Exploring Systems and Development toward Effective Theoretic Communication[1]

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Introduction

The theme for the 2012 Halifax conference is Functional Collaboration in Philosophical and Scientific Research, and Education. In a time of increasing specialization what is becoming more relevant to development and progress is effective communication between disciplines and sub-disciplines. With that in mind my essay for the conference this year explores the systems that have contextualized the science of medicine in the west over the past two millennia. I will focus on two different medical periods in western medicine to set the stage for a discussion of communications between contemporary philosophical studies and contemporary science. This process is an attempt to manifest an understanding of the systems that have contextualized medicine for it is to the systems held in the minds of the scientists with which one must eventually communicate if there is to be controlled genetic development of meaning in a science that will raise the probabilities of progress. First, one must have a systematic understanding of the science in order to understand the system; secondly, one must have an understanding of genetic method and finally, an understanding of development. It is only within these three contexts of one's own understanding that one has the possibility of communicating generalized empirical method[2] to the current system within which a science functions. Only then can strategies of effective communication, or effective strategies of communication, be developed.[3] I begin with a quote from Bernard Lonergan on the preconditions of effective communication.

Clearly, therefore, the historian of any discipline has to have a thorough knowledge and understanding of the whole subject.[4] And it is not enough that he understand it any way at all,

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[1] This paper was presented at the July 2012 Halifax Lonergan Conference at St. Mary's University in Halifax, NS.

[2] Bernard Lonergan, **A Third Collection**, Paulist Press, NY, 1985. Page 141: *Generalized empirical method operates on a combination of both the data of sense and the data of consciousness: it does not treat of objects without taking into account the corresponding operations of the subject; it does not treat of the subject's operations without taking into account the corresponding objects.*

[3] See 3 articles by Philip McShane on his efforts to communicate with botanists, biologists and zoologists on the relevance of adverting to their own operations in order to understand their own method. Philip McShane, **The Shaping of Foundations**: **Being at Home in Transcendental Method**, University Press of America, 1976. Chapter 1, *Image and Emergence: Towards an Adequate Weltanschauung*, and Chapter 3: *Zoology and the Future of Philosophers*. Philip McShane, **Lonergan's Challenge to the University and the Economy**, University Press of America, 1980, chapter 3, *Insight and the Strategy of Biology.* These articles manifest an understanding of the sciences of topic, the problems of naïve realism inherent in the sciences and the solution to that truncation. Unfortunately, to my knowledge, no one in the sciences addressed picked up on his work and more devastatingly, the Lonergan Philosophical School appeared to have no idea of what McShane achieved for himself in that labour.

[4] I was invited to co-lecture on medical ethics at the Dalhousie Medical School in Halifax for four years (1990-94) with a physician who was head of the liver transplant unit at the Victoria General Hospital in Halifax. Preparation

but he must have a systematic understanding of it. For the precept, when applied to history, means that successive systems which have developed over a period of time have to be understood. The systematic understanding of a development ought to make use of an analogy with the development that takes place in the mind of the investigator who learns about the subject, and this interior development within the mind of the investigator ought to parallel the historical process by which the science itself developed.[5]

Before venturing into these two medical eras of research it will be helpful to provide some understanding of a system and of development. The two terms are linked relationally in as much as a system is a context of foundational understanding of a science that is understood to offer development, e.g.: the standard model established in the periodic table; that its intelligibility holds the possibility of further development. As in the periodic table, once the patterns were acknowledged and laid out compounds were formed and development in pharmacology was made possible. So a system, if intelligent, is the source of a higher system made possible by insight. *Development may be defined as a flexible, linked sequence of dynamic and increasingly differentiated higher integrations that meet the tension of successively transformed underlying manifolds through successive applications of the principles of correspondence and emergence.*[6] Development within biological systems is an occurrence made possible by the emergence of non-systematic divergences from the lower manifold, but the understanding of these occurrences as an instance of development has its source in insight. So, the notion of development and systems are interconnected. And finally a system, if it is to be developmental, functions as a scheme of recurrence having the potential to create a higher system through the non-systematic. With these definitions, distinctions and relations in mind we will now follow the path of two medical researchers of two different periods in western history in an attempt to understand the systems they each worked within and whether or not the two systems are related and developmental.

The two medical periods which this study focusses on are represented by Galen in the 2nd century CE and William Harvey of the 16th century CE and their anatomical studies of the human cardiac system and the circulatory path of blood. These two periods will lay the groundwork for an analysis of the 21st century medical system and the current system contextualizing philosophical studies. A brief history of the origins of western medical research in the Greek culture will help contextualize Galen's contribution.

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for these lectures involved extensive reading in anatomy and physiology and knowledge of transplant procedures and protocols.

[5] Bernard Lonergan, *De Intellectu et Methodo,* p. 55. **Understanding and Method**, tr. by Michael Shields, pp. 130-132. Herbert Butterfield attempts to offer an exposition of Harvey's work but it lacks the larger context of an analysis of the contextualizing system in his **The Origins of Modern Science,** MacMillan, NY, 1960.

[6] Bernard Lonergan, **Insight: A Study of Human Understanding**, CWL 3, University of Toronto Press, 1992, page 479.

Greek Medicine before the Common Era

The first school of medicine opened in Greece in Cnidus in 700 BCE. Alcmaeon authored the first anatomical text and taught at Cnidus. Observation of patients was promoted at the school. A humoral medicine system was developed to restore the balance of humours within the body. Hippocrates (ca. 460 BCE- ca. 370 BCE) considered the "father of modern medicine" is believed to have authored approximately 70 medical works. He is of course most well-known for the Hippocratic Oath which still has some relevance today. Hippocrates categorized illnesses as acute, chronic, endemic and epidemic using terms such as; exacerbation, relapse, resolution, crisis, paroxysm, peak, and convalescence. After Hippocrates, Herophilus of Chalcedon (4th century BCE) and Erasistratus of Chios made attempts to map out the blood circulatory system. Their contributions were limited and they eventually became preoccupied with other anatomical issues. Galen (129-199 CE), a Greek physician, is considered one of the greatest surgeons of the ancient world having performed brain and eye surgeries. Galen did most of his work while living in Rome.[7]

This brief history tells us nothing of the content of the original documents and practices that emerged in various cultures of the BCE and early CE periods.[8] There are certain conclusions that I can suggest. The Greek culture was emerging from the context of mythic consciousness and many of the medical texts included sections on the supernatural and attributed some ailments to superstition and demons. There was a blending of mythic consciousness mixed in with the descriptive observations which were becoming more prominent. The efforts at this time were for the most towards anatomy which is a descriptive activity. Explanatory accounts of ailments and cures were centuries off. Almost in all cultures, especially in the west, it was held that a whole was comprised of parts and if one wishes to know the whole; one must know its parts and anatomy served that philosophical position.[9]

This period of anatomical work manifests a quest to understand the human body as well as empathy for human suffering and the idea that descriptive observation would or could help in understanding the human body and also in diagnosing an ailment helping in developing a cure.[10] Was this method of approach a belief or had experience verified such a method as having some degree of success? Possibly a bit of both, but physicians of this period were involved in surgeries

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[7] "If the work of Hippocrates be taken as representing the foundation upon which the edifice of historical Greek medicine was reared then the work of Galen, who lived some six hundred years later, may be looked upon as the summit or apex of the same edifice." **Galen on the Natural Faculties**, Harvard University Press, 1952. Translated by Arthur Brock, MD. Page ix Introduction.

[8] One would have to work through numerous ancient texts to determine the approach and method of how authors arrived at their medical findings and conclusions.

[9] Aristotle, *De part. An.,* II, 1, 646a8-647a8. Galen drew on much of Aristotle's biology and the ancient conception of homogeneous and heterogeneous parts.

[10] The heuristic anticipation was present and operative but unknown.

as well as herbal medicine, and over the centuries, even though relying for the most on descriptive observation, patterns of success and failure would have been observed.[11] Did they acknowledge these patterns and revise their understandings and practice? Obviously, they would have, for the texts that were comprised and the practices and experiments that were carried out could not begin all at once. The Greek physician, Galen, does mention in his writings that he had changed his mind about various conclusions that he had previously drawn.[12]

The desire to understand the human body through experimentation, observation and description was becoming an accepted manner of procedure for anyone wanting to be involved in medicine. The high civilizations of this period having begun to move out of mythic consciousness to some extent began to raise questions about anomalies in the human body. A minority of members of these cultures no longer accepted these anomalies as the will of the spirits or some punishment for deviations of behaviour. Questions were emerging and experimentation, observation and description, as an effort at objectification of that curiosity, became an accepted manner in understanding these anomalies. This exercise alone is a great leap forward when it is understood in relationship to the unquestioning poise of mythic consciousness.[13] Medical research was not alone in this leap. The early Greek Philosophers had been "reflecting" on life issues for some time.

One of Galen's Central Errors

Galen, a Greek physician of the 2nd century CE, focussed on anatomy in his medical work but he did write works in physiology in which he attempted to understand the function of each part in relationship to its *periballon,* (environment) his word. Because his dissections were on animals he made errors concerning his anatomical descriptions of the human body leading to even greater errors in his physiological conclusions. Even with these errors, Galen's work stood out at his time and when it surfaced in the 16th century it saved the anatomists of that period a lot of work and served as a foundation for developments during that period. Galen's written works show that he was an astute observer.[14] He had developed a refined ability towards describing his observations as well as being what was considered then a skilled surgeon. If we can trust his rather odd modesty, he often writes of the unskilled abilities of his colleagues and his own method which he regarded as faultless.

