

*The Proceedings
of the
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HISTORY OF MEDICINE DAYS

**FACULTY OF MEDICINE
THE UNIVERSITY OF CALGARY**



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Preface & Acknowledgements

History of Medicine Days, hosted every year by the Faculty of Medicine and co-sponsored by the Alberta Medical Foundation and Associated Medical Services, gathers medical students from across Canada to present papers on topics of their choice in history of medicine. The subjects range from ancient to modern history and touch on personal stories of doctors, attitudes to disease, economics of medicine, politics of health policy and curious anecdotes. They display the enthusiasm, curiosity, and wide knowledge of medical students and the interest they have in broad issues of society and their profession.

This year, 65 students from seven medical schools (Memorial, Dalhousie, McMaster, Ottawa, UWO, Manitoba, Alberta and Calgary) gave oral presentations during the two day event held March 19 and 20. Dr. Stuart Houston, University of Saskatchewan, was our keynote speaker this year and presented a fascinating talk on “*The Saskatchewan Steps to Medicare*”.

Scholarship, oratory and competence with PowerPoint were all of high quality and the audience was superbly entertained.

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Dr. William A. Whitelaw
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Notes

MAGIC AND MEDICINE IN ANCIENT EGYPT

By

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Preceptor: None

ABSTRACT

In ancient times magic was essential to the emotional and psychological well-being of the Egyptian civilization. Magic was defined as any measure that protected man against harm. Its primary purpose – to avert danger. The physical manifestation of magic consisted of three parts: the spell, the ritual and the sorcerer, each of vital significance.

Since prevention of disease was of the utmost importance in ancient Egypt, magic was an integral component of maintaining and restoring health. Medicine, magic, and religion were considered equal components of the healing process. Due to this synergism between magic, religion, and medicine, an integrated system of healing developed on the Nile. In order to treat the sick, be they physically or spiritually ill, the physician had to perform an act of magic followed by use of his medical skills to physically treat the patient. The magic ritual was vital to the healing process as it was an important expectation the patient.

The physicians of Ancient Egypt called on many gods and goddesses of healing such as Thoth or Sekhmet to drive away the evil spirits causing disease in their patient. The Physicians of Unknown Diseases, as one group was called, functioned very much as current day physicians. They took patient histories, performed physical exams, and prescribed medicinal treatments. Another group, the Shepherds of the Anus, were purveyors of the number one cure-all, the enema.

The life of the ancient Egyptians involved a strong focus on strength, vigor, and wellbeing. Health was considered to mean vitality and freshness (Stetter 1993). It signified vitality, not the absence of illness (Ghalioungui 1963). Prevention of disease was the utmost importance. The Egyptians found this belief of good health, and concordantly a good death, extremely important. So important in fact that many names had *seneb* in them, which means healthy and various greetings included phrases such as “let your father be healthy” (Ghalioungui 1963). The ancient Egyptians pursued many avenues to achieve their ideal of health. The importance of magic, religion, and medicine

in the lives of the ancient Egyptians led to the creation of a unified system of health care which integrated all three modalities and proved to be extremely beneficial.

Magic

In ancient times, magic was essential to the emotional and psychological well-being of the Egyptian civilization. Early man believed that his actions affected the people around him and that the things around him affected his life (Ghalioungui 1963). When early man discovered that he had a soul and a will of his own, it was assumed that so too did the things around him (Ghalioungui 1963). This belief was the basis for the creation of Egyptian theology and its many gods (Ghalioungui 1963). It was man's interpretations of the universe and of his place in it that was the basis for the creation of magic (Ghalioungui 1963). Magic was defined as including "all measures protecting man against harm" (Ghalioungui 1963). Magic was not considered, as it is today, to be supernatural method of changing your life (Borghouts 1995). The aim of ancient Egyptian magical practices was to achieve a desired effect by symbolic means which referred a great deal to the gods and religious beliefs of the Egyptians. As there was no clear dividing line between religion and state (Weeks 1995) in ancient Egypt every aspect of life, including magic, was complementary to religion (Borghouts 1995).

Magic consisted of various principles. It was said that an impersonal force existed which magic could tie down or set free to do whatever the magician wanted. However, this force had to be connected to something or else it could roam free and harm individuals, including the magician. The Egyptians also believed that the entire universe was connected by mysterious ties. If an event occurred at one end of the galaxy, then there was a response at the other end. Further, there prevailed a system of logic based on analogy and similarity in which there was a connection between two things due to resemblance in any shape, form, or colour. For example, if a particular plant had an appearance that was akin to a specific body organ, then that plant could be used to cure that organ. The concept of homeopathy, in which like-evokes-like, became part of everyday life. If a beneficial event occurred, then a similarly profitable event would be caused to occur and so on. The fourth principle of magic has persisted well into the 21st century. It was the belief that the body remains linked forever to parts of it that have been cut off or that the body has touched. For example, nail clippings, hair, or even a chair that the person has touched can be used for good or evil magic against them. Lastly, the Egyptians believed that death was a form of sleep in which the dead resumed their duties as they had in life (Ghalioungui 1963).

The Magic Act

The physical display of magic consisted of three parts: the spell, the ritual, and the sorcerer. The spell was the most important component of the magic act because it carried the power of the ceremony. It had to be said correctly for it was the sound and the

rhythm of its words that possessed the power. Once spoken, there was no way to neutralize the spell. It had become a free entity in its own right (Ghalioungui 1963).

The ritual consisted of the actions that accompanied the recitation of the spell. Wax or earthen dolls, similar to voodoo dolls today, or something that belonged to the patient was used. The ritual could incorporate simple gestures or dances or dramatizations of the legends of the gods (Ghalioungui 1963).

The final part of the magical act was the sorcerer. He was extremely powerful and therefore was generally feared. For this reason, sorcerers had to be chosen carefully. The rationale for such a decision was made according to the stars, dreams, and body markings. He had to be of royal blood or of the sorcerer's clan. The sorcerers were raised in isolation with many implicit taboos. They also received a great deal of education and thus used their wisdom to make it appear to the lay person as though they had supernatural powers (Ghalioungui 1963).

The Gods & Goddesses of Healing

In pharaonic times, magic and religion were essential to the practice of medicine. The basis of this amalgamated system of magic, religion, and medicine were the gods and goddesses of healing. The physicians and magicians called on many gods to drive away the evil spirits causing disease in their patient. The gods had to be honoured or a person's health would be endangered. Only the begging of the patient could cause a recovery. Eventually, the Egyptians tried to unify the gods together into one healing god by linking their names. But generally, health was a concept for all gods (Stetter 1993).

