The Status of Biology in Alexandrian and Graeco-Roman Science

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The progress man has made in his understanding of nature is traced here in its Greek and Roman phase.

Introduction

This article will comprise a discussion of the Alexandrian and Roman schools of science. It is not meant to be a specific account of the great many men and developments of this period, but rather, an account of a general nature of the trends, along with a general consideration of some of the more important men of this era. The inclusive dates of the two specific periods are not easy to set. There is much variation in the opinions of the authors as to the years involved, and it would appear as if clear-cut lines can not be drawn between the two as they overlapped, influenced one another to a great extent, and ran simultaneously for quite some time. The author will take the view that the Alexandrian period embraced those years between the fall of the Greek Empire created by Alexander, and the death of Ptolemy, although some minor contributions are made later, and some writers extend the closing date to the conquest of Alexandria by the Moslems in 642 A.D. I will consider the Roman period as closing with the sack of Rome in 410 A.D. even though scientific learning was effectively dead after Galen.

The Alexandrian School

The Alexandrian School might be thought of as a by-product of Greek imperialism. When Alexander extended his empire to include Egypt, he established the city of Alexandria. A great center of learning grew up here which was to have much influence for several centuries to come. This was part of Alexander's policy in spreading the Greek culture and in making scientific conquests as well as political. As Alexander's Empire broke up at his death in 323 B.C., the general Ptolemy saw a chance to grab Egypt and place himself on a throne. He established a line of rulers which was only to end with Cleopatra's death in the year of 30 B.C. Greece was exhausted but the Greek spirit was not dead. A new vigorous culture arose in this colony. The school of Alexandria silenced those of Athens.

Ptolemy, himself with a learned inclination, entrusted Demetrius to establish the greatest academy of learning — the Museum. He also selected scholars on their merits to work here and endowed them with a regular stipend. A great reading public grew up, books were collected, and the Museum at Alexandria eventually housed 700,000 volumes. There developed a boom in commercial publication of which Alexandria was the hub. A universal Greek language arose, and Greek became the language of the learned. Scholars here found optimum conditions for study. They practiced methodical and systematic observation but did not neglect their inheritance of abstract reasoning. There was a fusion of the Greek element with Arabic and Egyptian, and this mingling of these different cultures was to have great bearing on the future of science as the Arabs absorbed, compiled, and preserved the scientific Greek knowledge to be passed on to Europe after the Dark Years.

Greek mathematics at Alexandria kept many of its traditional features but absorbed the problems of the Orient on astronomy. This hybridization between Greek mathematics and Oriental astronomy produced vigorous offspring. Most of the productive work done in mathematics was done in relation to astronomy, and this school of mathematics made more advances than any other of the Hellenistic schools. The Greeks did just about all that could be done in geometry without the aid of algebra or trigonometry. They made little study of arithmetic, however, and had no system of algebra.

Euclid, or Eucleides, about 300 B.C., was one of the first men of learning to come to Alexandria. He was the very earliest mathematician of importance in this period of Alexandrian science. Euclid gave rise to a splendid line of scholars who received their inspiration from him. These were Archimedes, Apollonius, Hipparchus, Ptolemy, Diophantus, and others. His main contribution was the systematizing of the whole science of geometry in his work entitled *Elements*. He proposed his theory of limits, which Archimedes, his pupil, used to establish important properties of conic sections. Euclid worked in many branches of mathematics but his *Elements* was his outstanding work, and due to its fine quality became a textbook of long standing, and was in use as recently as eighty years ago. His tools were the compass and the ruler with which he worked up five regular solids. Others following behind him devised the ellipse, the parabola, and other special curves to aid them in their problems. In geometry the Greeks spent much of their effort to find the solution of three things: the squaring of the circle, the construction of a cube with the volume double that of a given cube, and the trisection of an angle.