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[11] Statistical method did not enter into medical experimentation or practice until the latter half of the 20th century. See Harry Marks, **The progress of Experiment**, Cambridge University Press, 1997. Part II on the difficulty of implementing statistical method into medical experimentation. Medical researchers resisted statistical method as they understood it to be a filing system of records and having nothing to do with research. Marks contributed much of the eventual acceptance of statistical method in medicine to R.A. Fisher's efforts.

[12] I was unable to find any texts on the success or failure rate of surgeries or medicinal remedies. Statistical method or records were centuries away. See footnote 11.

[13] This is not to imply that earlier cultures were void of medical practices. The shaman and medicine man traditions were common in most tribal cultures. Herbal remedies and incantations were common practices and traditions.

[14] Herbert Butterfield, op. cit., on page 41 Butterfield tells us that "It is perhaps not an accident that the first branch of science transformed by improved observation was that of anatomy."

I have limited this study and focus on Galen's error regarding the flow of blood in the cardiac system even though it was not his only error. The cardiac system was not one of Galen's central concerns but his occasional unverified assumptions and disagreements with Aristotle's biology[15] on certain points led him into errors about the circulation of the blood. Galen emphasized the importance of the liver and believed that all veins as centering in the liver. This focus on the liver led him to have a mistaken view regarding the function of the heart and the circulation of the blood.

Galen's error was that he believed that the blood from the liver carried the nutrients to the body and the blood from the heart carried the *pneuma*, a form of vitality for the body.[16] Galen believed that there was ebb and flow between the liver and the heart and was unable to grasp that the system of arteries and veins constituted a circulatory system. A further error of Galen's is that he believed that blood somehow passed through the interventricular septum, the wall in the heart which separated the left and right ventricles.[17] Harvey would eventually solve both of these problems 1300 years later. Unfortunately, for the development of anatomy and physiology during Galen's time, this error blocked further development in outlining the actual circulatory system.[18]

This error of Galen's exposes a limitation on description but also a limitation on the development of Galen's thinking regarding the context of Galen's resources. He dissected animals, dead for the most, and once dead the arteries leading to the lungs and then to the left atrium and ventricle of the heart would have drained of blood so he assumed they carried air from the lungs to the heart preventing any excess of heat within the heart. The point being that description can be limited due to the experimental context. But Galen, even though he could not

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[15] Butterfield, op. cit. page 40. This is not to infer that Aristotle had a correct anatomical understanding of the circulatory system. See Aristotle's *Historia Animalium*, tr. by J.A.Smith & W.D.Ross, Oxford University Press, 1962 edition. Book I, chapter 17 for Aristotle's discussion of the heart. Aristotle held that the heart had 3 cavities and that the veins from the lungs carried blood to both the right and left ventricles. Aristotle like Galen carried out numerous dissections on animals and perhaps very few on human bodies and may have made anatomical conclusions based on the animal dissections. Aristotle did, as did William Harvey, regard the heart as the central organ of the human body whereas Galen regarded the liver as the source of nutrients for the body and therefore regarded the liver as the central organ. This assumption contributed to further errors in Galen's work.

[16] Aristotle, *De anima,* II, 4, 415b7-20. Galen followed Hippocrates and Aristotle on the notion that the blood carried a certain type of vital spirit to the body parts. Galen called this vitality pneuma which meant either the inspired air or one of the three kinds of spirit: natural, produced by the liver, vital, produced by the heart and psychic produced in the brain and in each case carried by the corresponding veins, arteries or nerves to the extremities of the body.

[17] Galen: **On the Natural Faculties**, tr. By A.J. Brock, M.D., Harvard University Press, 1952. See page 321 on Galen's description of the blood passing through the septum. He does express the difficulty of seeing the perforations in the septum but holds to this conclusion. An Arabian physician, Ibn an-Nafis, in the 13th century, according to Wilson (1962) appears to be the first to reject Galen's contention that the interventricular septum is pervious. Vesalius would support this in the 16th century although probably unaware of Ibn an-Nafis' rejection.

[18] **Galen on the Usefulness of the Parts of the Body(De usu partium)**, op. cit., Professor May's commentary on Galen's anatomy and system of physiology , pages 39 – 64 highlight the increase in error of Galen's work as he moved from anatomy to physiology. A.J. Brock, MD, **Galen on the Natural Faculties**, op. cit.., on pages xxiv - xxv offers as an opposed viewpoint on Galen's work. Galen "was much more than a mere compiler and systematizer of other men's work: he was great enough… to present the whole in an articulated 'system'…"

find passages through the interventricular septum going from the right to the left ventricle, still offered this as the only possible explanation of the movement of the blood from one ventricle to another. This reveals a lack of development of Galen's thinking that he would be so astute about observation and yet, at the same time, refuse to accept the evidence of his observation regarding perforations. It is as if he decided that there could be no other way so he *settled* for this explanation.[19]

Let me not provide the notion that Galen was inadequate generally as an anatomist. In many ways his anatomical observations and descriptions were quite adequate.[20] Though he was humble in certain ways even though at times his writings manifest arrogance. Galen held that there were three *souls* or *pneuma* in the human body, 1) the brain, 2) the heart and 3) the liver. He referred to these three parts as having a faculty, a function, but in stating what he thought the function or faculty was he admitted: "So long as we are ignorant of the true essence of the cause which is operating, we call it a faculty…. and in each of the other parts a special faculty corresponding to the function or activity of that part."[21] Here Galen is making a distinction between description and explanation although he may not have understood that distinction in terms of contemporary science. And if he was aware of this distinction he seldom went beyond describing his observations except when he made assumptions because his observations would not provide an answer. Galen's error would stir William Harvey 1300 years later to correct these errors and these corrections would not only help anatomy but set physiology on a more exacting path. Harvey's effort to correct Galen's work forms a connection between these two periods of medical history that are relevant for this overall study.

The Greek Context 700 BCE – 165 CE

In order to understand Galen's error it is necessary to understand the intellectual system and climate in which he functioned. Historians of western philosophy put the origins of philosophy in the Ionian culture of the 6th century BCE. Thales is considered the first

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[19] **Galen on Anatomical Procedures**, (De Anatomicis Administrationibus) tr. by Charles Singer, Oxford University Press, 1956. Singer's introduction outlines 4 different schools of medical thought; 1) Pneumatic, 2) Methodist, 3) Dogmatist, and 4) Empirics. Singer places Galen in the Pneumatic school but because Galen moves into the dogmatist school from time to time, the "ratiocinative" (given to theoretical reasoning), Singer states that Galen is more appropriately placed in between the two schools. Regarding human dissection, Singer points out that Galen may have had access to human dissection but the mood of society at the time concerning such things prevented him from publishing on the matter. Singer points out (page xxii) that Galen made certain statements about human anatomy that would have required some human dissection experience.

[20] Galen's description of the liver and its functions were quite sophisticated for his time. Even though inaccurate in some cases without chemical knowledge and a microscope he did have some notion of the detoxifying function of the liver. Today we know that the liver carries out over 500 functions, most important being the detoxification of the blood. As a further example of how anatomical descriptions have stood the test of time Henry Gray's text, **Gray's Anatomy** published in 1858 has had 40 editions and was last published in 2008. It has been revised and kept up to date and much of its fundamental work is still relevant and used today by medical students.

[21] *De nat. fac.,* I, 4 (Kuhn, II, 9-10; Galen [1928, 16, 17]; translation by A. Brock. See Margaret May, **Galen on the Usefulness of the Parts of the Body (De usu partium)** op. cit., page 49-50 for her discussion of Galen's notion of faculty.

philosopher meaning that he attempted to determine the natural causes of phenomena rather than attribute such events to the gods. From the Homeric period of the 8th century BCE through to Euripides you have the expression of questions and events of life reflected through poetry and drama. A mood was slowly developing that was replacing the mythic views of Greek minding. The 5th century BCE would bring forth the thought of Socrates through Plato's dialogues, Plato's work and thought, the medical writings of Hippocrates and in the 4th century BCE, Aristotle's opus. You have here a period of approximately 7 centuries of intellectual stimulus prior to the medical work of Galen. It was a gradual move towards refining ways of understanding nature and the world.[22] This movement comes to its peak in Aristotle's work. Unfortunately, commentary rather than development would follow Aristotle's work.

Aristotle was an experimenter and an observer and he attempted to discover the causes of what he observed. Galen was influenced by Aristotle's method and biology, although he did offer what he considered corrections of Aristotle's work in biology from time to time. The more relevant point is that this exercise of experiment, observation and description was becoming an accepted practice by those involved in any intellectual effort to understand nature. The study and practice of medicine, from Hippocrates, 700 years before Galen, to the 2nd century CE, was a shift in focus that can be traced from Hippocrates to Aristotle to the medical clinicians and experimenters and finally to the application of their thought and work within the Mediterranean community of those times. This influence did not last. It is perhaps all too easy to blame the fall of the Roman and Greek cultures on the fact that this line of development did not persist.