Thoth

The god Thoth saved Horus as a child from a snake bite and made Horus immune to snake bites for eternity (Estes 1989). He also restored Horus' eyesight after Seth tore Horus' eyes out. Thoth was henceforth known as the god of oculists. Thoth was usually represented by the ibis or a man with an ibis' head and a sun disc. He held the *seshet* (inkstand and reeds) which was the scribe's symbol. Thoth was known as "the measurer" who invented mathematics, science, theology, magic, and the enema (Ghalioungui 1963).

Sekhmet

Equal in status to Thoth with respect to healing powers was Sekhmet. She was a lion-headed goddess who destroyed mankind by causing war and death and disease (Estes 1989). At first she was feared because of her great power (the translation of the name Sekhmet means "the powerful one"). As time progressed, however, Egyptians regarded her as a benevolent deity (Ghalioungui 1963). The priests of Sekhmet were classified as the first physicians. However, they were closer in description to what today we would call "mediums to the spirit world" because they acted as translators between the patients

and the gods. In performing this task, the priests inevitably developed some medical skills. Even though they treated a multitude of diseases, the one area they would not attempt to heal were the eyes. Their reasoning is unknown. Perhaps they felt that it was the duty of the priests of Thoth or alternatively they chose to avoid charges of incompetence as eye diseases were notoriously difficult to cure (Ghalioungui 1963).

Lesser Deities

Many gods in the pantheon of Egyptian theology maintained minor roles in the healing arts. Isis was known as a magician and was given the title “Great Enchantress” and “Patroness of Magicians” because of her resuscitation of Osiris. Her son Horus was physician in the house of Ra and her brother-in-law Seth was a symbol of evil, the cause of sickness and epidemics. Also notable were Taweret and Bes, the protective goddess and god associated with labour and delivery. Taweret was a hippo-shaped pregnant goddess who delivered the Earth and for this reason was the patroness of pregnant women. Bes was an ugly gnome with a large stomach and lion’s face. He wore a panther dress and hanging claws. It was believed that his ugliness scared away all evil spirits from the newborn (Ghalioungui 1963).

Magic & Medicine

Magic was an essential component of the Egyptian approach to restoring health. Magic, religion, and medicine all experienced the same level of belief and trust in their powers to heal. Due to this equality an integrated system of healing developed on the Nile. In order to treat the sick, be they physically or spiritually ill, the physician/magician must perform a magic act followed by the use of their medical skills. The magic ritual was necessary because it was expected by the patient and would thus lead to psychological well-being. Following the magical act, the practitioner’s medical skills would have been applied to heal the patient’s body.

There were many avenues the physician/magician could take when treating a patient. Initially, magical remedies were attempted. The physician/magician was considered to be a warrior and there existed a battle between healer and the illness—a battle that the physician could never forsake (Borghouts 1995). A belief in curing disease by similarity of homeopathy was widespread across Egypt. Therefore, animals, vegetables, and minerals could cure certain illnesses due to a similarity in appearance. For example, to halt the graying of hair, which was considered very shameful, the blood of a black oxen or the fat of a black snake was rubbed into the hair. It was also believed that yellow flowers relieved jaundice. The concept of transfer, whereby the evil spirits causing the disease or the disease itself could be terminated by “transferring” it to the medicine prescribed. For example, a migraine could be transferred to the head of a fried fish if it were rubbed on the afflicted one’s head (Ghalioungui 1963). Charms and knots were also popular healing techniques. Amulets representing various gods or charms of hair or vulture plumes were worn to prevent evil spirits from approaching the carrier. Knots

were made in linen or other cloth to represent gods who posted themselves on the material like guardians to stop undesirable influences and control bleeding. There also existed a form of sympathetic magic that could be used to cure or harm by proxy (Ghalioungui 1963).

Temples were the centres of spiritual healing. In temples called “Horus Places” water was poured on statues of Horus and other healing gods and the collected water was then considered holy for internal and external use. A greater significance was placed on dreams that occurred while asleep in the temples. Sleep was similar to death in that it was a state during which the soul delved in the Nun, the dwelling of the dead (Ghalioungui 1963). A man could connect with gods to ask them about his future or any curses placed on him. This was accomplished by giving the patient a brew consisting of an opiate or mandrake. Therefore, there was a need to spend one or more nights in the temple (Ghalioungui 1963).

The Physicians

The Egyptian word for physician is *swnw* pronounced sounou. When it was combined with the word for magician, *hk'w*, the two became indistinguishable. Together they formed a general definition of healing. However, as is today, the profession of medicine is not as noble as its ideal. There were those physicians whose sole desire was not to cure but rather to achieve status and wealth. This was accomplished by attempting to become a physician in the pharaoh's royal court. The next best thing was to be a physician to a noble house. Ultimately, most physicians attended to the poverty-stricken masses and were paid with whatever their patients could afford since the economy of Egypt was that of the barter system (Estes 1989).

The one conundrum that has yet to be solved is the question of where and from whom did ancient Egyptian physicians learn to become doctors? The only possible answer is that it was passed down from father to son in the absence of any evidence of medical schools (Stetter 1993).

The most significant physician in Egyptian history was Imhotep. Imhotep, which means “he who comes in contentment”, saved the life of the infant prince Djoser and that of his mother. Years later, he was rewarded for his actions by the Pharaoh Djoser who appointed Imhotep as his vizier, head architect, priest, and astrologer. It was because of his many talents that the public naturally assumed that only someone who had close ties with the gods could have such great knowledge. Thus, Imhotep was deified after his death, one of the only non-pharaoh mortals to have become a god (Stetter 1993).

Physicians of Unknown Diseases

All physicians were taught to practice a thorough clinical consultation on each patient to confirm the presence of disease, the steps of which were remarkably similar to those

taken by present day physicians. Initially, a detailed history and questionnaire were taken from the patient. This was followed by the notation of the general appearance and nutrition of the body as well as a detailed exam of the face, its colour, and secretions. Materials to be examined were the smell of the body, the observation of urine and fecal matter, and the palpitation of the pulse and abdomen (Ghalioungui 1963).

Curatives used by the Egyptians showed surprising innate knowledge of how to prevent and terminate disease. They used a wide range of plants, animals, and minerals. Moldy bread was put on open wounds to prevent infections while fresh meat was used to prevent haemorrhaging. Garlic, radishes, and onions were distributed among Rameses II work force because their anti-oxidant qualities inhibited the growth of bacteria. They also had the ability to prevent dysentery, typhus, and cholera, all potential problems in the close, poorly sanitized work camps. All of these remedies were usually followed by “million times proved” or “used since the time of Cheops” as an attempt at validation (Stetter 1993).

