The Edward Hand Medical Heritage Foundation Cardiology Exhibit: Exhibit Info and Research Findings

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INTRODUCTION TO THE EXHIBIT AND RESEARCH METHODOLOGY

This exhibit was designed to paint a picture of the many developments occurring in the field of cardiology over the past two centuries. I began my task of creating the exhibit by digging through the warehouse where the Edward Hand Foundation's artifacts are stored, locating the boxes designated for cardiology instruments, and searching the warehouse's PastPerfect museum software for artifacts which could have potentially been related to cardiovascular medicine. Once I had compiled a sizable collection of items putatively related to cardiology, I began seeking out the era in which each item was produced, the duration of its use, the purposes for which it would have been used, and any additional interesting facts about it. To accomplish this task, I researched the history of each object by utilizing three different methods: 1) I would scan every inch of the object, looking for the object's name, its manufacturing company, or its date of patent. I would then search the internet using whatever information I had found on the object, and attempt to uncover more detail about its use or production era. 2) I would then attempt to confirm whatever information I found by utilizing the William and Mary reference database, which allowed me to cross-reference nearly all medical and scientific journals which have been published in the last century. Often, I was able to confirm most of the multifarious information I found online by consulting articles published in cardiology journals. 3) Finally, for my last level of confirmation, I would consult the book *Antique Medical Instruments* by C. Keith Wilbur, which provided some of the best information on artifacts which dated to the 19th and early 20th centuries. By using all of these sources, I was easily able to compile enough information to determine each medical artifact's use, and to determine the era in which it was produced.

Once I completed my research, deciding which cardiology artifacts would be placed in the display was easy – I simply chose to display the items for which I had the most information, which were the most important as developments in the field of cardiology, and which had some of the most interesting and unusual backstories. In this overview of the display, after my brief introduction to the history of cardiology, you will be taken, in chronological order, through each set of items in the cardiology exhibit, and, hopefully, you will agree that each of these items was both important in the evolution of cardiology, and fascinating in its own right!

CARDIOLOGY

Since the evolution of man, he has been both enthralled and intimidated by the heart. For centuries, it has stood as a symbol of love, which, at the same time, it has been at the base of some of the vilest human activities, from Aztec sacrifices in which hearts were ripped out of live prisoners, to fights ending with a dagger through an adversary's heart. Since British physician William Harvey's determination in 1628 that the heart was the force which circulated the blood throughout the body (as opposed to the previously theorized "pulsative virtue" of the arteries), physicians and scientists worldwide have sought out the underlying anatomy and biochemistry of the heart, and have attempted to develop diagnostic tools and treatments to detect and combat heart diseases. [1] The history of cardiology can be constructed around a series of breakthroughs in the important areas of anatomical discovery and treatment development, from the first description of the heart's chamber and vessels by a French physician in 1706, to recent developments, such as the invention of the permanent, implantable, artificial heart in 1982 [2]. With the objects we display here, we are attempting to provide some concrete pieces of the evolution of the ever-changing field of cardiology, while also putting on display and providing descriptions for some amazing devices utilized by physicians who called Lancaster, PA their home.

DIGITALIS

In the late 1700's, William Withering, a British physician, conducted a scientific investigation into the therapeutic effects of digitalis (also known as the foxglove plant), focusing specifically on its effectiveness for the treatment of heart failure. Well before Withering's time, digitalis had been documented by the ancient Romans as an herbal remedy, and had been used for the treatment of heart defects in 10th Century Europe. However, after Withering's discovery that digitalis was effective at combatting heart failure in his patients, digitalis became one of the most widely used drugs in the 19th century, and was listed in the first edition of the Pharmacopeia of the United States, in 1820.[3] In the Edward Hand Medical Heritage Foundation's collection, and currently on display in the cardiology exhibit, is a liquid digitalis bottle, which we date to the early 19th century, based on its blown milk glass composition.