A deeper analysis of the system that had emerged over the previous 700 years might offer another explanation. The philosophical and scientific systems that had been developed failed to resolve all the questions that had been raised. If Aristotle's system appeared to reach the heights of Greek reflection and answer many of the questions that the Pre-Socratics and Plato raised and struggled with, it did not rise to an explanatory account of nature or an explanatory differentiation of procedures. Questions of a philosophic nature would be partially answered by Aquinas of the 13th century and Lonergan more fully in the 20th. Aristotle's notion of science and the universal would have to wait until the 16th century before it would be challenged although even the response of that era was inadequate. An adequate response would have to wait another 400 years. If Aristotle was familiar with insight, he failed to provide an adequate explanatory account of its procedures and implications for a philosophy of science. What prevailed and what the clinicians inherited of this time and after was an emphasis on experiential conjugation. When Galen shifted into physiology or when he was unable to explain how the blood moved from the right to the left ventricle, he resorted to assumption without evidence. Was this the result of his understanding of Aristotle, his particular mindset or the Greek mindset of his times? It is difficult to assess and perhaps a bit of all three. But what is prevalent is an incomplete account of human

[22] Even with this emphasis on the intellect Socrates, Plato and Aristotle all had a place for the Greek gods in their work and system. Aristotle was familiar with the act of insight and his distinctions of the 5 causes express a possible familiarity with the different modes of questioning.

cognition throughout the Greek culture of this time. This incomplete account would leave the work of any great thinker at the mercy of those not as adept as he or she, in this case, Aristotle and 500 years later Galen. The fall of the Greek culture and the Roman Empire would have been a catalyst to a system already in the hands of lesser minds.[23]

The 16th and 17th Centuries

It would be 1300 years before the medical texts of Galen and the classics of the BCE Mediterranean cultures would resurface and offer an impetus for further development through the emergence of the physical sciences in Europe.[24] In the 15th and 16th century Galen's work and the Greek classics were being translated into Latin. In Persia, which was a cross roads for much of the cultural and literary works from East and West, the Greek texts of Aristotle, Hippocrates, Galen and much more were translated into Arabic in the Middle Ages and these works laid a foundation for medical education and practice in the 16th century. Avicenna (11th century Iran) wrote 150 treatises on philosophy and 40 on medicine based much on the works of Hippocrates and Galen. His best known works on medicine were *The Book of Healing* and his *Canon of Medicine*. These texts were used in the Medieval Universities until the 17th century.[25]

Over the next century Galen's work would be translated into German and French and in the 20th century into English. These translations would have a significant effect on the medical researchers and practitioners in the European universities of the 16th century.

William Harvey, a medical researcher, was connected to the University of Padua in the 17th century. Padua had for some time been moving towards a more secularised environment in that it attempted to function outside the influence of Christianity and focused more on the physical sciences of Aristotle rather than his theological implications or applications. Padua had had a series of influential people working and teaching there during the 16th and 17th centuries

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[23] Butterfield states that there is a pattern in history in which great thinkers are seldom followed by a group that can adequately understand or add to that development. The transformation of the Roman Empire was only partially due to the constant invasions from the "Barbarians" and interstate fighting and rivalry. It was brought on not only by disintegration from within which came to a head in 476 AD but also by numerous events occurring throughout the entire continent such as the rise of the Germanic tribes, the cost of maintaining the Roman military, the loss of a tax base, and more. See Peter Heather, **The Fall of the Roman Empire**, 2005 and Peter Brown, **The Making of Late Antiquity**, 1978 for presentations and analysis of various views on the causes. Many historians today view the fall as a transformation of culture brought on by many interacting events throughout Europe and the Middle East.

[24] **Galen on Anatomical Procedures** (De Anatomicis Administrationibus) op. cit., Introduction page xxi. Singer notes that no recorded dissections occurred between Galen's death and the first printing of the Greek text in 1538 therefore if anyone had had access to the text, they would have had no reference to assist in understanding it. The scribes who translated the works had no understanding at all of its contents. Dissection again became a practice in the 16th century.

[25] In the Arabic culture Avicenna's works overshadowed Galen's for 4 centuries. His system was deduced as a logical sequence from theoretical premises rooted in Galenic and Aristotelian thought.

such as Vesalius, Fabricius, Copernicus and Galileo.[26] Padua's atmosphere provided for its professors and students an atmosphere of openness and empirical rigidity towards attempting to understand nature.

In the 16th century Andreas Vesalius (1514 – 1564) was a Flemish anatomist, physician, and author of one of the most influential books on human anatomy, *De humani corporis fabrica* (*On the Structure of the Human Body*). Vesalius is often referred to as the founder of modern human anatomy. He disagreed with Galen on his description of how blood could pass through the interventricular septum of the heart that divided the ventricles but failed to work out the actual circulatory path of the blood or how blood passes from one ventricle to the other. William Harvey would do so and in doing so he combined his observations and descriptions with an insight. There are no perforations in the septum,[27] so there had to be another route. If Galen had had a more developed notion of the process of explanation and verification he might have discovered what Harvey discovered 1300 years later and not resorted to assumption.

Harvey was also not satisfied with Galen's work on the circulatory path of blood in the human body. In rejecting Galen's "belief" that the blood passed through the interventricular septum of the heart from the right to the left ventricle, he looked elsewhere.[28] In 1574, Fabricius had published a work on the valves of the heart and concluded that the veins were carrying blood back to the heart. This was against everything up to that time as it was thought that all blood rushed away from the heart. An Italian author, Cesalpino, before Harvey, did disagree with Galen and his work was published posthumously in 1606 though he had not managed to outline the circulatory system.

The influence of these former writers, and Harvey's insightful rejection of Galen's "belief" that blood passed through the septum, provided the impetus to explain how blood did get from the right to the left ventricle. Apparently it was his teacher, Fabricius, who had worked on the positioning and direction of the heart valves that finally assisted Harvey in working out the directions of blood flow and eventually the blood's path from the right ventricle to the lungs,

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[26] Butterfield, ibid. p. 48. Butterfield states that Padua was the seat of the scientific revolution as he, Butterfield, understood those terms.

[27] In the interventricular septum of the newborn infant's heart there is a small "hole" (foramen ovale) that usually closes shortly after birth. This "hole" allows blood flow from the right to left ventricle during fetal development as the lungs are not yet functioning and oxygen is delivered to the fetus' blood through the umbilical cord. Often this hole does not close after birth and heart murmurs are the result of an excessive workload on the heart. This hole also causes oxygen poor systemic blood to mix with oxygenated pulmonary blood which is delivered to the body tissues which is detrimental to the proper development of the child's body. Today the foramen ovale can be closed through surgery although it is not usually carried out until the infant reaches the age of two providing time for a possible natural closure. In extreme cases surgery might be carried out earlier. Genetic testing may reveal gene mutation as affecting the closure. Galen may have observed this opening in his dissection of infant monkeys but it should not be observable in the adults.

[28] For a full account of Harvey's description see: Harvey, William; Translated by Kenneth J. Franklin. Introduction by Dr. Andrew Wear (1993). *The Circulation of the Blood and Other Writings,* London: Everyman: Orion Publishing Group.

back to the heart's left atrium, then through the valves and into the left ventricle and then out to the body returning eventually to the right atrium.

What has been going forth in these two medical periods separated by 1300 years of medical stagnation that I have been outlining? In the Greek culture there was a focus on experimentation, observation and description that ends with Galen's work. When Galen moved into physiology many of his conclusions were assumptions. He did not push the **Is** question. Harvey's rejection of Galen's assumption led Harvey to look further. You have a movement away from assumption or conjecture to a more empirical and critical approach. If the blood could not pass through the septum and yet did get from the right to the left ventricle, there had to be another "correct" explanation. Harvey invoked logic in that shift, but his logic was rooted in the concrete, the empirical and the desire to understand correctly. What could be verified in the data? He was pushing the **Is** question. All along the observing is intelligent as long as it remained descriptive. The refinement of observation and description in the Greek age led into a period of the 16th and 17th centuries to a more critical approach towards experiential conjugation and anatomy. The **What** and **Is** questions were going to become a more prominent context for the desire to understand. There was an additional occurrence in this period that would contribute to this emphasis on empiricism.

Accompanying Harvey's discovery in the 17th century is the work of Robert Boyle as well as the use and influence of Francis Bacon's scientific method which was slowly bringing about the demise of Aristotelian science. The notion of the universal was slowly passing, but more importantly at this time the four elements of earth, water, air and fire were being challenged by theories of particles within things. Boyle referred to these particles as corpuscles. This "idea" made two contributions to the evolution of scientific enquiry. The first being a more critical approach to data and the second being a contribution towards chemistry and eventually the formation of the periodic table.