Archimedes (287-212 B.C.) is considered by many writers of scientific history to be the greatest mathematician of antiquity, and some would rank him as equal to any of today. He was born in Sicily but was educated in Alexandria. He formulated the value of pi, developed the method for calculating the area of a sphere, and established other fundamentals of mathematics. He wrote extensively on all branches of mathematics, and his genius shows up especially in the physical application of mathematical principles. He formulated the law of the lever. He discovered the law of hydrostatics, and created a water pump using the principle of the screw. Archimedes, alone of the Alexandrians, made some advances in physics, but they were merely incidental to his work on mathematics. He measured the densities of various materials and studied phenomena of floating bodies. He designed certain machines of war but did not make record of them possibly due somewhat to the general adversity of the Greek mind to practical application of science. Archimedes' principles formed the basis for the work of the Alexandrian mechanicians and helped to establish the laws of static equilibrium of solids or the laws of weights and balances as previously mentioned. His greatest contributions were in the realm of integral calculus involving areas and volumes. His work was surprisingly original and as a mathematician he is set apart by his persistent proficiency of calculations.

The third great mathematician of the Alexandrian School was Apollonius who lived probably from 260 until 170 B.C. His important work was the eight-volume treatise *Conics* on the ellipse, parabola, and hyperbola of conic sections. He was also an astronomer and probably developed the epicyclic theory of planetary motion which held that the outer planets moved through an orbit which itself moved on the edge of a larger orbit. In this period, as in all others, we find work in astronomy and mathematics closely interwoven.

Aristarchus, about 310-230 B.C., boldly proposed a heliocentric theory of the universe, which did not receive much consideration in that age. He attempted to work out the size and distance of the sun and moon by geometric methods. His views on the universe were too radical for the established philosophical conceptions of the day to become established. The world waited until the sixteenth century for acceptance of a similar theory. Using the phases of the moon on which to base his calculations, this early Alexandrian astronomer and mathematician estimated the distance to the moon in ratio to the distance to the sun to be one to twenty.

The most ardent opposer of Aristarchus' views of the universe was Hipparchus, who made observations in the years 161-126 B.C. Hipparchus propounded his own theory of the universe with the earth as the center, which, after some elaboration by Ptolemy at a later date, became the prevailing notion of the universe until the time of Copernicus. His view was that the planets move in a circle at the end of an imaginary spoke which itself rotated around the earth. This was decidedly a step in the wrong direction and further complicated the geometry of the heavens. Much credit is due him, however, for his careful systematic observation. Through patient research, he located accurately 850 stars and charted them. He also calculated the solar year, and the length of the lunar month with uncanny accuracy. He is said to have been responsible for raising trigonometry to a separate branch of study. This great scientist estimated the distance to the moon to be 280,000 miles and calculated the distance to the sun, based on the study of eclipses, to be 51,000,000 miles. He also computed the bulk of these heavenly bodies. Hipparchus observed that each pole of the earth varies as it turns on its axis and thus describes a circle once every thirty-six hundred years. He represents the end of the great line of Greek astronomers as well as mathematicians. The age in pure mathematics came to an end for the Alexandrians were reaching the limit of what could be obtained by geometric methods alone. They were in dire need of some type of algebraic notation, and although Diophantus (3rd century A.D.) developed a system of algebraic symbols, it came too late to stimulate Greek mathematics to any extent. The decline in this field is also tied to the increasing interest of the Alexandrians in astrology. The inroads of astrology were as a parasite growing on this legitimate science, and weakened it considerably. Some later astronomers attempted to hold the line and Claudius Ptolemaeus (Ptolemy), about 150 A. D., compiled a treatise including much of the efforts of these earlier workers.

Developments which unfolded after the fall of Alexandria in 30 B. C. might be thought of as a second Alexandrian period, for science during this time fell under the domination of Rome and was decidedly Graeco-Roman in nature. Nicomachos (100 A. D.) was one of the first mathematicians to come under this so-called second Alexandrian era. His greatest work *Arithmetic Introduction* dealt with subjects similar to those of Euclid's *Elements,* and had much influence on following medieval arithmetic.

Ptolemy (100-170 A.D.) produced an exhaustive abridgement of the previous works in astronomy by Hipparchus and others. In this *Syntaxis,* he put forth his ideas of epicycle, and placed the earth at the center of the universe. In spite of his misconception of the true nature of the universe, this was a masterpiece of astronomy, and Ptolemaic astronomy provided the technical knowledge of the future great world navigations. The above document of Ptolemy also contained a trigonometry, in which he places the equivalent of a sine table of angles and a beginning of spherical trigonometry. The astronomer calculated the sun to be twenty times the distance of the moon, thus confirming the result of Aristarchus. He wrote in a dry but completely scientific style, and his theory of the universe so well fitted the astronomical observations that it stood the test of time for many years to come. But following the tendency of the later-day Alexandrian astronomers, he seems to have been seduced by the spell of astrology, and gave it sanction in his work entitled *Tetrabiblos.* In this he points out the powers of the stars over earthly affairs. This endorsement of astrology by such a renowned scholar led the way to a rapid degeneration of astronomy and its brother science of this period — mathematics.