In 1957, chemists isolated digoxin, the active ingredient in the leaves of the digitalis plant. Today, digoxin is marketed under the trade names of Lanoxin, Digitek, and Lanoxicaps, for the treatment of various heart conditions, and is commonly prescribed for heart failure which other medicines fail to control. The use of digoxin remains controversial, however, due to its extremely high toxicity when used above the recommended dosage, and the questionable nature of its effects. In 1997, the Digitalis Investigation Group determined that digoxin did not reduce mortality in the long-term for patients with heart failure (in fact, in a subsequent study, in women, digoxin was shown to *increase* mortality due to heart-related conditions), although it was helpful to reduce hospitalizations and slow the worsening of heart failure, in the short term. However, in the wake of these studies, as of 2002, digoxin is still recommended by the American College of Cardiology and the American Heart Association for the treatment of patients with heart failure.[4]

STETHOSCOPES

Stethoscopes are acoustic devices used for auscultation – listening to the internal sounds of the human body. Today, physicians commonly use stethoscopes to listen for sounds of the heart, lungs, intestines and blood vessels.

The earliest stethoscope was famously used in 1816 by French physician René Laennec. That year, Laennec was examining a young woman with heart trouble. She was quite stout and well-endowed, physical qualities which obstructed Laennec's attempts at using the traditional auscultation technique of applying his ear directly to the patient's chest. He also found the use of this technique to be considerably embarrassing, and sought out an alternative method of listening to her heart. In desperation, Laennec rolled 24 sheets of paper into a compact cylinder and pressed it against patient's chest. To his relief, his modesty was preserved, and he found that he was able to hear the sounds of her heart with more clarity than ever before.

In the years following Laennec's discovery, many instruments were developed attempting to replicate the utility of Laennec's paper cylinder. Known collectively as "monaural" (one-eared) stethoscopes, these instruments, made initially from wood, and later from metal, resembled candlesticks, with a thin shaft, a flat earpiece, and a conical chest-piece. In the EHMHF display, we have two monaural stethoscopes, one fashioned out of wood, resembling models produced in the 1830s, and the other made from metal in the 1870s. Beginning in the 1850's, physicians discovered that binaural (two-eared) stethoscopes provided greater accuracy, and stethoscopes resembling the modern two-eared design were developed. The chest-piece (the part of the stethoscope which contacted the patient) of the earliest binaural models resembled a bell, and was especially effective at picking up lower frequency heart sounds. However, physicians required a method to listen for higher frequency sounds of the chest, and as a result, in the late 1800's, "diaphragm" stethoscope models were born. In the last two decades of the 1800's, many diaphragm stethoscope models were conceived, going under many names, including hydrophones and phonendoscopes. However, by the mid 1900's, stethoscopes combining the functionality of both bells and diaphragms were developed, and by the 1960's, Littman stethoscopes, made from this combined mold, became the norm, and remain the most popular stethoscope type today.[5] In the EHMHF cardiology exhibit, we display both Littman and modern combination stethoscopes.

Blood Pressure Instruments

Since 1628, when William Harvey first determined that the heart's beating was the force which circulated the body's blood, physicians have sought out the mechanisms by which this complex process occurs. When it was determined that the blood-pumping force required of the heart varies with the health of a person's cardiovascular system, physicians began to use a patient's blood pressure – the pressure of the blood flowing through the arteries, as a result of the force of the heart's contractions – as a diagnostic tool to assess the health of a person's heart.

Some of the earliest attempts at constructing instruments to measure a person's blood pressure involved direct insertion of tubes into a person's arteries. In the 1840s, Karl Ludwig created a "Kymographion," an instrument which measured blood pressure by connecting a tube directly inserted into a patient's femoral artery to a U-shaped tube of mercury. The pressure from a person's blood would counterbalance the pressure exerted by the mercury, displacing the mercury, and moving a small pen, which would record blood pressure variations on a revolving sheet of paper. Obviously, this method for measuring blood pressure was far from perfect, and few patients were willing to have a tube inserted directly into their arteries!

Later attempts at measuring blood pressure were far more precise, and utilized less direct (and far less dangerous) methods. In the late 1800s, the sphygmomanometer ("sphygmo-"is Greek for "pulse") approached blood pressure measurements from a new angle. The sphygmomanometer measured the force necessary to prevent the passage of blood through an artery, as this force is directly proportional to a person's arterial blood pressure. The most advanced form of this design was developed by Leonard Hill in 1885, and consisted of a thin calibrated tube of glass filled with mercury, which had a small flexible plunger foot on the bottom which compressed an artery until the person's pulse below the plunger disappeared, and a blood pressure reading could be made based on the level to which the tube's mercury ascended.