But what of the system that Harvey worked within? If Aristotelian science was being replaced by Bacon's view of science, what was new and did it respond to the unanswered questions of Greek science? Two main aspects that were being repudiated were; 1) a traditional metaphysics, and 2) the elimination of supernatural or superstitious causes of events. There was no place for gods in 17th century science as there had been in the antiquity of Greek philosophy. The astrologers and alchemists of the 16th and 17th centuries were still lurking in the wings but people such as Boyle[29], Kepler, Newton and Lavoisier were seeking the laws that functioned in nature and events. Although positivistic and materialistic in approach, such a focus did serve to keep superstition at bay and discover laws, some of which would stand the test of time or aid in an advance in a particular field. Witness Boyle's law of pressure and volume, Kepler's laws of

[29] Robert Boyle did involve himself in his early life with alchemy but gradually let it go. Alchemists were experimenters and it is worth noting that their experimentation did provide methods of experimenting to even those who did not hold with alchemy.

planetary motion, Newton's laws of gravity and Lavoisier's discovery of patterns and organizing of a list of some of the chemical elements.

A brief discussion of causes and laws will help in understanding the differences in these two systems of these two periods in history and how it influenced the direction of future anatomy and physiology. A cause is an explanation of an event or an occurrence. I will not venture into statistical method here, but it does bare relevance in terms of occurrence. Let us stay with the single event and the nature of causes and laws.[30] The notion that there were laws governing the events in nature was fast becoming a major influence in the science of the 16th and 17th centuries. Laws add to causes and an explanation is the cause of an event but laws provide further data helping to reach an even more adequate explanation of an event. It is one thing to say that bodies fall towards the earth due to some *attraction* between the two bodies. It is quite another thing to explain what that force is in terms of acceleration and velocity. It is still another to say that all objects on planet earth fall in a vacuum at 32.2 ft/s squared. (9.81 m/s squared) What the laws add to the causes is not only a more adequate explanation of data but also the ability to recognize anomalies more easily and develop statistical data of the occurrence of these anomalies. This said we can distinguish between Aristotle's emphasis on causes and in the 16th century and beyond, an emphasis on the patterns inherent in nature and then formulated into laws by the human mind. Does this form a connection between these two time periods? If not for the emphasis on experimentation, observation and description with a view to understanding, which was a focus of the Greek period, would the 16th century have been able to discover the notion of laws? The 16th century was adamant about bringing Aristotle's heavens down to earth and in doing so it emphasized, or refocused observation onto the data of the senses. The eventual invention of the microscope would contribute to an expansion of data but also to a more sophisticated reductionism. A sharper focus on data and patterns in data would seem to have led researchers to go deeper "into" the data and in doing so, discover recurring patterns in recurring schemes of recurrence-laws. It is not just the discovery of laws that is so paramount, but the discovery of the notion of law that is far more important.

The significance of the discovery was that laws were understood to govern the events in nature. The Aristotelian system acknowledged the existence and types of causes[31] but did not follow through to explanatory causes nor did it discover laws that were verifiable in experience. The distinction between causes and laws was not formulated, but the search and discovery of laws in the 16th century enabled advances in the various sciences. Unfortunately, the relationship between causes and laws would not be worked out adequately until the 20th century.

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[30] **Insight**, op. cit., chapter 3, section 4.1, *Classical Laws* and experiential conjugation. See also pp. 640-642 on the nature of the difference between the laws of matter and the laws of consciousness.

[31] Aristotle, *De anima*, II, 4, 415b7-20. The efficient, formal and final causes of the body were understood to be the soul. This is not an explanatory account of how the soul functions as a cause.

Galen and Harvey's Different Contexts

It would be quite easy to state that Harvey made the leap he made in understanding the circulatory system of the blood because he was *brighter* than Galen. Such a response would shift our focus away from theory into the common sense horizon and offer an inadequate response. Galen was educated in the peripatetic school.[32] Galen was "familiar" with the Greek intellectual tradition as well as Hippocrates' works. Harvey was familiar with both Galen's writings and also with Aristotle's writings. Both men worked and lived in times when intellectual activity was promoted. But in Galen's time it was beginning to wind down whereas in Harvey's time it was just beginning to take off. The Dark Ages saw medical research stagnate and medical practice continued on with little or no development. The fall of the Roman Empire would change the face of Europe and, in doing so it contributed to the stifling of the intellectual spirit which had dominated the Greek culture for over seven centuries. The Renaissance was a resurgence of a similar spirit but it was driven, in part, by an effort to put an end to Aristotelian science, a more rigid empiricism and a focus on not just the causes of events but the laws governing those events.

What was lacking in Galen's approach to anatomy? Galen, even though he had studied in the peripatetic school, did not assimilate Aristotle's system in the way that Aquinas would ten centuries later. Galen was not a methodologist in the philosophical sense of the word. He was an observer, a practitioner, who became quite apt at dissection and experiential conjugation. His contribution to medicine did not reach anywhere near the heights that Aquinas did in philosophy.

Galen's work on dissection did save some work for the medieval anatomists and influence the direction that biology would take in the future. Harvey's approach using Bacon's notion of scientific method was still lacking in the explanatory view but advances were made. The inadequacy in both systems was an incomplete and inadequate account of the cognitional heuristic that would have provided a foundation for explanatory science and scientific method.

In other words, the education system and culture that these two men experienced did not provide an account of their own intellectual operations. The full rectification would have required an adequate theory of knowledge, development and history as operative in the schools and universities. The line of development, with its shortcomings, in medicine and in the systems contextualizing medicine that I have traced from 8th century BCE Greece to 16th century Europe provides a glimpse of the pace of development when an inadequate system is operative. There are relationships between the two systems and the later one does feed off the earlier. But the feeding, although grounded in a desire to understand, is obfuscated first by efforts to end one

[32] The peripatetic school usually refers to Aristotle's habit of walking about as he was teaching. Galen in fact preferred to be dissecting while he taught. It gave his students firsthand experience of what he was talking about. Galen having been educated in the Peripatetic school was influenced more by Stoicism and that demonstration was a form of syllogistic reasoning. Fred Copleston, **A History of Philosophy**, (1993) Image Book, NY, Vol. 1, page 427. A reading of Galen's work supports this position. Galen dissected while teaching and describing the procedure and parts.

system and secondly by the lack of an adequate cognitional theory that would have obliterated the unacknowledged dualism and set the limits of experiential conjugation.

A development has occurred linking the two periods of history separated by 1300 years. Galen's emphasis on experiential conjugation is assimilated into Harvey's work, partially through the influence of the Baconian view of scientific method creating a more empirically refined approach towards data, patterns and anatomy. It would have also reinforced the need to verify observations, an objectification of the **Is** question even though researchers were not fully aware of the distinction between experiential conjugation and verification as conscious operations. In that way, the objectification was inadequate. Awareness of this would have set the scientific revolution as Butterfield describes it in a quite different direction. The next four centuries would provide advancements in chemistry and technology that would set the stage for a more systematic account of human anatomy and physiology.

Twenty-first Century Medicine[33]

Let us now move to a discussion of contemporary medicine. To begin let us do a brief "image-read" through a quotation from a contemporary text on the anatomy of the heart[34] in order to expose our own processes as well as the processes of the writer.

The heart has four chambers, two superior atria and two inferior ventricles. The internal partition that divides the heart longitudinally is called the interatrial septum where it separates the atria, and the interventricular septum where it separates the ventricles. The right ventricle forms most of the anterior surface of the heart. The left ventricle dominates the inferoposterior aspect of the heart and forms the heart apex.

Two groves visible on the heart surface indicate the boundaries of its four chambers and carry the blood vessels supplying the myocardium. The coronary sulcus, or atrioventricular groove, encircles the junction of the atria and ventricles like a crown. The anterior interventricular sulcus, cradling the anterior interventricular artery, marks the anterior position of the septum separating the right and left ventricles. It continues as the posterior interventricular sulcus, which provides a similar landmark on the heart's postoinferior surface.[35]

When I am reading anatomical descriptions of the cardiac system I create or envisage an image in my mind of the "parts" being described. As I move along I continually adjust or revise the image to fit the meaning of the description being offered. The image at this stage is of "seen" parts but eventually the writer moves "inside" the heart to discuss valve action and blood

[33] My exclusion of the period between the 16th and 20th centuries is not a judgment of its lack of contribution to medical science. This period was one of a great many advances but would require much more than an essay to elaborate. The positivism dominating the 16th century prevailed through this period as it does today in medical research indicating that the system contextualizing medical research remained unchanged.

[34] Elaine Marieb & Katja Hoehn, **Human Anatomy & Physiology**, 8th edition, Benjamin Cummings Pub., 2010, chapter 18: *The Cardiovascular System: The Heart*.

[35] **Human Anatomy & Physiology**, ibid, page 664.

movement through the 4 chambers. I can either imagine what the description would be like or seek out diagrams to assist my imaging. When I am reading this section the images become more complex but description is still apparent in the writing by the author. If you have experience of human dissection your images would be of recalled visual images. My images are created by the meaning I create from the writer's words combined with the diagrams offered in the text. The focus is on description and few questions of an explanatory nature emerge in the writing or reading of the text.

When I reach the section in the chapter on physiology I have to bring the image forward from the anatomical readings as the effort now by the writer is to describe processes and relate those processes to the functions of the other parts or processes. There is also an effort at homeostasis, a relating of each process or function to the heart as a whole functioning organ and system. In order to achieve this, the author begins a discussion of the ionic processes involved in the functioning of the heart. At this point images become much more complex as the author discusses the conduction system of the heart. This involves a description of the source of the ionic pulse that initiates the contraction of the heart muscles. Three ion channels, potassium K+, Calcium Ca2+ and sodium NA+ function in unison in order to properly provide the depolarization and repolarization of the sinoatrial (SA) node in the right atrium. The opening and closing of ionic channels will vary depending on the demands of the whole body system.[36] The ionic activity functions towards creating an ionic charge that is distributed throughout the heart muscles via the atrioventricular (AV) node resulting in a contraction of the heart muscles in a well-orchestrated sequence so that all 4 heart chambers function in unison to move the blood in and out of the heart's chambers simultaneously. Let me quote from the physiology text itself regarding the conduction process of the SA node.

