
- Control Chemistry
- Metallurgy
- Petroleum Chemistry
- Pharmaceutical Chemistry
- Synthetic Chemistry
- Textile Chemistry

I C. Geosciences

- Geochemistry

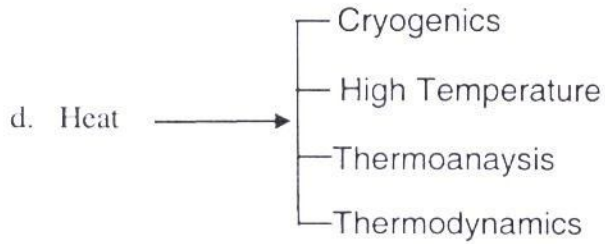


Applied Geosciences:

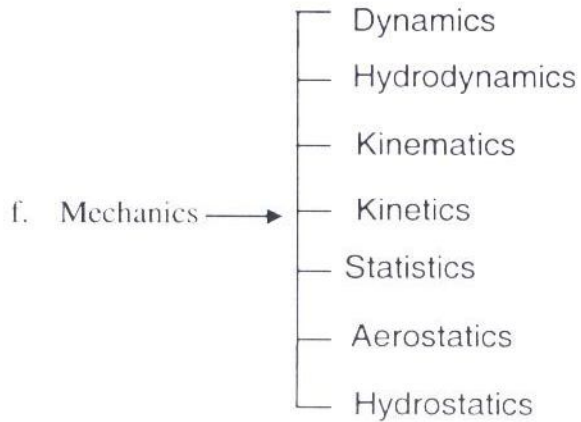
- Coal Technology
- Engineering Geology
- Meteorology
- Mining Geology
- Petroleum Geology

1D.Physics

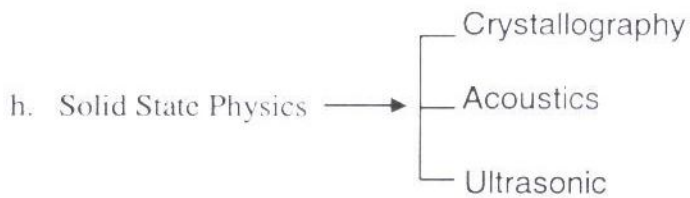
- a. Biophysics
- b. Electricity & Magnetism
- c. Electronics

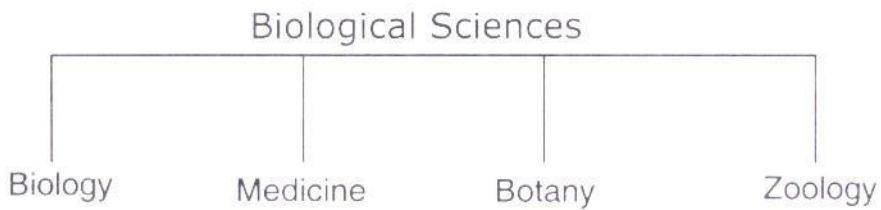


- e. Light (optics)



- g. Nuclear Physics





A. Biology:

- Anatomy
- Astrobiology
- Biometry
- Ecology
- Genetics
- Physiology

B. Medicine

- Allergy and Immunology
- Anesthesiology
- Colon and Rectal Surgery
- Dermatology
- Internal Medicine
- Neurological Surgery
- Nuclear Medicine
- Obstetrics / Gynecology
- Ophthalmology
- Orthopedic Surgery
- Otolaryngology
- Pathology
- Pediatrics
- Physical Medicine
- Plastic surgery
- Preventive Medicine
- Psychiatry/Neurology

- Radiology
- Surgery
- Thoracic Surgery
- Urology

Related Disciplines

- a. Dentistry
- b. Osteopathy
- c. Psychology

NB: Medicine is perhaps the first science to become independent of philosophy. It is concerned with the prevention and treatment of diseases and the preservation of life. Medicine cannot be divided into pure and applied because each special branch of medicine includes treatment as well as constant research

C. Botany

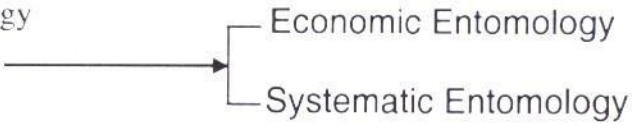
- Bacteriology
- Dendrology
- Economic Botany
- Geobotany
- Mycology
- Paleobotany
- Phytobotany
- Plant Geography

Applied Botany

- Agriculture
- Forestry
- Hydroponics
- Plant Breeding
- Pomology

D. Zoology

- Archeology
- Comparative Anatomy

- Comparative Physiology
 - Conchology
 - Embryology
 - Entomology
 - Helminthology
 - Herpetology
 - Ichthyology
 - Mammalogy
 - Ornithnology
 - Protozoology
 - Zoogeography
- 
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graph LR; Herpetology --> EconomicEntomology[Economic Entomology]; Herpetology --> SystematicEntomology[Systematic Entomology];
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### **Applied Zoology**

- Animal Genetics
- Apiculture
- Entomology
- Veterinary Medicine
- Wildlife Management

### **Cultural Studies (Humanities):**

These are academic disciplines that study the human condition using approaches that are basically analytic, critical or speculative. The approaches of cultural sciences or humanities are distinguished from the empirical sciences. Humanities include:

- a. Philosophy
- b. Classics
- c. Art
- d. Religion
- e. Law
- f. Anthropology
- g. Archaeology
- h. History
- i. Linguistics

## REFERENCES

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<sup>1</sup>M. Crosland, *Science Under Control: The French Academy of Sciences 1795-1914*, New York: Cambridge Univ. Press, 1992, P.13

<sup>2</sup>S.E. Stumpt, *Philosophy: History and Problems*, Bk. I. New York: McGraw-Hill Pub.Co. 1977, P.4-5

<sup>3</sup>M. Crosland, *Science Under Control*...P.25

<sup>4</sup>Aristotle, "Metaphysics", 1.5. 985<sup>b</sup> 22 in Richard Mckeon (ed.) *The Basic Works of Aristotle*, New York: The Modern Library, 2001, P.698

<sup>5</sup>Aristotle, "Metaphysics", 1.5. 985<sup>b</sup> 22 in Richard Mckeon (ed.) *The Basic Works of Aristotle*, P.690-691

<sup>6</sup>"Meaning of Science," *Wikipedia, The Free Encyclopedia*  
[http://en.wikipedia.org/wiki/human\\_science](http://en.wikipedia.org/wiki/human_science) (accessed 2012)



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