The precursors to the most popular modern blood pressure instruments – sphygmomanometers – emerged at the end of the 19th century. The earliest models in the Edward Hand Med Heritage Foundation collection dates back to the early 1920's. The sphygmomanometers most strikingly similar to those in the 21th century were developed in 1895 by Riva-Ricci. This model utilized an inflatable rubber cuff which, when wrapped around a patient's arm, applied fairly uniform pressure to the patient's arteries. This model was the first that could read both the systolic and diastolic pressures – the highest and lowest pressures of the heart's beating cycle, respectively – measurements which should sound very familiar, as they are the two blood pressure readings our doctors record during our check-ups! By 1910, the Riva-Ricci model was the most popular in the U.S.[6]

In 1917, the Baumanometer – the blood pressure instrument in our exhibit – was developed by William A. Baum, a worker in a large clinic which engaged in pre-employment exams. Baum's design was the first of the sphygmomanometers which needed no adjustments or recalibration, and its well-sealed tube prevented oxidation of the mercury used for measurement. Its simplicity and striking accuracy caused it to catch on with physicians across America, and variations of Baum's simple design stand today as some of the most popular blood pressure instruments.[7]

The Electreat Mechanical Heart

The Electreat Mechanical Heart on display in the EHMHF cardiology exhibit is a cure-all device patented by Charles Willie Kent in 1919. This tool was designed to relieve chest pain, improve circulation, and regulate internal organs, among many, many other reputed therapeutic effects. The device was one of the first transcutaneous electrical nerve stimulators (TENS), devices which claimed to offer pain relief as a result of the application of electrical shocks to a person's skin. It has been estimated that, in the 25 years following its patenting, the Electreat Manufacturing Company was able to sell over 250,000 of these devices.[8] Historically, the Electreat carries great significance, as Charles Willie Kent was the first person to be prosecuted for the misbranding of a medical product under the Food, Drugs, and Cosmetics Act of 1938 – the first U.S. legislation to combat quack medical devices, and false advertising. Kent had charges brought against him in 1947, and in 1950, he was given a verdict of guilty for making false and misleading statements about the medical effects of his product. In his trial, legend has it that when asked what a battery was, Kent answered that "there are 10,000 batteries and no two are alike." When asked to describe the workings of an electrical transformer, he replied "I am not a walking dictionary. It is an unanswerable question." And finally, when asked if he had used the Electreat himself, the medically ignorant Kent replied, "Yes sir, for menopause!"[9]

An interesting story was related by one of the residents at Willow Valley, who reported that his mother told him when she was a child a mischievous neighborhood boy would walk up to people and shock people with his Electreat.

Electrocardiograms (EKGs)

An electrocardiogram (also called ECG or EKG) is a noninvasive test that records the electrical activity of the heart. This examination is useful because, with each heartbeat, an electrical signal spreads from the top to the bottom of the heart. As this electrical signal travels, it induces the heart to contract, and to pump blood throughout the body. Since the heart's electrical signals determine the rate and the rhythm of the heartbeat, an EKG can be used to show how quickly the heart is beating, whether the heart's rhythm is steady or irregular, and how strongly the electrical signals pass through each part of the heart. Based on these readings, a physician may discover a number of conditions, such as arrhythmias or recent heart attacks, and may also monitor the functioning of implanted pacemakers.[10]

The earliest electrocardiogram was designed in 1901 by William Einthoven, a scientist from the Netherlands. The earliest EKG in the Edward Hand Medical Heritage Foundation Collection is from the 1930's. In Einthoven's design, currents from the heart's electrical signals were carried down a silver coated glass conducting wire which was suspended between two electromagnets. The fluctuations of the wire as a result of the changing electrical currents were transcribed onto a photographic plate and produced readouts similar to those given by modern EKGs. Einthoven's original machine weighed 600 pounds, took up two rooms, and needed five people to operate.[11] By the 1920s and 30s, many "portable" EKGs were produced. These units were the size of large briefcases and weighed 30 to 40 pounds. In 1927, Lancaster General Hospital purchased its first EKG machine, one of the "portable" smaller units, which were widely produced in the 1920s and 30s. In the Edward Hand Medical