…the autorhythmic cells making up the intrinsic conduction system…have an unstable resting potential that continuously depolarizes, drifting slowly toward threshold. These spontaneously changing membrane potentials, called pacemaker potentials or prepotentials, initiate the action potentials that spread throughout the heart to trigger its rhythmic contractions.

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[36] Genetic research has shown how gene mutation affects the QT repolarization of the sinoatrial node which can lead to sudden cardiac death. See *Recommendations for the Use of Genetic Testing in the Clinical Evaluation of Inherited Cardiac Arrhythmias Associated with Sudden Cardiac Death: Canadian Cardiovascular Society/Canadian Heart Rhythm Society Joint Position Paper* by Michael Gollob, Louis Blier, Ramon Brugada, Jean Champagne, Vijay Chauhan, Sean Connors, Martin Gardner, Martin Green, Robert Gow, Robert Hamilton, Louise Harris, Jeff Healey, Kathleen Hodgkinson, Christina Honeywell, Michael Kantoch, Joel Kirsh, Andrew Krahn, Michelle Mullen, Ratika Parkash, Damian Redfearn, Julie Rutberg, Shubhayan, Anna Woo. Canadian Journal of Cardiology, Volume 27, Issue 2, pp. 232-245, March 2011. The article outlines the role of genetic testing in various clinical scenarios, the specific genes to be considered for testing, and the utility of test results in the management of patients and their families. (Abstract) For similar collaboration in medical research see footnote 62. Genetic research will probably dominate medical research for some time. Presently, technology such as the pacemaker and pharmacology are utilized to stabilize irregular rhythms of the heart due to genetic mutation and other aetiologies.

The pacemaker potential is due to the special properties of the ion channels in the sarcolemma. In these cells, hyperpolarization at the end of an action potential leads to both closing of K+ channels and opening of slow Na+ channels. The Na+ influx alters the balance between K+ loss and Na+ entry, and the membrane interior becomes less and less negative(more positive). Ultimately, at threshold (approximately -40 mV), Ca2+ channels open, allowing explosive entry of Ca2+ from the extracellular space. As a result, in autorhythmic cells, it is the influx of Ca2+ (rather than Na+) that produces the rising phase of the action potential and reverses the membrane potential.

As in other excitable cells, the falling phase of the action potential and repolarization reflect opening of K+ channels and K+ efflux from the cell. Once repolarization is complete, K+ channels close, K+ efflux declines, and the slow depolarization to threshold begins again.[37]

What was it like to imagine the ionic processes expressed in this quotation? You might compare this reading from a section on physiology, with the reading quoted earlier from the same text on anatomy. Our ability to create adequate images, functions and relations would be inhibited or assisted by three areas of understanding; 1) our anatomical knowledge of the heart, 2) our understanding of chemistry and its interaction, 3) our understanding of medical terminology, and 4) our understanding of cellular composition. As an exercise try reading through this quotation line by line 2 or 3 times pausing after each line in an attempt to distinguish between when you are creating images and when you are attempting to imagine functions and relations. You should have found it difficult to imagine functions and relations. Did you? If so, it is because you are moving away from imagining and towards explanation, not necessarily there yet, but at least towards it. You may have an image of a cell or of ionic processes but explaining the interaction between potassium, sodium, and calcium ion channels may be a different process for you. Was it? See the Appendix for a diagram that should assist you in providing a more adequate image of the pathway of the process of ionic induced contraction of the heart muscle but obviously not the relations between the ion processes described in the quotation. What is the difference between the "seen" diagram and the meaning you may have achieved from the quotation? Is the above quotation descriptive or explanatory? This "description" of the cellular interaction in the heart describes the source of the pulsating visual heart. So, descriptive underlying schemes of recurrence assist in explaining imaginable or visual events occurring on a higher level of organization, in this case, from cellular processes to organ functioning. But is it an adequate explanation? The following few questions reveal some of what is missing. 1) What is an unstable resting potential? 2) What process brought that potential into existence? 3) Is its instability a systematic requirement? And one can go on.

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[37] **Human Anatomy & Physiology**, op. cit., page 676. A comparison of this conduction process and the physiology of Galen and Harvey would seem incomparable. Galen and Harvey compared functions of seen parts without knowledge of underlying processes. The discovery of the patterns of elements outlined in the periodic table in 1869 and the invention of the electron microscope in 1931 made it possible to provide images of macromolecules enabling an understanding of underlying processes. In essence they were all attempting to understand heart function.

Researchers are *aware of a distinction* between description and explanation but not in terms of their own operations therefore their distinction is blurred and they move back and forth between description and explanation often unknowingly without a systematic control of one or the other.[38] When the distinction is understood in terms of the researcher's own operations a more exacting clarity would be provided offering the foundation for a heuristic view of development. For present purposes in terms of exploring effective strategies of communication these distinctions need be made in the mind of the communicator. With this lack of distinction in mind what form of system contextualizes contemporary medical teaching, research and practice?

Twenty-first century medical researchers are taught *procedural* methods of doing research and accept as the standard model not just the methods they study and work within but also views on reality which remain unquestioned. Do they reflect on the cognitional elements involved in such work? Modern medicine does have at its disposal the standard model of chemistry in the periodic table, a reasonably adequate descriptive account of anatomy and physiology as well as numerous discoveries and advancements in technology. Medical researchers and physicians still lack an explanatory account of their own operations, an understanding of the tri levels of the human subject and their interplay.[39] A genetic account of development of the six-levelled subject is still wanting.[40] Coupled with conceptualism, medical research and practice are further restricted by a deductive positivism.[41] Development and results

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[38] **Insight**, op. cit. page 104. "Thus, one would be inclined to say that physicists move easily and unconsciously back and forth between the use of experiential and pure conjugates." This lack of distinction in terms of the researcher's own operations is manifested in much of contemporary science.

[39] William Zanardi; *Scratching the Surface of the Future*, Unpublished paper presented at the 2012 Halifax Lonergan Conference on the various activities, functions and relations of neurochemistry to the occurrence of conscious acts. Zanardi's approach is not just an effort to discover the method of working out these relationships between neurochemistry and psychic events but also an attempt at effective communication within the context of generalized empirical method with neuroscientists. See also Candice Pert, **Molecules of Emotion: The Science Behind Mind-Body Medicine**, Touchstone, NY, 1997 for a study of the relationship between biochemistry and consciousness. Pages 184-189 for what Pert understands as a major paradigm shift in medical science. To date it is only a possibility.

[40] As much as physiology attempts to explain how the parts of the body function and relate to other parts much of physiology is an ongoing refinement of description of anatomical observations. Inventions, such as the electron microscope, periodic table, scanning techniques and cellular understanding coupled with theories in electrodynamics have provided an immense field of data to be studied. At the same time because it is dominated by positivism coupled with a lack of a genetic understanding of development and method physiology attempts to account for emotional states in a purely chemical and physical manner. See Lauralee Sherwood, **Human Physiology: From Cells to Systems,** 7th Edition, Brooks/Cole Learning, 2010, page 157. "Events perceived as being stressful can trigger depression, but the underlying link has not been determined." See page 158 for a discussion of storing concepts awaiting retrieval. The author goes on to discuss how humans learn using the analogy of how a dog is trained to urinate outside one's home. Both statements are strictly positivist and behaviourist in their approach towards development and reality inhibiting the discovery of the functional and integrative relations between the psyche and chemistry of the human body. These views are what current medical and nursing students "learn" in the classroom as well as from their contemporary medical texts in anatomy and physiology.

[41] Royal College of Surgeons of England; College of Anaesthetists; *Report of the working party on pain after surgery.* London: RCS; 1990. "Concern about overestimating pain and overprescribing analgesics deters clinicians from treating pain adequately. A possibly greater deterrent is that, to understand pain better, clinicians have also to think partly in non-positivist ways: to accept patients' subjective views and see pain as more than physical, involving the mind as well as the body."

occur but not within any suspected context of a fully systematic system or a genetic explanatory account of ontic or phyletic development.[42] These additions to the field of medical research would increase the probabilities of a science that contributes to emergent probability in a cumulative and progressive manner. It would provide the heuristic of development in as much as a researcher would be able to anticipate the structure of what is to be known. With these developments what Butterfield and scientists of today understand by science and the scientific revolution would be understood as a precursor to a systematic scientific revolution that would initiate systematic development.[43]

Reflecting on the Process

I bring forward Lonergan's quotation from the first page of this essay as a way of reflecting on what I have attempted.