After Ptolemy's work, Alexandrian science sank to near hopeless depths, and only a few mathematicians of any note presented themselves. One of these was Diophantus (about 250 A.D.) of whom only an indefinite amount is known. In his work he gives an algebraic treatment of arithmetical problems with the first use of definite algebraic symbols. Even the Arabs consider him to be the originator of the science of algebra. The next and last Alexandrian mathematician worthy of mention was Pappos, who worked near the end of the Third Century A.D. His annotated historical treatment of Greek geometry was effective in preserving the work of some of the older authors that might not have otherwise been sustained.

Soon after the founding of Alexandria, the city established itself as a commercial and shipping center. So naturally, it was important that there be a good deal of effort toward development of scientific geography. Some of the greatest contributions of the scientific minds of this area were in the field of earth survey. Their need for large scale measures antiquated the old Greek geometry and arithmetic, and entailed the creation of new innovations toward magnitudinal measurements. They developed star maps, introduced the use of longitude and latitude in geography, and worked out the size of the earth. The circumference of the earth was first determined by Eratosthenes (about 225 B.C.) by geometrical means, and using information available to him as librarian of Alexandria. His figure was given in stadia and proved to be within 4% of that arrived at in the present day. Ptolemy later erroneously reduced this figure which was probably responsible for Columbus' idea afterward, that India was much closer than it is in reality. Erastosthenes precisely set the distance to the sun as proved by modern means. Poseidonius produced a similar number for the sun's distance. He later became the teacher of Cicero and Pompey. Erastosthenes discovered, through the observations of others, that the seas are all one, and wrote a geographical handbook which was the first scientific description of the world. And it has been said that he contributed more than any other single individual to an understanding of the earth's delineation. Hipparchus proposed a more carefully drawn system of longitudinal and latitudinal lines on the basis of measurements of the sun's shadows in different geographical regions. The work of these early geographers is preserved in writings by Starbo and Claudius Ptolemaeus. Ptolemy himself worked out in detail the sphericity of the earth, and his maps of the world known to him showed fairly accurate latitude and longitude. But his maps were largely forgotten as man went to spiritual teachings to create a largely imaginary world. The only important contribution after the second century in geography was by Posidonius, who wrote a treatise *On the Ocean,* and made an attempt to study the Atlantic.

It might be well to call attention to some work done in optics and mechanics by Alexandrian scientists. Ctesibus (about 200 B.C.) invented a keyboard organ supplied by a constant source of air by hydraulic pressure. This practical scientist is known to have built such things as an air-gun, and steam engine of a type. But most of these things had no demand and assumed little importance. In the first century, Cleomedes made a study of refraction and referred to the apparent bending of objects immersed in water, and also suggested the possibility of atmospheric refraction. Hero, who lived in the second century, devised many sorts of steam engines, and developed a pneumatic water fountain. He is also credited with creating a 'penny-in-the-slot' machine for dispensing holy water. Ptolemy continued the work done on optics by Cleomedes. He showed that light rays, when passing from one medium to another, are diffracted, and even attempted to measure the diffraction. In measuring time the Alexandrian mechanicians built elaborate water clocks that would run continuously, whereas previously man had relied on hourglasses or phases of the moon. Water-clocks of the type developed by them were used as late as the seventeenth century.