Heritage Foundation cardiology exhibit, we have on display a portable EKG machine issued to medical technicians deployed in World War II.[12] This model recorded its readings on photographic film which required development before its data could be viewed. EKGs remain one of the most important diagnostic tools today, and in 2011, 87,707 EKGs were performed at Lancaster General Hospital (or affiliated healthcare institutions), which amounts to a staggering 226 per day![13]

DR. CHARLES BAILEY'S COMMISSUROTOMY KNIVES

The first successful series of truly modern cardiac surgeries were performed by Dr. Dwight Harken, a U.S. army surgeon, in the week following D-day (June 6, 1944). Before Dr. Harken's work, cardiac operations had previously been considered too dangerous. However, in that one week following the American invasion of France, Dr. Harken operated on 134 young men by removing pieces of shrapnel lodged in or around their hearts and managed to save all 134 of these soldiers. Some of the operations were truly stunning, as he would sometimes simply stab a surgical clamp into the heart, pull out the piece of shrapnel, and stop blood from gushing from the hole in the heart with his hand (often by sewing his rubber glove directly to the heart!). With these incredibly bold and consistently successful surgeries, Dr. Harken set the stage towards modern cardiac surgery.[14]

Dr. Harkin's procedures laid the foundation for surgery to alleviate the condition known as mitral stenosis, probably the first cardiac surgical procedure to be developed. At the turn of the century, rheumatic fever had become a widespread disease, with pathology of the mitral valve as a frequent associated condition. The mitral valve, which normally has two leaflets, controls the flow of blood from the left atrium into the left ventricle. The left atrium is the heart chamber which receives oxygenated blood from the lungs and the left ventricle is the heart chamber which pumps the oxygenated blood out of the heart and throughout the body. These leaflets become hardened and thickened, allowing blood to leak back into the left atrium when the ventricle contracts (mitral insufficiency or regurgitation, or if severely narrowed, prevent blood from flowing normally from the left atrium into the left ventricle (mitral stenosis). To alleviate the narrowing or stenosis, in 1948, Dr. Charles Bailey, a professor of thoracic surgery at the Hahnemann Medical College in Philadelphia, developed a pair of curved knives (a pair of which are on display in the cardiology exhibit), which could be used to cut apart the thickened leaflets. After four unsuccessful surgeries, for which he received harsh criticism, he finally performed a successful procedure on a 24 year old housewife. Although, had he been governed by today's ethical standards, he may not have been allowed to continue, Dr. Bailey's successful commissurotomy became a standard to alleviate mitral stenosis. Since the procedure was performed without actually inspecting the valve visually, it was termed a "blind commissurotomy".

In 1953, Dr. John Gibbon of Thomas Jefferson Medical College in Philadelphia utilized a piece of equipment he had been working on for years, the so called heart-lung machine, to operate on a non-beating heart. This initiated a new era in which congenital and acquired heart disease could be dealt with directly. Today, using this technology, a poorly functioning valve may occasionally be repaired, more commonly replaced.

PACEMAKERS

Pacemakers – devices which control abnormal heart rhythms by the emission of electrical pulses which prompt the heart to beat at a normal rate – have been around since the late 1950s. The earliest pacemakers were large, bulky devices which were attached to the outside of a patient's chest, and contacted the heart with permanent wires inserted through the chest wall and attached to the surface of the heart. By 1950, physicians in Sweden had succeeded in implanting the entire pacemaking device inside a patient's chest. Their first patient, a 40 year old man, was given a pacemaker whose battery failed in a few hours. The next pacemaker he received lasted a few weeks, yet he survived and received yet another pacemaker in 1960. He lived for 40 more years (and received 26 pacemakers in his lifetime).