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[42] Lauralee Sherwood, **Human Physiology: From Cells to Systems,** op. cit., page xxi. In Sherwood's Introduction she states that she focusses on *homeostasis* (how one body system fits into the whole body system) in an attempt to show the relationship among cells and systems. This attempt is compromised by a later statement of her difficulty in deciding the order of the chapters on various physiologic processes. (Page xxiii) That difficulty would be reduced by an explanatory account of genetic development within the context of an account of the ontic and phyletic development of human evolution. In the explanatory mode if distinguished in the operator/researcher's own mind the heart disappears and the genetic account provides the possibility to imagine a better heart than evolution has provided to date. See Alan Templeton, *Has Human Evolution Stopped?*, June 2010, Vol. 1 Issue 1*, Rambam Maimonides Medical Journal* for a discussion of the future of evolution and reasons why Templeton understands evolution to be ongoing. Within the context of emergent probability as an explanatory account of evolution beyond natural selection, mutation and adaptation, the heart is still evolving. Templeton's view of evolution is positivistic and he is not acquainted with the dynamism towards finality of intelligibility. A genetic historical account of the evolution of the heart would provide the needed heuristic to anticipate possible developments. The key issue here is whether or not an adequate genetic understanding of the heart is present in contemporary medical science providing the possibility of an evolution in the understanding of the heart and of the researcher's operations. There is needed a distinction here between the foundation of evolution and the development or adaptation of organs and organisms. The genetic code has not changed for billions of years but the emergence of organisms, genus and species in providing a solution to existing within an environment is ongoing. The first organisms with a simple circulatory system including tissue that helped pump the fluid were protostomes in the Lophotrochozoa (Molluscs, Annelids, and Arthropods). It is believed that this occurred sometime in the Cambrian period, about 600 million years ago--or possibly even earlier. Sensory systems appeared sooner than a circulatory system and even the simplest animals (Radiata) had nervous tissue that eventually gave rise to sense organs and sensory systems.

[43] Research in oncology, immunodeficiency, forms of dementia, microbiology and the genome project (which could help physicians achieve insight into the body's emergent properties) would profit from a system that accounts for the ontic and phyletic development of gene and cellular evolution. This study is a history of medical development which at this time in history need be distinguished from a systematic history of development of a gene, a cell or an organism which would entail a quite different and far more sophisticated study in the various sciences. As much as these two studies are distinct they are related. A systematic understanding of the development of an organism in terms of its ontic and phyletic development would contribute to a development in the methodological approach to medical research that would create an increase in the probabilities of success due to the heuristic character offered by the former development. This development in methodical research would in turn transform the future of medical research into one of a higher control of meaning to be written as part of the history of medicine in some future time. See McShane's *Insight and the Strategy of Biology*, op. cit., p. 59 for a discussion of the contrast between the present history of biology and a history of development of biological processes.

Clearly, therefore, the historian of any discipline has to have a thorough knowledge and understanding of the whole subject.[44] *And it is not enough that he understand it any way at all, but he must have a systematic understanding of it. For the precept, when applied to history, means that successive systems which have developed over a period of time have to be understood. The systematic understanding of a development ought to make use of an analogy with the development that takes place in the mind of the investigator who learns about the subject, and this interior development within the mind of the investigator ought to parallel the historical process by which the science itself developed*.[45]

I have attempted in this brief essay to determine the nature of the systems that have contextualized different periods in the history of medicine and whether those systems had the potential for development. I began with numerous readings and texts by the medical people involved and the philosophical sources that influenced those people. In coming to a renewed understanding of the heart I gathered texts on the subject and puzzled over images and later functions, processes and relationships between the parts. It was a movement of development from data as images to questions about functions, processes and relationships, to some insights into those functions, processes and relationships and finally to some conclusions about the functioning of the whole organism. I could only understand what Galen and Harvey were up to once I had achieved some understanding of the heart revealing the need to understand the whole subject if one is to understand the past and the system that contextualizes that work. I could understand the system once I understood their quests, the type of insights they achieved and the nature of their formulations. In grasping their own operations I was able to ascertain the manner in which their mental operations were used and only then reach an understanding of the system within which they were operating. All of this enabled me to achieve some understanding of the mentality and type of consciousness that they were operating within and the types of questions they were asking.

The issue now is to ascertain what, if any, contribution(s) this essay may offer to medical history, medical science and the study of a sequence of systems. The single contribution lies in my attempt to understand whether or not the system a medical researcher is working within is developmental. One must have a *systematic* understanding[46] of the particular science in question if one is to make any judgment on the system as it existed in the past and in order to determine what was inadequate and what was developmental. Galen's "system", highlighted experiential conjugation, Harvey perfected Galen's descriptive ability and made corrections in Galen's work.

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[44] I would not claim to have extensive knowledge of medical science. Keeping abreast of the issues I had to deal with when teaching medical ethics was an enormous task. I did find that student discussions relating to medical issues remained within the descriptive category.

[45] Bernard Lonergan, *De Intellectu et Methodo,* p. 55. **Understanding and Method**, tr. by Michael Shields, pp. 130-132. Herbert Butterfield attempts to offer an exposition of Harvey's work but it lacks the larger context of an analysis of the contextualizing system in his; **The Origins of Modern Science,** MacMillan, NY, 1960. (First edition 1949).

[46] A *systematic* understanding of a science is to be distinguished from an understanding of a science. The term systematic implies an explanatory account of the history and development of a science.

Neither system was explanatory. The descriptive approach exposes a naïve realism which still persists today in medical research. "Thus when studying the heart, the anatomist *studies it chiefly as a visual object and owing to our persistent naïve realism it is extremely easy to fall into the error of thinking of the visual heart as the very concrete heart itself."* [47] In over 2500 years of medical research the heart has never knowingly[48] "disappeared". To rectify this epistemological error is to develop strategies of effective communication concerning the role and function of the operations of the researcher in relationship to their data and the construction of their formulations.

What inhibition does "naïve realism" create in terms of development in medical science? Once a medical researcher moves into physiology he or she searches for the processes, functions and relations within and between cells, tissues and organs. The distinction between the data of sense and the data of consciousness as the source of a systematic understanding of processes, functions and relations and a control of the types of meaning remain blurred or neglected within the context of naïve realism.[49] Modern medicine in the west tolerates "talk" of such things. This is an offshoot of naïve realism. The relationships between the physical, chemical, psychic and intellectual levels are taken into account only at a minimal level. The study of human psychology and consciousness is tolerated but regarded as a "soft" science.[50] The implication being that it offers little, if any help in understanding the "real" issues of human anatomy, physiology, disease, diagnosis, prognosis and cure. In other words, the current system that contextualizes medical research is still unknowingly inhibited by the same issues with which Galen and Harvey were unknowingly inhibited. The challenge is to develop effective strategies of communication

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[47] J.H.Woodger, **Biological Principles**, London, 1948, page 328. Quoted in Philip McShane's article; *Insight and the Strategy of Biology,* chapter 3 in **Lonergan's Challenge to the University and the Economy**, University Press of America, 1980, page 46.

[48] By the use of the term knowingly, I mean that there have been explanatory accounts of some features of medical research that render the heart invisible, but the researcher is not aware of the disappearance or the meaning of that event. In understanding that meaning, an opportunity would be offered to distinguish between the data of sense and the data of consciousness and their relationship.

[49] J. Habermas has pointed out how positivism, as the denial of reflection, has scientistically monopolized methodology by negating the concerns with cognitional subjectivity in its theoretical and practical dimensions, and by concentrating upon an objectivistic theory of scientific inquiry. See **Erkenntnis und Interesse, (**Knowledge and Interest**)** Frankfurt, 1968, pp. 11-14, 88-92.

[50] **Insight**, pages 597-598 for a discussion of the biological and psychic levels as systems related and on the move as dynamic systems. In contemporary medical thought the "soft" sciences deserve that comment in as much as naïve realism has affected their development in a more negative way then it has the natural sciences. Medical researchers for the most are not aware of the epistemological problems in both the natural and social sciences associated with positivism. Different approaches emphasizing different views of the body and how to treat and heal the body are functioning in different parts of the world. The East and West are still divided on a basic medical approach. Positivism is dominant but some insights into holistic medicine are revealing. See Candice Pert, **Molecules of Emotion: The Science Behind Mind-Body Medicine**, Touchstone, NY, 1997, pages 18-19 on a holistic approach to medicine. A shift out of reductionism would eventually bring forth an appreciation of the integral functioning levels of the human subject and offer a way of integrating these approaches into a larger and more efficient medical system in line with the functioning of the human body. See my *Judgment, Reality, and Dissociative Consciousness*, in **Method: Journal of Lonergan Studies**, The Lonergan Institute at Boston College, Vol. 18, # 2, Fall 2000. For the full online text see http://roberthenman.com/articles/judgment.pdf

between those with an understanding of generalized empirical method and medical scientists assisting them in adverting to their own operations in relationship to their object and vice versa when they are doing research.[51]

There have been refinements in technology, in the specialized collection of specimens, laboratory methodology, scanning techniques, nanotechnology, biophysics, genetic research, gathering of statistical data, refinement of statistical methods and much more that assist in the accumulation and analysis of massive amounts of data for either research purposes or for diagnosis and prognosis. Technology has made available these massive amounts of data and understanding this data is an ongoing and challenging task. Clinicians today are encouraged to specialize as the field of medicine widens and differentiates into numerous subfields. General Physicians are challenged more and more to become referral specialists. To become a referral specialist one must have some *idea*[52] of the whole and what data the specialist will require to make their diagnosis. The suspected diagnosis requires not just a battery of tests but the referral to a specialist in the related area who will either confirm or revise the GP's suspicion.[53] A medical student today in the west spends eight years in the classroom, in the lab, in a hospital setting and then an internship as a resident and only then may he or she choose to specialize in a particular area of medicine usually for a two year period.[54] No student today can master the entire field.