The knowledge of the scholarly Greek philosophers concerning chemical transformations was almost non-existent. The attitude of these scholars was to discredit manual labor and experimentation, which kept them from contact with this knowledge and from contact with those individuals in a position to impart this information to them. Many of them considered only pure thought as worthy of the occupation of their time and efforts. But in spite of this disregard of practical knowledge and experimentation, the influence of their thinking carried forth for many years and made itself felt even into the present century. Chemistry appeared as alchemy in Alexandria about 100 A.D. after science had well begun its decline. During the Alexandrian period, the Greek philosophy, along with Egyptian magic, clouded the knowledge of metallurgy, and confused the descriptions of chemical transfers which existed in Alexandria at that time. Alchemy, which was to occupy so much time of workers in later centuries, and which had its beginning in the writings of the Chinese and Egyptians of earlier days, was stimulated through this marriage of the knowledge of metallurgy to mysticism and philosophism. Underlying Alexandrian alchemy was color change as produced by alloying various metals. The production of a white alloy by the addition of mercury, arsenic, or antimony, to a previously black alloy of tin, lead, copper, and iron, to the alchemist of this period, actually became the noble metal silver as measured by his ideas of the essence of matter. To him only the Aristotelian properties, such as color, were important, since he had little knowledge of chemical properties. So also, the above alloy became gold to him when treated with calcium sulfide, after the addition of a little gold as "ferment." Alchemy continued in this area until A.D. 296, when books on the subject were ordered destroyed by the Emperor Diocletian. Unfortunately, when the practice of alchemy was revised in Europe during the Dark Ages, the workers lost sight of the spirit in which this work had been done, and searched wildly for the philosopher's stone which would change baser metals into pure gold. The real secrets of Alexandrian chemistry were confused and later Europe was slow in recovering them without even being aware of it. There were, however, positive results in this primitive chemistry. The Alexandrians became acquainted with the principle of testing and detecting fraudulent metal objects by dissolving them in acids and precipitating them again as their salts. And the retort was widely used and helped to add new chemicals to the known list. These alchemists also devised various chemical techniques, and invented such things as condensers, filters, funnels, flasks, beakers, sublimation apparatus and others.

In the field of organic sciences, the Alexandrians made little in the way of advance, and scientifically, there was no improvement over Aristotle and Theophrastus. The lack of interest in the biological sciences is surprising in that there was a wealth of material in the area for study, and the scholars had fine conditions under which to study. Ptolemy II built a zoological garden and had his hunters bring back rare specimens from their hunting trips. In spite of this opportunity, the only works produced were, for most part, mere compilations of existing writings which tended toward the weird and fantastic.

Medicine fared somewhat better in Alexandria, and surgeons took great care in the study of anatomy. An anatomical building was erected. They overcame previous prejudices against human dissection, and were aware of its value. And it is said that they may not have had misgivings even about human vivisection. Even in the light of this freedom for experimentation, there was a general lack of understanding of the physiology of the body. Many theories of questionable value were proposed. Their notion of physiology consisted mostly of some idea of the combination and workings of the four humours. Medicine, however, seems to have exerted an influence on the other sciences; for example, in chemistry, some new chemicals were discovered while new medications were being sought.

Typification of the standing of medicine and anatomy in the early part of Alexandrian science can be found in two physicians—Herophilus and Erasistratus. At an early date, they demonstrated the value of dissection and observation. They distinguished the nerves of the body from sinews and traced their paths. They explained the functions of the nervous system and showed the difference between the sensory and motor nerves. Herophilus (about 280 B.C.) came close to the discovery of the relationship between the blood system and the lungs by a study of the pulse and the rhythm of the lungs. Erasistratus stands out prominently and completed a great anatomy of the nervous system that disproved Aristotle's theories on the subject. The work of these two men was recorded by Galen later in his medical encyclopedia. As the knowledge of anatomy increased with these men, surgery became a reality. Another attribute of these Alexandrian practitioners was their sense of public service by which they would enter dangerous epidemic areas, or give medical aid without monetary benefit. Stagnation in most fields gradually took place, however, and might possibly have been due to a lack of precision instruments. But this could hardly be listed as valid cause of lack of progress. A more reasonable explanation might be their preoccupation with magic and astrology, moral and social degradation, and increased interest in things spiritual, among others.

In the way of summation of the achievements of the Alexandrian scientists, I might say that they accomplished more in the field of natural science than any like period previous to them. Their work pointed the way to further research in the future. They were logical thinkers, and fair geometers, astronomers, and mathematicians, and made notable advances in the relative fields. Their use of mathematics to measure the heavens pronounced the death sentence to classical ideological cosmology. They were, however, handicapped by a lack of precision apparatus and a system of algebraic symbols.