The Shephard of the Anus

Ancient Egyptian society advocated moderation in food and drink. Therefore, when an individual became ill it was most likely due to an episode of overeating. As Kent Weeks learned, “putrefaction was associated with death, disease and infection and that such decay was known to occur in the intestines, where food was turned to excrement. Thus, the digestive process was potentially a disease-causing process” (Weeks 1995). This belief led to the preventative measures of enemas or purges, a good diet, and prayers or incantations. The enema was the number one cure-all and a large percentage of all prescriptions were for purges. It was the duty of the Shepherd of the Anus to administer enemas and to assure the individual that he possessed no more decay within his body.

Looking back at ancient Egyptian medicine one might automatically conclude that current Western medicine is superior to the crude, unscientific beliefs of the medicine of the pharaohs. However, many of their curatives have been proven to aid healing. As J. Worth Estes states, “the ancient physician’s efforts merely permitted nature to complete her usual healing course” (Estes 1989). Due to their society, there arose the necessity to blend religion, magic and medicine into a unique health care system. It could be argued that the Egyptians did indeed live healthier lives than modern individuals because their method of health care incorporated the mental, spiritual and physical well-being of the patient. The ancient Egyptians were truly gifted with their health care system.

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SECRETS OF MEDICINE IN ANCIENT EGYPT

By

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Preceptor: Dr. Steve Loken

ABSTRACT

Egyptian medicine has provided much knowledge of how medicine was practiced in the past and has provided many advances to modern medicine. The medicinal practices in ancient Egypt have been recorded in papyri, illustrating the methods of diagnosis and treatment. One of the most significant papyri that have contributed much information on past Egyptian medicine includes the Edwin Smith papyrus. Information such as the description of diseases and symptoms were recorded, allowing researchers to discover the types of diseases that people faced in the past. Interestingly, the papyri described diseases that are commonly found today such as tuberculosis and leprosy. Researchers have also used human remains that have been well preserved through mummification to determine the types of diseases present in ancient Egypt. Most of the knowledge on medical treatments used in the past was obtained from the papyri. The written records have shown that medical treatments involved religious and scientific aspects. Various drug therapies that were recorded in the papyri illustrated the importance of certain factors from natural sources that provided relief from disease. Records from well-known Egyptian physicians such as Imhotep have provided much medical knowledge and improvements to medicine practiced in the past, allowing important advances to be made in modern medicine.

The Medical Papyri

The medical papyri were an important source of information on how the Egyptians practiced medicine. There are a total of forty-two books of knowledge that were kept by the ancient Egyptians which included topics such as the structure of the body, diseases, instruments of doctors, remedies, eye diseases, and diseases of women. The Ebers papyrus was known to contain most information on the structure of the body and the diseases that ancient Egyptians recorded. Other well known papyri include the Hearst, Berlin, and Chester Beatty papyri which described the diseases observed in ancient Egypt and the types of remedies used for treatment. Records on the instruments of doctors have been lost. Eye diseases were described in the Ebers papyrus and there is a small piece of information in the Kahun papyrus that described women diseases.

The most important papyrus discovered was the Edwin Smith papyrus. This papyrus described mostly information on surgery and trauma. This papyrus text was different from other discovered papyri because it was found to contain no magical remedies and shows a rational method of identifying a diagnosis and determining treatment. Nearly all of the forty-eight cases in this text describe patients suffering from trauma. The Edwin Smith papyrus conveyed instructions to the reader to treat the patient, which enables the reader to visualize the actions of a physician during ancient times. Therefore, studying the Edwin Smith papyrus has provided much valuable information on medical practices in ancient Egypt. Each case described in the papyri was explained in organized sections. The title of each case is usually very concise such that the reader is able to visualize the patient and the situation. An example of a title would be: "Instructions for a gaping wound in his head, penetrating to the bone and splitting his skull" (Nunn, 1996). The first part of the case would describe the examination process where the writer conveys the reader the actions that a physician should take if he is seeing a patient that has the features described in the title. The next section conveys the diagnosis and prognosis. The final section will describe the treatment, which was omitted in some cases when there was an unfavourable prognosis. The Edwin Smith papyrus contains much information that correlates to the practice of modern physician.

Although the papyri describe the medical practices of physicians in ancient Egypt, many of them were lost or stolen and have not been found. It was also discovered that many of them were destroyed by disastrous fires or by people who burned them for fuel or used them to prepare magical remedies. To learn more about the past, other tools were used besides the papyri. These included examining mummies by doing radiology and histology to study any abnormalities that would convey the types of diseases that the Egyptians faced in the past.

Diseases of Ancient Egypt

One of the parasitic diseases that affected the Egyptians in the past and present is schistosomiasis. Interestingly, the existence of this disease in the past was discovered by identification of calcified *Schistosoma* ova in the kidneys of two mummies. This disease is caused by an infective worm called *Schistosoma* that has a complex life cycle between the humans and fresh water snails of the genus *Belinus*. The snail releases the worm in a free swimming form (cercariae), which could infect humans when they immerse into water that contains these worms. The cercariae penetrate into the intact skin and enter the veins of the human host where they mate and deposit the eggs into the bladder and rectum. The eggs ulcerate through the bladder and are released with blood in the urine. Once the eggs reach fresh water, they rupture to release miracidia that will swim to find a snail and the cycle restarts again (Nunn, 1996). Interestingly, one fifth of modern Egyptian deaths are caused by schistosomiasis (Estes, 1989).

Historical findings of miniature engravings in jewellery suggested that people who have gross myopia were employed to diagnose this disease because they would be able to see

very small objects that cannot be seen with the normal eye. The main symptom of schistosomiasis is hematuria. Infected patients suffer from serious anemia, urinary infections, loss of appetite and loss of resistance to other infections. This disease has led Napoleon's troops to report that Egypt was "a land of menstruating men" (Nunn, 1996).

Many types of diseases present today were also shown to be present in the past by examination of mummies. Tuberculosis was a disease found to be present in ancient Egypt. Evidence for this disease came from discovery of tuberculosis of the spine in Nesparehan, the priest of Amun from the twenty-first dynasty (Nunn, 1996). Another mummy was found to have a collapsed lung with pleural adhesions, resembling the findings that one would expect from a person with pulmonary tuberculosis. Leprosy was another disease that was well described in the medical papyri. There has been no mummies found to have characteristics of leprosy but this may be due to the fact that leprosy was known to be highly infectious and therefore victims were denied of mummification after death. Leprosy was described in the following excerpt from the Ebers papyrus (877):

"Instructions for an anut-tumor of the slaughter of Khonsu. If you examine an anut-tumour of the slaughter of Khonsu in any part of a man and you find its head pointed and its base (?) is straight; his two eyes green and burning; his flesh hot under it...If you find them in his two arms, his pelvis and his thighs, pus [being] in them, you should not do anything against it". (Nunn, 1996)

Evidence of leprosy also came from artwork, which illustrated the grotesque features of victims with leprosy.