If the limitations of present medical research are to be addressed and a turn to the operations of the researcher is to be initiated the question now is; how is this to be accomplished? This question raises the issue of strategies of effective communication within the context of an emerging appreciation of generalized empirical method (GEM) and functional collaboration. We are not there yet. One merely need imagine having the necessary background and sitting down with a medical researcher attempting to discuss the role of the human mind in medical research. What would you say and how would you say it?

Conclusion

The topic of "effective communication" is not isolated to the implementation of GEM into medical science or any science and this brings us to a central problem in Philosophical

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[51] Bernard Lonergan, **A Third Collection**, Edited by Fred Crowe, Paulist Press, 1985, page 141 on generalized empirical method involving the operations of the subject and the corresponding objects.

[52] I use the term *idea* here in a restricted sense. No GP can have a full *idea* of the whole in contemporary medicine. He or she can have some *idea* of the whole if he or she keeps abreast of the medical journals throughout their entire career. But the volume of work even in one field requires that one specialize. In such a necessary setup collaboration is the only manner in which medicine can progress and it requires communication between all collaborators.

[53] Hodgkin P., Medicine, postmodernism, and the end of certainty. *BMJ.* 1996; 313:1568–1569. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2359088/pdf/bmj00573-0004.pdf Physicians today are exposed to various paradigms that can obfuscate their methodologies. Positivism is further complicated in its own deficiency by theories on reality such as structuralism, social critical theory, postmodernism, and functionalism.

[54] Medical students are now, in some medical schools, being encouraged to choose a specialty earlier in their studies to meet the needs of society or the needs of a particular region.

Studies. These two different audiences call for different forms of effective communication. Central to both of these audiences is the need to lay foundations towards the eventual effort to communicate functionally and theoretically. In other words efforts of effective communication begin with who we are here and now with a view towards functionality, theory and collaboration. How does one get that across to philosophy students who for the most are not schooled in the sciences?[55] With or without a science background one can express even in question form what one understands and what one does not understand. Effective communication is existential and that has to slowly mount to a functional and theoretical level if it is to eventually have any probability of implementing generalized empirical method into the sciences.[56]

But one has to at least reach for or have some experience of theory to know that. Philosophers too often in speaking "about" theory quote Lonergan's definition that theory is the relating of things to things. That is a nominal definition.[57] It becomes an implicit definition when one has an experiential reference,[58] in other words, one has actually experienced doing theoretical work. It becomes an explanatory definition when one has that particular type of account of a science coupled with an account of one's own operations.

There are levels of process in the development of this essay that expose the process. There is the gathering of data and much of that data is historical facts. I had to put those facts into an order that was first chronological but later developmental through determining the relationships between the eras and systems which became for me a thread through history of a particular focus of medical research. That thread was the result of an insight that revealed that experiential conjugation has dominated medical research, writing, teaching and practice for 2500 years in the west.[59] I verified this insight by reflecting on passages in current physiological texts used in medical schools. Because the vocabulary is often highly technical, especially in the area

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[55] Effective communication within the context of functional specialization was a major aspect of the E-seminars directed by Philip McShane in an effort to manifest the experience and the need.

[56] This is the role of functional specialization in history. If functioning, even inadequately, it would eventually expose counterpositions and encourage positions. It would create a form of effective communication and collaboration within the sciences leading to higher controls of meaning and a higher probability of cumulative and progressive results. There is implied in the above statement (Effective communication is existential) a conversion of a psychological nature, that one overcomes the fear or dread of not knowing, something the child is free from but very quickly becomes intellectually crippled through life and living in the axial period. See **Method in Theology 101 D 9011: The Road to Religious Reality** by Philip McShane, Axial Publishing, 2012, page 47 on pretense and opting out of that personal defect.

[57] *Haute vulgarization* was a concern of Lonergan's. He obviously was well aware of its use and its danger. Phil McShane has also often written and spoken of its inhibition to curiosity. But little progress seems to have been made in the area of pedagogy towards creating a scientific bent in students although this is a widespread phenomenon in the higher sciences and in the pedagogy of many universities outside Lonergan studies. I teach philosophy and ethics in an undergraduate university and the students have high school science consisting of memorization that for the most has long fallen away.

[58] **Insight**, op. cit., chapter 1, section 2.8 *Implicit Definition*.

[59] My original quest was to understand how a genetic understanding of a sequence of systems would help in making a contribution to a science and effective communication. The insight referred to above occurred when I was a few months into the work. It answers my original question but not quite in the manner I expected which is of course the nature of insight.

of cytology, one might assume it is theoretical. Not necessarily so. At the end of each section in the physiological text the authors provide a section called "Check your ***understanding***." They pose 3 or 4 questions for the reader. In fact the questions focus purely on one's descriptive memory of what they read. Even the passage quoted on the ionic processes of the heart is a highly descriptive passage of a process.[60] Note the use of the term ***understanding*** in the heading above for descriptive/memory type questions.

The key question here is: Did my reader get that insight from what was presented in this essay? In other words, was my communication effective? Did my insight get across? Did I raise all the relevant questions? Answering these questions exposes whether or not effective communication occurred. Effective communication is a basic dynamism if we are to form a foundational beginning for ourselves and for philosophical studies and students. That dynamism of direct and effective talk is a central concern in history and for many of us attending this conference. What could it possibly mean? I have no illusions about my present effort making no inroads into the science of medicine. It was a personal learning experience and hopefully a small bit of encouragement for readers to take Lonergan's advice seriously concerning the need for the theoretic horizon. I did learn something in carrying out this work beyond some physiology in that we are only at the beginning stage of possible effective communication concerning generalized empirical method. The key point here is that one has to make the effort to empirically verify that statement for oneself.

I offer now a set of questions as a way of reflecting on the present system(s) contextualizing Philosophical Studies with a view to developing a standard model.

1) Is there a system (standard model) operative in the minds of Philosophers?
2) Have any serious inroads been made into the sciences?
3) If not, why is that so? [61]

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[60] This is not to state emphatically that all researchers in medical research are functioning in the descriptive horizon. Some are in the explanatory horizon, the problem being they are not aware of their operations that constitute that horizon leading to a lack of control of meaning. The questions posed at the end section on conduction are: 1) Which part of the intrinsic conduction system directly excites myocardial cells? In which direction does the depolarization wave travel across the ventricles? 2) Describe the electrical event in the heart that occurs during each of the following: a) the QRS wave of the ECG; b) the T wave of the ECG; c) the P-Q interval of the ECG. The answers are given in Appendix G of the text and they too are descriptive. Now in order to read an ECG graphic record one needs to have this descriptive knowledge but one also has to know what those readings mean in order to diagnose. The problem of such questions and answers as descriptive within a physiology context is that physiology espouses to be explanatory in nature.

[61] In 2010 and 11 I carried out various *statistical* and comparative studies on the Lonergan literature. My conclusions were not very positive. See http://www.sgeme.org/BlogEngine/archive.aspx for my five articles. They are incomplete studies on Lonergan literature that require a similar treatment to that which I have attempted in medical science. Is it time for a history of philosophical studies to be carried out within the very structures that Lonergan himself provided for such tasks? It has long been my contention that I could not understand Lonergan's philosophical analysis without a background in at least the lower sciences, mathematics, physics, chemistry and biology. This study has verified for me that contention. I add that this is the stumbling block to development in philosophy and Lonergan studies, that students, for the most, do not have a sufficient background in the sciences that would assist them in understanding Lonergan's achievements. Effective communication that would enable inroads

4) Are philosophers functioning with an agreed outcome?
5) If so, what is that outcome?

Answering these questions would require a process similar to what I have attempted with medical research. I leave that project to the future but would offer that it need be carried out by the group in question. The need for creativity, for collaboration, for a developing grasp of theory is paramount if philosophers and philosophy is to retain any relevance in science education. Even with its deficiencies in epistemology and genetic development, medicine, on the practical level has been far more successful than philosophy.[62] The immanent and yet limited intelligibility that was present in Galen's descriptive method set in place a system that could be built upon. Over a period of 2500 years beginning with Hippocrates in the 6th century BCE history has slowly provided the practice of medicine with a system of descriptive refinement and some degree of explanation that does provide a statistics of adequate results even without an understanding of heuristic development.

This study, even though brief, reveals a glimpse of the experience and difficulty of offering a genetic account of the history and development of a science. It is an effort focussed on the first three functional specialities with a specific emphasis on functional history. But two very important challenges remain which focus on dialectic and on the forward four specialities. They are suggestively present and they are in fact more difficult than what I have attempted here so far. Those two challenges are; 1) how do we teach generalized empirical method effectively to philosophy students, and 2) how to speak effectively to the scientific community about generalized empirical method and the need for an explanatory understanding of genetic systems. The answer to these two challenges lie in an effective form of communication that is backed up by the former seven specialities and specifically by the previous three specialities that I have only hinted at in terms of what would be a foundational system for the future of philosophy and

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to the sciences is not possible without such a background and subsequently cumulative and progressive results are not possible. The E-seminars directed by Philip McShane over the past 14 months revealed this problem.