In mechanics, they made some minor gains. They seem to have gotten chemistry on the road of development, even if in the form of alchemy. In the realm of organic sciences, their accomplishments were insignificant except in fields of medicine and anatomy. It is hardly understandable that there was such a negligence of the biological sciences, when evidence indicates that there was a maximum of opportunity, with optimum study conditions and availability of material. In the early years before the destruction of the library in 47 B.C., and the fall of Egypt to the Romans in 30 B.C., the flame of learning glowed brightly in Alexandria after transfer from Athens, but in the following years, the flame became dimmed, clouded by oriental magic and astrology, and subdued by the influence of Rome. Later-day Alexandrian scientists chose to explore the invisible world and neglect the scientific.

Roman Science

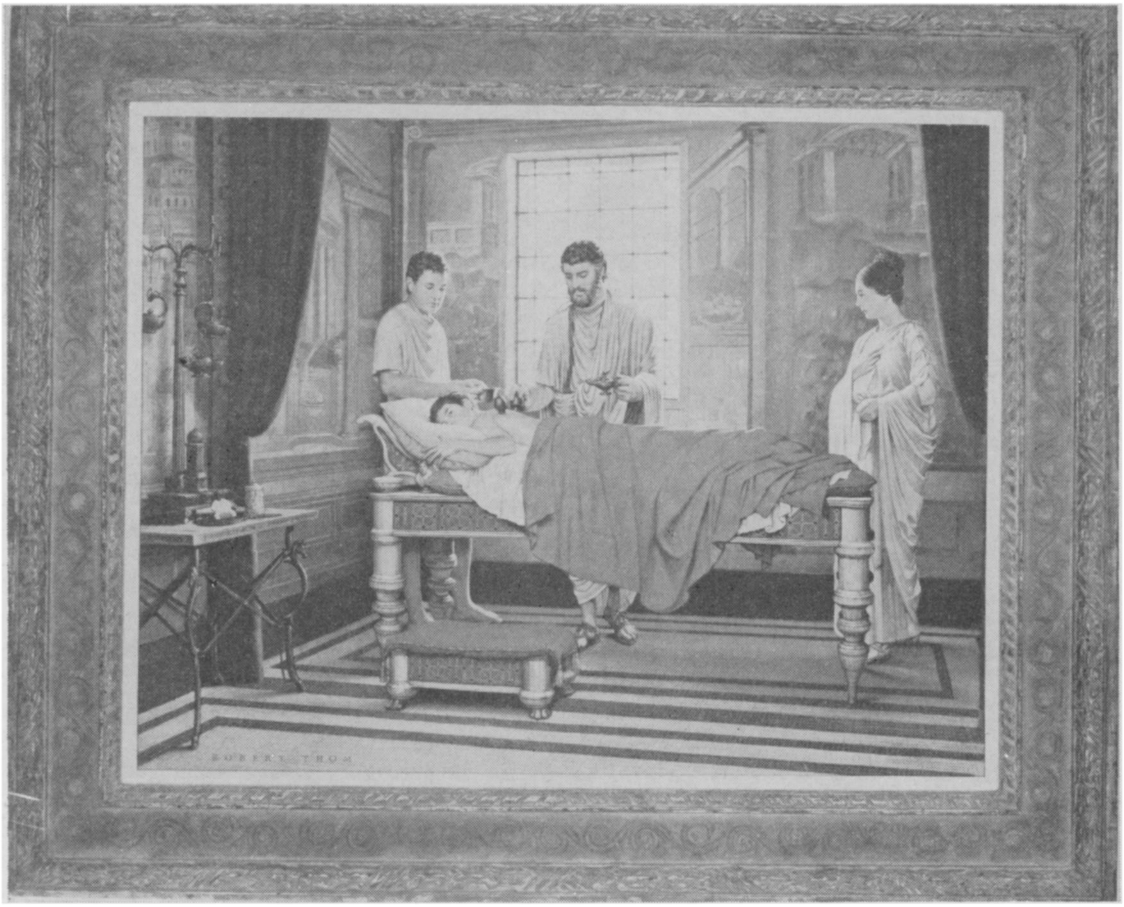
As Rome continued to extend the Empire, its influence in all fields became greater and greater until the time of the beginning of the Christian era, when it had effectively become the cultural center of the world as well as the political. Actually, however, only Ptolemy stood out in Alexandria after 150 B.C. as being more than a mere compiler or poor critic. Thus science as it was transferred from the Greeks to the Romans was on the down-road; but it was to sink lower. The Roman successors had little taste for science and were content to spend their time expounding the works of Aristotle and later of Ptolemy. The Greeks had made a great contribution of scientific spirit, but the Romans were mere followers, and added only significantly to the fields of literature, law, and history. It can be said that Rome conquered Greece and in time was herself conquered by Greek culture. But the flame was lost in relay and Roman science was but a cold imitation of the Greek. Research and free thought were stifled by Roman insistence on utilitarian values in science.