The earliest pacemakers implanted were ungainly devices, powered by large zinc-mercury oxide batteries, delivered stimuli to the heart at a preset rate, regardless of the changing needs of the patient, continuing to deliver stimuli even when the patient's heart was working normally. The earliest pacemaker rates were set by the manufacturer, usually at a rate of 70 per minute. A subsequent modification allowed the rate to be changed, utilizing a screw driver like device inserted through the chest wall.

In the late 1960's, physicians began developing pacemakers which were deactivated when the patient's heart was running normally. They were activated when the patients' rate dropped below a certain level. These pacemakers, known as ventricular inhibited (VVI) or ventricular triggered (VVT) were the dominant model from the mid-1960s to the early 1980's. Initial pacemakers stimulated the right ventricle. Subsequent improvements led to pacing of the right atrium and right ventricle in sequence, simulating normal heart electrical function. In the 1970's, the major developments in the pacemaker field included the introduction of the lithium-based batteries (which allowed pacemakers to become markedly smaller), and the development of programmability. In the late 60's and early 70's pacemakers could have their rates adjusted only by surgical intervention. In 1972, however, pacemakers were introduced which could have functions changed without surgery, using an external device. These programmable pacemakers became almost universal by the 70's and, as such, are similar in this respect to modern pacemakers which can be checked over the phone without a visit to the doctor!

Also, modern pacemakers, building on a development of the late 1980's, can offer high-energy stimuli (in the same manner as the external defibrillators we see on TV) to combat heart malfunctions; these pacemaker models are called implantable cardioverter defibrillators (ICDs).[16] In the Edward Hand Medical Heritage Foundation cardiology exhibit, we display an early ICD manufactured by Cardiac

Pacemakers Inc. in the 1980s. The earliest models in the EHMHF collection date back to the 1970's.

OTHER EXHIBIT ITEMS

A minor item included in our cardiology exhibit is the Flowscope (c.1980), an instrument which could be used to diagnose a number of heart defects by measuring the velocity at which a person's blood is moving through his arteries. The flowscope utilizes the well-known Doppler Effect, which states that the frequency of the sound waves produced by a moving object (in this case, arterial blood) varies with the velocity at which that object are moving.

Bibliography

Bailey, Charles Philamore, M.D. "The Surgical Treatment of Mitral Stenosis." *Chest* 15, no. 4 (April 1949): 377-93. Accessed June 13, 2012. http://chestjournal.chestpubs.org/content/15/4/377.

"Baumanometer." W.A. Baum Co. Inc. Accessed June 13, 2012. Last modified 2010. http://www.wabaum.com/aboutus.aspx.

Cardiograph, portable. Washington, D.C., 1944. Accessed June 14, 2012. http://digital.library.unt.edu/ark:67531/metadc29974/m1/4/.

"Digitalis." Drugs.com: Drug Information Online. Accessed June 13, 2012. Last modified 2009. http://www.drugs.com/npp/digitalis.html.

Grubin, David. "The Mysterious Human Heart." Educational Broadcasting Corporation. Accessed June 13, 2012. Last modified 2007. http://www.pbs.org/wnet/heart/history/index.html.

"History of the Heart." The Franklin Institute. Accessed June 13, 2012. Last modified 2012. http://www.fi.edu/learn/heart/history/firsts.html.

Jeffrey, Kirk, and Victor Parsonnet. "Cardiac Pacing, 1960-1985: A Quarter Century of Medical and Industrial Innovation." *Circulation* 97 (1998): 1978-91. Accessed June 13, 2012. doi:10.1161/01.CIR.97.19.1978.

McCann, William, M.D. "History of Cardiology (unpublished)."

Naef, A.P. "The mid-century revolution in thoracic and cardiovascular surgery: Part 5." *Interactive CardioVascular and Thoracic Surgery* 3 (2004):415-22. Accessed June 13, 2012. http://icvts.oxfordjournals.org/content/3/3/415.full.pdf.

National Heart Lung and Blood Institute. "What is an Electrocardiogram?" National Institutes of Health: Department of Health and Human Services. Accessed June 13, 2012. Last modified 2010. http://www.nhlbi.nih.gov/health/health-topics/topics/ekg/.