Small pox was also a common finding in mummies, identified by the presence of small lesions. However, there has been no evidence of small pox described in the medical papyri (Nunn, 1996).

Magic and Religion

Besides medical therapy, magical and religious remedies were an important type of treatment for patients in ancient Egypt. The belief of the supernatural powers having control over disease and providing the cure for illness was prevalent throughout the world, even in Europe for many centuries. For example, the "sacred disease" referred to epilepsy and the "king's evil" referred to scrofula and leprosy (Nunn, 1996). Since the Egyptians had the belief that the disease had a supernatural origin, it was natural for them to look for a supernatural cure. The use of magic was a common method of treatment described by the papyri as mentioned previously. Although modern physicians agree that religion and magic have no healing powers, one should not omit the placebo effect that may play a small role in the healing process. As well, it is also possible that since the physicians in ancient times were unable to explain the reasons for having a disease or did

not have the knowledge to explain the origins of a disease, religion and magic were used to provide the explanations for the patients.

There were many gods and magicians that played roles in healing for the people but only three will be discussed in this report. One group of magicians that were well known in ancient Egypt were the priests of Serqet. These priests played a role in preventing and treating attacks by snakes and scorpions. In one of the papyrus (Brooklyn papyrus), a section on snakebites describes treatment to be taken care of by the priests of Serqet (Nunn, 1996). Serqet was a goddess who protected people from scorpions and other venomous animals. She is represented in various artworks with a scorpion on her head. The people had to please her (presumably by prayers or offerings) in order to prevent being harmed by venomous animals.

Taweret was another well-known goddess known for helping women with their childbirth. This goddess has a distinct body with the head of a hippopotamus, legs and arms of a lion, tail of a crocodile and a body with pendulous human breasts. Another well known deity that was concerned with childbirth was the dwarf god Bes. This dwarf god was thought to help women through pregnancy and childbirth. The images of Taweret and Bes were common in amulets carried by various people because besides being helpful for women going through childbirth, they were also thought to provide protection (Nunn, 1996).

Drug Therapy

Egyptian physicians used various types of minerals and animal products in the past for treatment. Some of these minerals were shown scientifically to be effective in healing. The recipe for many of the drugs used in ancient Egypt came from the papyri. A few of the drugs will be described in this report.

Natron is a mineral deposited as a mixture of evaporites in areas where water has evaporated due to dry weather. The composition of natron varied depending on its location of origin but the major constituents are sodium chloride, sodium sulphate, sodium carbonate and sodium bicarbonate (Nunn, 1996). Its usage in its solid state or as a paste has an osmotic effect, which could be used to reduce swelling. Natron was described by some of the papyri to be used to draw out pus and was used mainly on the outside of the body.

Common salt was another common drug used along with a mixture of other drugs. It was thought that common salt played a larger role in providing taste in drug solutions that were ingested by patients. Salt was also used as an anal suppository and a local application to the eyes, ears, and skin.

Malachite is a green colored mineral that was used mainly for treating eye diseases. Interestingly, a study had shown that malachite was effective in inhibiting the growth of

Staphylococcus aureus (Nunn 1996). This mineral was used to treat various wounds or for dressing burns that was described to have become foul. However, researchers are unsure if the Egyptians knew the anti-bacterial effects of malachite or if malachite was mainly used for decoration due to its attractive color. Another mineral used to treat eye diseases was Lapis lazuli. It is a different mineral from the others mentioned so far due to the fact that it is not found in Egypt and is imported from Badakshan in Afghanistan. However, it has been found to be insoluble in body fluids, which suggests that it may not have any effectiveness in treating disease. Interestingly, studies of the past showed that the Egyptian physicians have recorded much information on eye diseases since eye diseases are common in Egypt due to the Nile and the unusual climate changes that occur during the year (Stetter, 1993).

Besides drugs of mineral composition, there were various drug products obtained from animals that have been useful for treating disease. Honey was a widely used medicine in ancient Egypt. Many papyri described it being used externally to treat wounds. The honey would provide an important medical effect because its osmotic effect would reduce swelling and could prevent bacterial growth. Oral intake of honey was prescribed to relieve cough and to treat children with gastroenteritis to shorten the duration of diarrhea (Nunn, 1996). An experiment was carried out to determine the antibacterial effects of honey on *Staphylococcus aureus*. The study showed that increasing doses of honey inhibited the growth of the bacteria (Estes, 1989).

Milk was mainly used as a solvent to mix in other substances that may have therapeutic effects. Milk was also used externally to be applied on the skin, eyes, and ears or poured into the vagina. However, most of the remedies involving milk were described to be taken orally. An example of a remedy, containing milk, from Ebers 193, to treat an obstructed stomach is shown below:

“tiam (unknown plant), 1/ 16; grains from umbrella pine of Byblos (peret-sheny), 1/16; ? valerian (shasha), 1/8; cyperus grass of the island (gyw n iw), 1/16; cyperus grass of the garden (gyw n hesep), 1/16; wine and milk; to be eaten and swallowed with sweet beer, to make him well immediately”. (Nunn, 1996)

This recipe does not specify the amount of milk or wine to use, suggesting that milk and wine are used more as a vehicle to make it easier for a person to take in the mixture orally. The origin of the milk was not conveyed but in other sources, it has been shown that milk was obtained from cow and at certain times, the origin of milk was of a human source (Nunn, 1996).

Excrement was obtained from a variety of animals such as cat, ass, birds, lizard, crocodile, fly and even man. It was used in various drug mixtures to be applied externally. However, it was suggested that bird and fly excrement should be ingested for medical treatment. Excrement was mainly used externally to treat eye problems (Nunn, 1996).

Blood was also a substance used in remedies. Blood from a number of species were used mainly for external applications. The Ebers papyrus (section 425) described the use of blood to be applied externally to prevent an eyelash from growing into the eye once it has been pulled out (Nunn, 1996).

Urine was used mainly as a vehicle in drug mixtures. It was used mainly as an external application for treatment. The Ramesseum papyrus III describes urine to be applied to the eyes to treat eye problems. Another common vehicle used in remedies was animal fat. Fat was boiled with oil and honey to produce an ointment that could be applied externally. It was suggested that the ointment produced by the fat from a specific animal may be applied externally in hopes that the healing effects from the animal could be transferred to the patient by the fat (Nunn, 1996).

Bile obtained from cow or from goat was used to treat human bites. Fish and pig bile were used to treat the eyes where fish bile was used to strengthen the eyes and pig bile was used to remove “evil things” in the eye. Bile was also used to treat wounds or abscess in the breast (Nunn, 1996).