[62] As an example of collaboration (although not within the context of Generalized Empirical Method) I recommend a reading of the 52 page introduction to **MicroRNAs in Cancer Translative Research**, edited by William Cho, M.D., Springer, 2011. The text is 600 pages consisting of 21 chapters on the expression of miRNA (micro ribonucleic acid) and mRNA (messenger RNA) on oncogenes and tumour suppression genes. 62 medical researchers over a period of five years collaborated in research to determine the effects of miRNA on the different forms of cancer that attack the human body. Each scientist understands the work of each other. They have a standard model in the periodic table, a contemporary understanding of cancer and cellular processes. Even with the absence of an understanding of genetic method coupled with the epistemological error they are able to provide some positive results through their collaboration. Each study revealed common patterns of miRNA as therapeutic molecules that they believe at this stage will lead to new forms of pharmacology and opportunities rather than established applications. (page 52) The collaboration and a common background is what eventually brought this to light. Interestingly, researchers know that stress inhibits apoptosis (programmed death of a cell) and yet they focus on the cellular activity in isolation from the causes and solutions to the stress factor. Alterations in the biochemical processes of the organism through pharmacology always raises the risk of introducing new biochemical processes into cellular processes that may be in conflict with the cellular drive to finality resulting in new problems. Stress is usually related to personality factors within the subject or external issues thought to be beyond one's control.

Lonergan's discoveries.[63] In order to communicate effectively to medical researchers one needs to understand the present science, the system that is inherent in that science, the system that would transform that science and finally be able to demonstrate to current medical people how that new system would transform that science.[64] The question remains: even with that background, what form of communication would be effective?

This is the massive project of history that Lonergan outlines in section 3 of chapter 17 of **Insight** and provides a method of doing so in his formulation of functional specialization. The same process would seem to be required and applied to philosophy and Lonergan studies in order to rectify its inability to rethink its mode of operations and implementation. If the legacy of philosophy and Lonergan Studies is to avoid science and self-reflection on scientific operations then it is not Lonergan's wished for legacy. Until human intellect is exercised within the context of one's own struggling self-appropriation in a science, an adequate history of a genetic systematic understanding of any science will not emerge, generalized empirical method will not be implemented and the possibility of initiating progress towards a creative world system will be stalled. Do we really want to repeat what happened to Aquinas over an 800 year period? *Thomism*[65] did very little if anything for the advancement of science. *Thomism* provided Catholicism with a temporary, though false, foothold that would eventually breakdown in the mid-20th century while science was struggling to understand, and today, in the 21st century we have *something* called *postmodernism* which extends the neglect of the scientist's operations into an uncertain future. The character of "talk" that has followed Lonergan's achievements differs very little from Thomistic talk. Thomas had a system and he applied it to the problems of his day. Lonergan developed a system and he did so that it would also be applied to the problems of our day.[66] It would seem to be unfair to compare the system contextualizing Lonergan Studies with the experiential conjugation of Galen. But Galen did have a system, however inadequate, and advances did occur and have occurred in medical science that can be traced back to Galen's experiential conjugation. Philosophy and Lonergan Studies are presently functioning within the context of a global culture and an academic system that are in decline. Let me finish on a more

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[63] Bernard Lonergan, **Method in Theology**, Herder and Herder, NY, 1972. Page 355; "Without the first seven stages, of course, there is no fruit to be borne. But without the last the first seven are in vain, for they fail to mature."

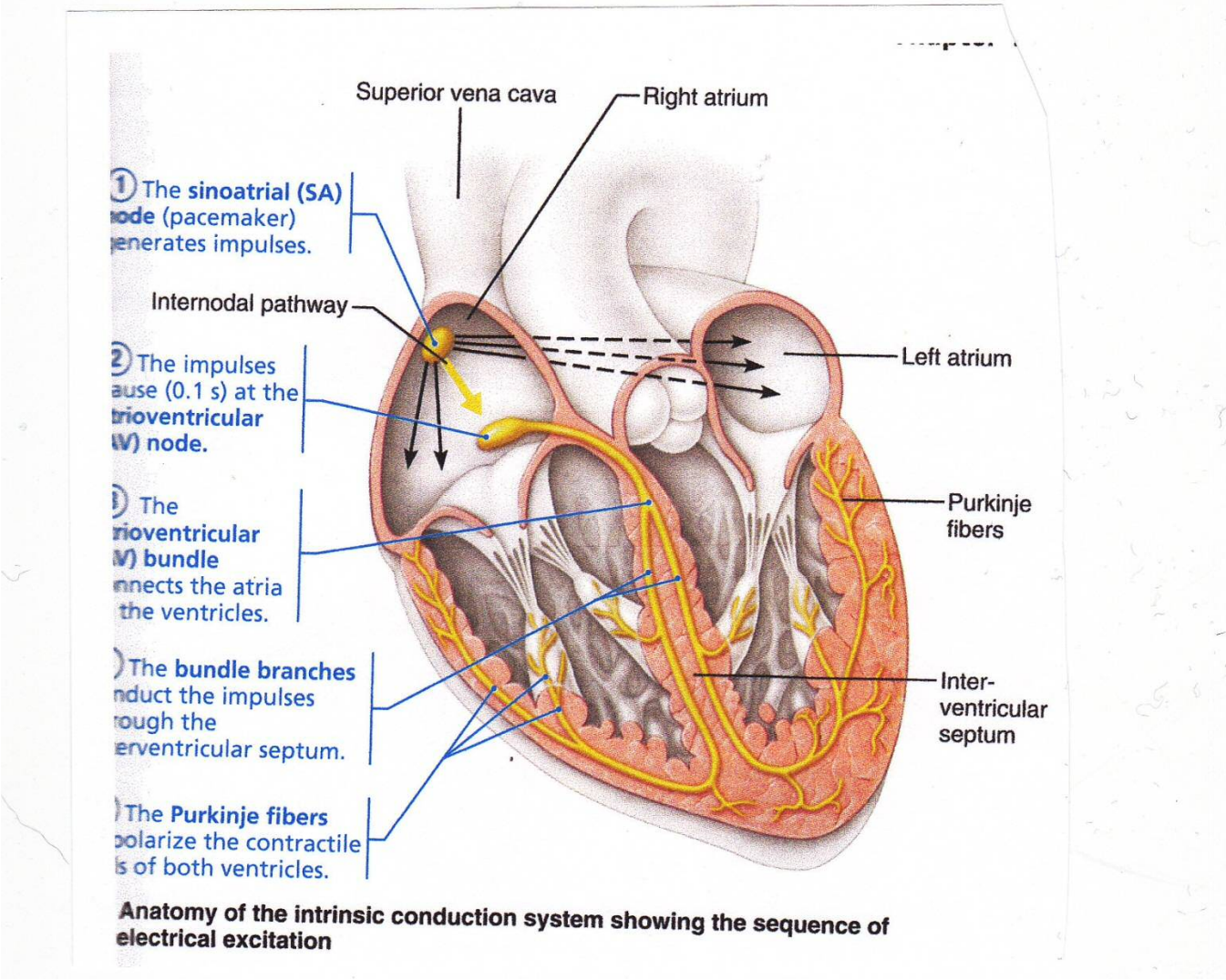
[64] The reader might be able to work out the different functional specialities inherent in such a project.

[65] *Thomism* refers to the conceptual analysis that dominated commentaries on Aquinas for 800 years. Aquinas was not a conceptualist nor a naïve realist. This error would not be corrected until the 20th century when Lonergan, for himself, discovered the error and corrected it for himself probably in the early 1930's. See Lonergan's letter of 1935 to his superior, pages 144-154 in **Bernard Lonergan: His Life and Leading Ideas**, by Pierrot Lambert and Philip McShane, Axial Publishing, 2010. Lonergan would not fully formulate this until the 1940s and it would appear in print in his Verbum articles in the late 1940s. Conceptual analysis still dominates philosophy and 21st century medical research, teaching and practice.

[66] With the demise of classical culture and the gradual emergence of historical and empirical consciousness philosophy is challenged beyond debating issues. I teach introductory philosophy courses occasionally and students believe philosophy is about debating. Efforts to move them into self-attentive scientific procedure as philosophical are met with varying degrees of adversity. See my "An Ethics of Philosophic Work" at http://journals.library.mun.ca/ojs/index.php/jmda/article/view/359/231 for a discussion of the need for an empirical approach to philosophy to end the debates about positions.

positive note by the use of two questions for our reflection. 1) What can be done to assist philosophers and students to effectively communicate and collaborate with one another?[67] And 2) how can philosophy effectively communicate Generalized Empirical Method to the scientific community?

APPENDIX



Anatomy of the intrinsic conduction system showing the sequence of electrical excitation

[67] Coincidentally, as I am writing, Philip McShane is inaugurating a new website project titled **Moving Lonergan Studies into Functional Talk** at http://www.philipmcshane.ca/qa-01.html It is to be a Q & A process inviting questions regarding the character of effective functional talk. This process would seem to respond to my first question with a view towards fulfilling the second. The answer to both questions summarily is for philosophers to take up science within the context of self-attention.