New York Spine & Wellness Center. Accessed June 13, 2012. http:/www.nyspineandwellness.com/education_printouts/historyofpain.pdf

Rathore, Saif S., M.P.H., Yongfei Wang, M.S., and Harlan M. Krumholz, M.D. "Sex-Based Differences in the Effect of Digoxin for the Treatment of Heart Failure." *New England Journal of Medicine* 347, no. 18 (October 2002):1403-1411. Accessed June 13, 2012.

Schwarcz, Joe. "If science fails, quacks move in." The Morton Cure Paralysis Fund: That All May Walk Again. Accessed June 13, 2012. Last modified 2003. http://www.mcpf.org/Research/tabid/141/articleType/ArticleView/articleld/1225/If-science-fails-quacks-move-in.aspx.

Wilbur, C. Keith. *Antique Medical Instruments*. Westchester, PA: Schiffer Publishing Ltd., 1987.

David Grubin, "The Mysterious Human Heart, "Educational Broadcasting Corporation, accessed June 13, 2012, last modified 2007, http://www.pbs.org/wnet/Heart/history/index.html.

"History of the Heart," The Franklin Institute, accessed June 13, 2012, Last modified 2012, http://www.fi.edu/learn/heart/history/firsts.html.

"Digitalis," Drugs.com:Drug Information Online, accessed June 13, 2012, last modified 2009, http://www.drugs.com/npp/digitalis.html

Saif S. Rathore M.P.H., Yongfei Wang M.S., and Harlan M. Krumholz M.D., "Sex-Based Differences in the Effect of Digoxin for the Treatment of Heart Failure," *New England Journal of Medicine* 347, no. 18 (October 2002):1403, accessed June 13, 2012.

C. Keith Wilbur, *Antique Medical Instruments* (Westchester, PA: Schiffer Publishing Ltd., 1987, 20-9.

C. Keith Wilbur, *Antique Medical Instruments* (Westchester, PA: Schiffer Publishing Ltd., 1987), 29-33.

"Baumanometer," W.A. Baum Co. Inc., accessed June 13, 2012, last modified 2010, http://www.wabaum.com/aboutus.aspx.

New York Spine & Wellness Center, s.v. "The History of Pain Treatments: Fact Sheet," accessed June 13, 2012, http://www.nyspineandwellness.com/Education_printouts/historyofpain.pdf

Joe Schwarcz, "If science fails quacks move in," The Morton Cure Paralysis Fund: That All May Walk Again, accessed June 13, 2012, last modified 2003, http://www.mcpf.org/Research/tabid/141/articleType/ArticleView/articleld/1225/if-science-fails-quacks-move-in.aspx

National Heart Lung and Blood Institute, “What is an Electrocardiogram?” National Institutes of Health: Department of Health and Human Services, accessed June 13, 2012, last modified 2010, http://www.nhlbi.nih.gov/health/health-topics/topics/ekg/.

C. Keith Wilbur, *Antique Medical Instruments* (Westchester, PA: Schiffer Publishing Ltd., 1987), 37.

Cardiograph, portable (Washington, D.C., 1944), i-iii, 23-33, accessed June 14, 2012, http://digital.library.unt.edu/ark:/67531/metadc29974/m1/4.

13William McCann M.D., History of Cardiology (unpublished).”

A.P. Naef, “The mid-century revolution in thoracic and cardiovascular surgery: Part 5, “*Interactive Cardiovascular and Thoracic Surgery* 3 (2004):415-7, accessed June 13, 2012,
http://icvts.oxfordjournals.org/content/3/3/415.ful.pdf.

Charles Philamore Bailey M.D., The Surgical Treatment of Mitral Stenosis,” *Chest* 15, no. 4 (April 1949):381,389, accessed
June 13, 2012, http://chestjournal.chestpubs.org/content/15/4/377.

Kirk Jeffrey and Victor Parsonnet, “Cardiac Pacing, 1960-1985: A Quarter Century of Medical and Industrial Innovation,” *Circulation* 97 (1998):1978-85, accessed June 13, 2012,
Doi:10.1161/01.CIR.97.19.1978.