Meat was used to dress wounds. This could be a useful remedy since meat provides blood clotting factors to stop bleeding. In some cases, the prescription of meat could be taken in by mouth as a way to treat dietary problems since it has also has a nutritional value. The liver was another popular product used for various treatments. Liver could be used to treat megaloblastic anemia due to its rich source of vitamin B12. However, there has been no evidence in the papyri that liver was used for this purpose. Liver also has a high source of vitamin A, which could be used to treat night blindness. In the Kahun papyrus, it was written that raw liver is to be ingested orally by a person who cannot see (Nunn, 1996). In the Ebers papyrus, there was a section, which suggested the treatment of cooked liver for “sharu-blindness”. However, in both cases, the writer did not indicate the use of liver for night blindness but it could be assumed that the writers were able to see that prescription of liver could improve eyesight.

Imhotep

Imhotep, a name that signifies ‘he who cometh in peace’, is a man whose knowledge and intelligence clearly distinguish himself in ancient Egypt. Imhotep is a commoner who rose through ranks of a peasant and was among the first few people with non-royal backgrounds to gain huge respect and admirable power.

He was born in Ankhtowe, Memphis on our equivalent of May 31 circa 2850 B.C. He is a son of a famous architect and court builder, Kanofer, his father and Khreduonkh, his mother. He is said to have receive all the education that one could possibly get in those far-off days and rose quickly through the ranks of temple and courts. He grew up as a versatile man whose wisdom is beyond words. He devoted his life to various activities

and brought wonders to ancient Egypt. He was the vizier, chief lector or priest, sage and scribe, astronomer, architect and above all a magician-physician (Hurry, 1928).

It is believed that Imhotep served under four Pharaohs beginning with Pharaoh Khasekhem. However it was with King Zoser that he held the office of vizier. Other great sages who had held the office included Kegemni and Ptah-hotpe. As a vizier, he had multiple responsibilities, which included chief judge, overseer of the King's records, bearer of the royal seal, chief of all works of the King, and supervisor of everything in the entire land. During his viziership, there was one particular incident that is worth mentioning called the Legend of Seven Years' Famine. Insufficient Nile floods for seven years is the physical cause of the famine in Egypt but the legend blames that the dryness of the Nile River was caused by the neglect of the Egyptians in the worship to Khnum, the god of the first Cataract. Imhotep advised the Pharaoh to build a temple in regard to this disaster but it was his plan of irrigation, food preservation and fisheries management that ended the famine (Hurry, 1928).

Imhotep was a great medical practitioner whose passion and love provided relief to the sick and poor. He earned the distinction to become the first known physician. Words about his magical touch spread to the ears of the royalties that he was summoned to save the life of Pharaoh Khasekhem's wife, who had a very difficult time giving birth to Prince Zoser. In the time of the Pharaohs, magic and medicine were closely allied. Therefore, the ability of Imhotep to cure the ill was regarded as some kind of wizardry work. He is believed to be the author of Edwin Smith Papyrus, Berlin Medical Papyrus and much of the Ebers Papyrus (Hurry, 1928).

Imhotep was a notable architect who has inherited his architectural knowledge from his master-builder father. He is said to be the first named architect in the history. One of his greatest creations is the Step-Pyramid of the Saqqara (the world's first known stone building). This pyramid is an index of a high state of civilization due to the huge amount of wealth, stable administration and experience in labour management that were needed to build such an extraordinary building. This pyramid eventually became the tomb of King Zoser who was buried with some of his most prized treasury (Hurry, 1928).

Imhotep was also the chief lector priest who belonged to the higher class priest who served as prophets or servants of the gods. In the eyes of the commoner, he represented the King and has the mysterious powers that raised him far above the level of ordinary humanity. He was quoted as 'Chief lector priest, scribe of the god, Imhotep the great One, Son of Ptah'. (Hurry, 1928)

After the death of Imhotep, there was a cult that spread throughout Egypt. He was accepted as the deity of medicine and was worshipped with the gods of Egypt. He was deified as the Egyptian "God of Medicine", and later as a universal God of Medicine. Several temples were built to honor him. The main one was at Memphis, which later

became a famous hospital and school of magic and medicine. There were also festivals held to commemorate him (Nunn, 1928).

Summary

The study of ancient Egyptian medicine has provided much information on medicine in ancient Egypt. The research of the past has conveyed the way the physician worked: how diagnosis was made, the types of treatments used and the prognosis of certain disorders at that time. Furthermore, the studies have eluded much information on the types of diseases the people faced with in the past. Much of the historical background of ancient Egypt could also be applied to other areas in the ancient world, allowing us to have a greater understanding of the past.

Tutankhamen's Curse

Learning about the medical practices in ancient Egypt has been a very interesting experience. The rest of the report will describe a historical event that occurred in Egypt that has been a popular topic for scientific debate. This section provides a brief summary of the research has been carried out regarding this incident to determine whether there was truly a curse that affected the discoverers of the tomb of Tutankhamen.

Tutankhamen curse was started with the discovery of Tutankhamen's tomb. He was believed to be murdered at the age of nineteen. He was not an important figure in the Pharaoh's history but the discovery of his undisturbed tomb that is ranked as one of the most important archeological findings brought him the limelight that he has never had when he was alive. Howard Carter was the ambitious archaeologist who was convinced that there was at least one undiscovered Pharaoh's tomb. He was able to convince and receive support from wealthy Lord Carnarvon to fund his journey. He discovered the tomb of Tutankhamen in 1922 (Carter, 1972).

It was said that at the entrance of Tutankhamen's tomb, there was a written curse in hieroglyphs, the translation being "*They who enter this sacred tomb shall swift be visited by wings of death*". Carter's pet canary, which he had brought with him back to Egypt for luck in his search for the missing tomb, was killed by a cobra on the same day of the tomb discovery. Reporting of the curse was fuelled by the death of Lord Carnarvon seven weeks after the official opening of the tomb. On the same night, his dog howled once and died. Five months after Carnarvon's death, his brother died suddenly (Rigby, 2000).

Only six of the twenty-six personages died within ten years of the opening. So was it really a curse or another story made by the media? Perhaps, the power of a curse is in the mind of the person who believes in it. Howard Carter, the man who actually opened the tomb, never believed in the curse and died at age 65 – that is 17 years after entering tomb. Lady Evelyn Herbert was the first to enter tomb, and she died at age 79. Dr D. E. Derry

who carried out the autopsy of mummy died 46 years after Carnarvon's death (Rigby, 2000).