Some of the Romans were antagonistic to the coming of Greek culture, and conservatives such as Cato (234-149 B.C.) tried to resist it. His type of prejudice is not uncommon in the present time. Cicero (106-43 B.C.) is reported to have thanked God that his fellow scholars were not as the theoretical Greeks, but kept mathematics in the confines of practicality. It was the prevalent attitude that no intelligent Roman would waste his time in the exact sciences. In this atmosphere, mathematics, geometry, and astronomy were stagnated.

In scientific philosophy, Cicero worked diligently at developing a repertory of philosophical Latin, and at dispelling the superstitions rampant at that time; however, it is reported, that his friend Nigidius Figulus was responsible for instilling astrology into Roman literature. *De Rerum Natura* was made up of six books of poetry by Lucretius (98-55 B.C.), in which the author puts forth his idea of a world of atoms. No new views were expressed by this writer, the work being in the way of a representation of the ideas of others that had gone before him. Compilation writing, it can easily be seen, was the typical form of scientific expression of Rome, and of all the authors, only Galen stands out as a scholar of science in the true sense of the word.

The real status of science in Rome is also well typified by the writings of Pliny the Elder (23-79 A.D.). This general and author wrote thirty-seven volumes which have been handed to us in some completeness. In his *Natural History*, we find a record of the views of plants at the time. He minimized observation and raised classification out of proportion. But again, following the vein of the day, the work was encyclopedic and not original. In passing, we may further illustrate the point by calling attention to Pliny's use of M. Terentius Varro's book *De novem discipinis* as his source for a description of the eccentric orbits of the planets.

In Roman science there was a dearth of work in biology as such, and the nature of what was done was for most part related to medicine or anatomy. So in the most influential botanical work of that age, we find a description of plants along with a declaration of their medical uses. This work, by Dioscorides, is called *Materia Medica.* This medical botany was written in 64 A.D., and was to have great effect on following botanical activity until the seventeenth cen-



The picture shown is "Galen," one of a continuing series, "A History of Medicine in Pictures." It is reproduced by special permission of Parke, Davis and Company, who commissioned the original oil paintings and by whom they are copyrighted. The project is written and directed by George A. Bender, painted by Robert A. Thom.

tury. His classification was roughly on the basis of form and occasionally in series by families. The names he used for plants still form a large part of the popular vocabulary in botany.

Botany in Rome withered after Dioscorides, and only one more example need be mentioned to illustrate its standing. Crateus, who lived in the first century, and who was one of the more intelligent rhizotomists, made a collection of plants and drawings of them. It is probable that many of his drawings were handed down through a later manuscript in the sixth century containing copies of the originals. The manuscript was referred to by the name *Julia Anicia*, and appears to have been a compilation of the trends in botanical representation of that and previous centuries. Copies other than these also appeared in later years.

Galen (130-200 A.D.) towers above all others in Roman science. He was the most notable anatomist, and the greatest medical writer, that the ancient world produced. His works were forceful and had a resounding influence for centuries to come. Galen's *Anatomy* became a text book for Moorish science to be later introduced into medieval learning. For centuries after Galen, when in the process of dissection, men saw only what Galen had taught them to look for. We have seen such a policy often in science that when certain conclusions have been arrived at, they then form a body of supposed established facts and are then transcribed from one book to another as if the finality of the problem had been reached.

Galen's ideas on physiology may be cited as examples of the prevalent opinions on the subject in Rome. His view of the liver was as an organ to separate *natural spirits* from digested food. The heart, to his notion, was for the separation of *vital spirits* from the blood and the air which met in the heart, from whence it traveled to the brain for further transformation into *animal spirits.* According to him, these *animal spirits* traveled by way of the nerves to the muscles where they brought about contraction. Galen emphasized the liver and taught that there existed two types of blood in the body, one running through the veins to all parts, and the other through the arteries. He held the fantastic belief that the pituitary gland secreted the mucous appearing in the nasal tract. He believed in supernatural intervention in the curing of diseases, and related how he himself was cured of a chronic pain between the liver and diaphragm, after the appearance of the god Asclepius in a dream to advise bleeding from an artery. Due to this successful "cure," Galen stated, he became convinced of the value of arteriotomy. He thought the main part of the action of the heart was in diastole, and taught that there was direct passage of air from the lung to the heart upon which it had a cooling action. The greatest "boner" of Galen was probably his claim that blood passed through the ventricular septum before it passed into the arteries. Naturally the holes through which the blood passed were so small that no one should waste his time and effort trying to examine them. Galen had spoken!