There was a speculation that Lord Carnarvon's death was attributed to septicaemia, occurring after infection through a mosquito bite. This could have been due to anthrax acquired by inhaling spores from inside Tutankhamen's tomb. Anthrax certainly existed in ancient times and is often assumed to have been responsible for the fifth and sixth plagues of Egypt. Anthrax spores could well have been present in the tomb, and there would have been a real risk of exposure if the dust were inhaled (Kezwer, 1998). As to date, there has been no conclusion to the mystery of Tutankhamen's curse.

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THE APPEAL OF HOLES IN THE HEAD

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ABSTRACT

In 1863 Abraham Lincoln appointed Ephraim George Squier as a United States envoy to Peru to settle a financial dispute between the two nations. Squier was an American writer, diplomat, and self-taught archeologist with a passion for Central and South America. Following his diplomatic duties, Squier pursued his archeological interests. On examining a private collection of artifacts in Cuzco, Peru, he made one of the greatest discoveries in the history of cranial trepanation – an Inca skull fragment possessing a rectangular opening measuring 15 mm by 17 mm. The opening was irrefutably manmade, created while the individual was still alive. Trepanation of the skull is the removal of a piece of calvarium without damage to the underlying blood vessels, meninges, and brain. It is one of the earliest forms of surgical intervention of which there are authentic records.

Squier's discovery was an immediate sensation. Squier consulted Paul Broca, the renowned French anthropologist of the day who is better remembered for his contributions to neuroscience. Broca developed an instant interest in the subject and encouraged fellow anthropologists to look for even older trepanned skulls. Consequently hundreds of Neolithic skulls with perforations, estimated to be 4000 to 5000 years old, were discovered on French soil. Additional discoveries were made later all over Europe with even older skulls unearthed in the 20th century.

Trepanation remains so fascinating because it is such a dangerous and technically demanding procedure. Many different reasons for prehistoric trepanation have been proposed, but they can be broadly categorized into mystico-ritual and therapeutic motives. Trepanning has survived through history, with classical references by Hippocrates and Galen and renaissance accounts by Nicholas Tulp. Even today there are primitive cultures that continue this practice, and Hugo Bart Huges, a Dutch medical student, created a modern day revival by trepanning himself in 1965.

Introduction

Imagine a world where the most influential and enlightened individuals have holes in their heads. The medical specialists that perform this operation are equally revered. Furthermore, their operating theatre is not in the confines of a specialized, sterilized operating room, but rather their patient's home or outdoors in the natural world. The skull pieces that are removed to create these holes are dearly valued as good luck charms. Indeed this is a scenario that sounds like it hails from the vaults of Ripley's Believe It or Not! Yet amazingly it is a description of the earliest form of surgical intervention of which there are authentic records. Trepanation is a procedure that involves the removal of a piece of calvarium without damage to the underlying blood vessels, meninges, or brain. The word trepan derives from the Greek *trepanon* or *trypanon*, which means borer (Cook, 2000). This implies a drilling action, but in reality, several different techniques were used to perform the operation.

Trepanning remains so surprising and fascinating for a number of important reasons. First, there was a lack of knowledge of the modern medical principles of asepsis and anaesthesia. Second, trepanation was a highly successful operation with relatively low mortality. Third, it was incredibly widely distributed across both time and space. Finally, it is difficult to ignore a natural discrimination against the ability of prehistoric and primitive cultures to perform such a precise and exacting procedure. However when examined in the proper context, it becomes clear that trepanation can be considered a rational response to the daily experiences of the peoples who practiced it.

Discovery of Cranial Trepanation

Ephraim George Squier was a fervent American patriot who lived from 1821 to 1888. He was a man with many different talents who worked, at different times over his career, as a teacher, an engineer, a journalist, an author, an archaeologist, and a diplomat. However he had a notable passion for ancient cultures, a passion that was sparked by a group of ancient Indian mounds in Ohio. He believed he had a duty to show the world that the United States had a magnificent archaeological past, similar to the histories of Egypt, Greece, or Rome. Devoting himself fully to his archaeological work, Squier eventually published several works and established himself as one of the leading figures in American archaeology (Fernando and Finger, 2003).

In 1849, Squier successfully lobbied President Zachary Taylor for a diplomatic appointment to Central America. He viewed the situation as an ideal opportunity for funding new archaeological research south of the border. He served as a representative of his country admirably and also seized the chance to travel and study the history and cultures of Central America firsthand. Throughout this experience, he wrote numerous articles and published several volumes about the region. Because of his diplomatic skills and expertise in Central America, President Abraham Lincoln appointed him as a United States envoy to Peru in 1863. The diplomatic team was responsible for settling a financial

dispute between the two nations. Squier's role was minor, but this trip afforded him the chance to pursue his archaeological interests. Because of his reputation as a cultured man with historical and archaeological interests, he was invited to the home of a wealthy woman in Cuzco, Peru. It was in her museum-like home that he made one of the greatest discoveries in the history of cranial trepanation – an Inca skull fragment possessing a rectangular opening measuring 15 mm by 17 mm (Finger and Fernando, 2001).

Squier recognized the significance of this specimen, as the opening was irrefutably manmade. Upon returning to the United States, he presented the trepanned skull to the New York Academy of Medicine. The committee report concluded that "...at one portion of the opening there seemed to be evidence of the attempt of nature to form new bone, to repair the injury done by the operation" (Squier, 1877). However there was significant disagreement over the true nature of the skull. Another member of the academy did not see clear evidence of the reparative process and suggested that the procedure might have been done post-mortem (Squier, 1877).

Broca and His Influence

Because of the lack of consensus, Squier solicited Paul Broca, the renowned French anthropologist of the day, for his expert opinion. Although Broca had recently gained fame for his research on language, he also had a strong interest in human prehistory and a good measure of sensibility. The two men mutually respected each other (Fernando and Finger, 2003). After careful examination of the Peruvian skull, Broca concluded that the openings had to be the result of an "advanced surgery" on a living person. He pointed to the way that the bone around the opening was stripped of its periosteum to show that the operation was performed while the individual was still alive. Furthermore, the sharp edges around the hole and signs of inflammation suggested that death probably occurred a week or two later (Broca, 1867).

Broca's conclusions about the Peruvian skull were doubtfully received. His audience had trouble comprehending a pre-Columbian culture that could successfully carry out such a difficult surgery (Schiller, 1992). His friend and associate P.-Barthélemy Prunières, while working on some excavations in central France in 1868, discovered many skulls with large openings and rounded and polished pieces of skull bones within or near these specimens. He mistakenly suggested that these skulls had been used as ceremonial drinking cups because the edges of the holes were smoothed, but Broca postulated that the smoothed surface was the result of an extended period of healing after a trepanning operation (Finger and Clower, 2003). Prunières' excavation site confirmed that primitive cultures could trepan successfully (Gross, 2003).

Broca developed an instant interest in the subject and encouraged fellow European anthropologists to start searching for unusual skulls on their own soil. To his delight, hundreds of old, perforated crania were soon discovered, beginning in his native France and including Spain, Portugal, Germany, Czechoslovakia, Scotland, Denmark, Sweden,

Austria, Poland, Italy, and Russia. Furthermore, several previous specimens had to be re-examined and reconsidered as possible trepanation candidates. Some had been erroneously attributed to infectious processes, tumors, openings made by animals, accidents, or battle wounds (Finger and Clower, 2003).

Distribution across Time and Space

The distribution of trepanation is remarkable both in geography and in time. Some recent discoveries have been dated as early as 10,000 BC, placing the earliest trepanned specimens in the Mesolithic era (Lillie, 2003). It was widely practiced in Europe during the Neolithic age. Subsequent time periods, including the Iron Age, Greek, Roman, and Medieval times, all possess evidence, actual specimens and relevant literature, of the continuation of the trepanning tradition (Lisowski, 1967). The Hippocratic manuscript *On Wounds of the Head* advised that all skull fractures should be trepanned in the first three days after injury. Although the Hippocratic authorship of this manuscript is dated to about 400 BC, most scholars agree that he was not a surgeon and could not have written this book. However, *On Wounds of the Head* stands to be one of the earlier sources of written knowledge on trepanation (Martin, 2000). Along with Hippocrates, Galen of Pergamum stands as one of the most famous doctors in antiquity. His clinical and experimental studies indicate that by his time, trepanation was an established procedure for dealing with skull fractures and depressed fractures of the skull (Roca, 2003). These classical writings solidified trepanation as part of the Western medical tradition. It experienced a revival in the 16th century as a result of improved knowledge of human anatomy through the works of Andreas Vesalius and other anatomists. General indications for trepanation had been described by several authors, most notably Berengario da Carpi in Italy and the famous French surgeon Ambroise Paré. One of the earliest case reports of a trepanation was written in 1641 by the famous Dutch physician Dr. Nicolaes Tulp, immortalized by Rembrandt's famous work *The Anatomy Lesson of Dr. Nicolaes Tulp* (van Alphen, 2001).

Even to this day trepanation has survived among many primitive cultures, especially in Oceania and Africa. There are literally hundreds of twentieth century accounts of trepanning (Margetts, 1967). Incredibly, the practice is not confined to surgical theatres or traditional medicine men. Hugo Bart Huges, a Dutch medical student, created a modern day revival by trepanning himself in 1965. His theory of trepanning as a means of enlightenment and enhanced consciousness (Mellen, 1967) has been advocated by the International Trepanation Advocacy Group. This group maintains a sophisticated web site, <http://www.trepan.com>, with links to several historical papers, first person accounts of trepanning, and audio and video clips.

Geographically, trepanation has occurred throughout the world with skull specimens found in Europe, Asia, Africa, North, Central, and South America, and Oceania. Major centers have been identified in both France and Peru, with the French area probably a type of surgery center between 1900 and 1500 BC. New World specimens tend to be

more recent than some of the European skulls, with the oldest examples coming from Peru, dating to about 400 BC (Liu and Apuzzo, 2003). Clearly, the art of trepanning has been well practiced all across the globe.

Trepanning Methods

Earlier trepanations were performed most probably with the use of instruments made of flaked stone, obsidian, and bone. Several methods of operation have been described: scraping, grooving, straight incisions, boring and cutting, and trepanning. The scraping technique requires the removal of an area of bone by gradually scraping away, first the outer layer, then the inside diploë, and finally the inner layer to expose the dura mater within. The resulting opening is larger on the outer surface than the inner surface, creating a bevelled edge (Lisowski, 1967). The radius of movement on the part of the surgeon is small, visualization of the developing opening is good, so this method is relatively safe (Kirkup, 2003).

The grooving method involves the creation of a series of circular grooves drawn and redrawn on the skull until the bone between becomes loose. In similar fashion, four straight incisions intersecting at right angles could be made in the skull. The resulting fragment could then be removed (Lisowski, 1967). These two techniques are both difficult and hazardous because the arm motions involved are large, and the depth of the groove is visually obscured (Kirkup, 2003).

Boring and cutting requires the creation of a circle of closely adjoining perforations extending to the internal layer of bone. The resulting holes are connected by cuts and the freed fragment is levered out. The last method involves the use of a trepan. A trepan is an instrument probably used in ancient Greece and at a later period in Rome. The hollow cylindrical head is pressed into the skull to cut out a disc of bone from the skull. Clearly, a wide repertoire of trepanning methods was available to the operator (Lisowski, 1967).

Success without Asepsis and Anaesthesia

One of the more incredible aspects of trepanation is its high success rate and low mortality in the pre-asepsis and pre-anaesthesia era. In one study of 214 trepanned skulls from Peru, greater than half showed complete healing and only 28% showed no healing at all. In New Britain, an island in Oceania, it has been estimated that the mortality rate was only about 20% (Lisowski, 1967). The usual estimates for survival of different samples of trepanned skulls range from 50% to 90% (Gross, 2003).

The success of trepanning before the development of aseptic surgery in the 1860s can be attributed to the conditions under which the operation was performed. Although far from aseptic, the operating environment was relatively free from the hazards and contaminations of infection. It was not carried out in an operating room where previous operations had occurred, but either in the patient's home or a well ventilated open space

outside. The healer probably didn't attend to the cases immediately after each other, so the carrying of contamination on the person of the healer would be minimized. Finally, the patient was not confined to a hospital full of individuals with transmittable, pathological conditions (Rogers, 1985). In stark contrast, surgeons in London in the late 1800s had a mortality of 78% for trepanations at the teaching hospitals (Ballance, 1922).

The matter of anaesthesia use is rather uncertain. In Peru, coca leaves or other herbal preparations could have produced an anaesthetic effect. Alcohol could also have produced such an effect. However, it is far from certain if such agents were actually used (Rose, 2003). Surprisingly, skull surgery itself is relatively painless once the scalp has been cut (Martin, 2003). Today, among the Kisii of Kenya, restraint instead of mind-altering substance is used to perform the operation (Margetts, 1967).

Rational in Context

To merely attribute trepanations to magic does an immense disservice to humanity and does not adequately explain the thinking that led to the operation. The context behind prehistoric trepanation must be examined to fully understand its rationale. Neolithic humans lived in a significantly more dangerous and hazardous environment compared to the present. Although the New Stone Age signalled the advent of animal domestication and agricultural practice, hunting was still an integral part of life. There must have been a considerable amount of experience based knowledge about weapons, vital spots, blows, and wounds (Pioreschi, 1991). Through accidents, battles, and hunting, head trauma must have occurred at a significantly higher rate than at present. It is not out of the question that prehistoric humans would be familiar with accidental scalp lacerations or wounds.