However, to dwell on his misconceptions does not give the true picture of the nature of his influence on medicine and anatomy. He brought together the work of his predecessors. He established the system of experimental physiology. He believed in learning first hand from the study of living animals. He described only what he himself had witnessed. His *Corpus Galenicum* contained a complete osteology, a good mycology, and an admirable neurology. His vascular system was not so notable, but he made some advances. Galen inflated the cerebral vessels with air, thus making them easier to trace out. He pointed out the value of personal dissection, and is reported both to have practiced human dissection, and not to have practiced it. Most writers on Galen state that he merely applied what he learned on lower forms to man. After Galen, Graeco-Roman science decayed.

In summary, I would like to say that the Romans contributed little to science in the fields of geometry, mathematics, or astronomy. Study in these fields was not looked upon with esteem. What they wanted here they borrowed from the Greeks. In scientific geography, their accomplishments were almost non-existent. They made some minor gains in optics. But even if the Roman scientists added little to the work of the Greeks, they, in a way, preserved it, and handed it on to future generations. The Greeks were mostly theory with little practice, whereas the Romans were the opposite. The work of the Romans probably had a positive effect in that dissemination of practical knowledge was accomplished by them. Plants of importance in agriculture were spread. Baths were built. Aqueducts were constructed. Sanitation of a sort was practiced. And wineries, fisheries, and mines were developed.

As the Roman Empire began to disintegrate through a loss of military and political power, its weakness allowed the barbaric tribes of the north to ravage the Empire and eventually destroy it. There seemed to be a rotting of the moral fabric of the Roman society. The conquesting hordes smothered what was left of intellectual thinking, and in the following unsettled times there could be little freedom for the pursuit of scientific work save in the monasteries. Even here men's minds were bogged down with the theological dogma of the time. So, we find the decline of Roman learning followed by dark years in which science wallowed in the mire of superstition and prejudice, and during which the minds of men were almost wholely preoccupied with thinking toward the spiritual.

Various contributing causes to the fall of Rome and the decline of classical learning have been listed as: disorders of military despotism, attacks by the barbarians of Germany, and the rise of Christianity. Dampier and Whetham (1930) note the shortage of coin as a possible underlying basic cause of some of the troubles that beset the Empire and eventually led to its downfall. But Graham (1940) differs with this idea in saying that there is reason to believe that the mines of the Empire were sufficient to supply the needed currency. By the time of the final crumbling of the Empire in the fifth century, creative thinking had, for all practical purposes, long since died, and the actual fall of the Empire marked only the complete and final burial of Roman learning. An age of indolence was upon Europe as it sank into indifference. The world scholars were reduced to a pitiful group of compilers and commentators; and there was but corruption and darkness in learning.

Some writers, for example, Dampier and Whetham, list the rise of Christianity as an important contributing factor in the causes for this decline. Singer (1950) however, discounts this opinion. On the basis of the reading I have done, I tend to agree with the former that the new, vital, Christian doctrine must have worked to precipitate a final collapse of free creative thought (though perhaps not an original underlying cause). The Christian fathers gradually became antagonistic to learning, setting themselves apart in an opposing group, and developing a philosophy in which all men of learning were classed as heathens, and any type of experimentation or other forms of learning, were looked upon as work of the devil. It was many years before this philosophy could be effectively subdued and a new one developed by which science and learning could live side by side with Christianity in at least some degree of harmony.

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Grobman Resigns from BSCS

Dr. Arnold B. Grobman, director of BSCS since its inception, announced his resignation to become Dean of the College of Arts and Sciences at Rutgers University in New Jersey.

NABT members will immediately recognize that Dr. Grobman is the President-Elect of the organization.

His contributions to the BSCS are seen throughout all of the materials which have been produced as well as in the memories of the many biologists and biology teachers who worked on the BSCS project.