Such insults could easily reveal the bare skull. If left untreated, exposed bone dries out and dies. After an extended period of time, the dead bone will separate from the living and drop out. However, this could take up to six months or may never happen. Throughout this time, the dead bone acts as a constant reservoir of infection with pus continually discharging from the area. The demarcation between dead bone and living skull is clear to the human eye. Dead portions appear either pale and bloodless if kept clean and covered or black and necrotic if the blood pigments are allowed to oxidize with air. It is relatively simple for an individual to take a sharp flint and to scrape away at the dead bone. Such action would actually speed the closure of the wound and minimize further complications (Martin, 2003). Trepanation could thus be invented out of daily experience. This helps explain the widespread distribution of the practice all over the world and over the course of history.

Because science and magic in their early stages are indistinguishable, it is difficult to differentiate between therapeutic and mystico-ritual motives. There are three broad therapeutic reasons for trepanation. Trepanning can treat skull fractures, both in cases of depressed fractures and to drain out blood from beneath the bone. It can also be used to

remove dead and dying bone exposed in a scalp wound. Finally, fever or headache may be alleviated by removal of a piece of the skull if the malady is caused by pus under the skull (Martin, 2003). The trepanned skulls retrieved from Peru are most likely examples of operations conducted for therapeutic reasons. Of 250 skulls recovered from the south of Lima, from the fifth century BC to the fifth century AD, almost 70% were male (Rose, 2003). Additionally, many trepanned skulls were recovered with both fractures and with trepan holes on the left-side of the head. This is indicative of trepanning for injuries suffered mostly by males in the midst of warfare. Furthermore the left-sided trepan holes indicate a blow to the head by a right-handed individual (Rogers, 1985).

Mystico-ritual motives must have also been important, as the Neolithic French skulls lack fracture signs or signs of trauma. Trepanning could be used to permit the escape of evil spirits causing illness from the skull. Additionally it could have been used as a prophylactic measure to promote health and well-being during later life or as an initiation ritual. Finally, it may have been important to obtain part of the skull as an amulet, much like the specimens that P.-Barthélemy Prunières discovered. The accompanying polished, rounded pieces of skull, known as rondelles, were probably thought of as possessing mystic properties (Rogers, 1985). The broad categorization between therapeutic motives and mystico-ritual motives can be illustrated by a modern day example. Today in Africa, the Kisii tribe uses trepanation to alleviate headaches while the nearby Lugbara tribe uses the procedure to release evil spirits (Margetts, 1967).

Conclusion

Cranial trepanation is a practice that was most probably tied to a multitude of factors including magic, religion, and ancient medicine. This phenomenon cannot be fully understood without the contributions from many disciplines, including archaeology, anthropology, neuroscience, history, psychology, and osteology. Trepanation is a difficult phenomenon to comprehend, especially in this day and age where the head is highly valued as the seat of the intellect. However, the significance of the brain wasn't the same to other cultures. The Egyptians threw the brain away when making mummies (Nunn, 1996), and Aristotle thought that it was a sponge to cool the blood (Singer, 1957). One must consider the context to understand the reasons and motives for such a difficult and hazardous procedure. It is not known whether Paul Broca would have recognized the trepanned French Neolithic skulls for what they are if he had not been introduced to Squier's Peruvian skull. However, Squier's specimen has provided today's scholars with a new perspective on primitive archaeological artifacts; the ultimate lesson is that one should always keep an open mind.

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DEFORMITY AND DISABILITY: A GRAECO-ROMAN PERSPECTIVE

By

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ABSTRACT

The treatment of persons considered outside the confines of physical normalcy has historically been a black mark on humanity. Dating back to the Classical World, the treatment of deformed, malformed, and disabled individuals has often been fraught with ignorance and cruelty.

Although Greeks and Romans had differing perspectives the meaning of a malformed child, those who did not appear healthy or properly formed at birth were susceptible to infanticide. The Greeks appeared to take a more pragmatic approach to dealing with children born with birth defects. They acknowledged that certain deformed or disabled individuals may live a painful existence, would likely never grow to contribute to society, and would end up being a financial burden to their family. Spiritually speaking, many Greeks believed that malformed children were a punishment from the Gods for sins done by the parents or forefathers.

On the other hand, Romans were driven by fear of the unknown. They believed that malformed individuals were portents, warning of impending disaster. As a consequence, many infants, children and young people were killed as a way of preventing disaster, or at least, alleviating public anxiety. As time moved towards the Imperial era, the fear of those physically different turned into more of a morbid fascination. Instead of being cast out, the upper class bought physically and mentally disabled people as slaves, to be used for their own entertainment.

Proposed causes of birth defects were highly imaginative for the most part, however, only a few individuals, such as Aristotle and Hippocrates, recognized that there was a hereditary basis to many types of physical deformities. Treatment for physical abnormalities ranged from the dangerously absurd, as in the case of hunchback, to the extremely useful, as in the case of clubfoot.

In present day, developed countries have a variety of means to assist those affected with mental or physical disability. Whether the disability was congenital or acquired, society has means of supporting those people so that they can have a more functional life, a more meaningful life, and if possible, make valuable contributions to society. Part of this assistance is due to advances in Medicine, which have created ways to correct what would in the past have been debilitating or even lethal disabilities. However, this type of social system has not always existed. What would life have been like for a baby born with a congenital malformation, deformity, or disability 2500 to 2000 years ago in ancient Greece or Rome? For a variety of reasons, these people were destined for a different fate.

When discussing the topic of deformity and disability, it is important to acknowledge the different meanings of specific terms, which are often used interchangeably. A congenital malformation is a structural difference caused by an intrinsic developmental abnormality, for example trisomy or polydactyly, whereas a congenital deformity is a physical affliction present at birth due to extrinsic forces on a normal fetus, for example oligohydramnios causing developmental dysplasia of the hip. Acquired deformities are physical afflictions that have occurred throughout the course of life. In the Graeco-Roman era these were very common because of wars, heavy work, and disease. I have classified afflictions such as blindness, epilepsy, and mental handicaps under the term disability even though they are present at birth. I do this because these conditions would not necessarily be detectable at birth and therefore would result in a different outcome for that infant as compared with an infant having a noticeable physical malformation or deformity. I will use the terms malformation and deformity interchangeably as a way to encompass both meanings.

Present day estimates of congenital deformity and malformation are about 3% of all live births (Personal communication, Dr. J. Gerritsen). Incidence in antiquity was likely equal or slightly higher due to increased levels of malnutrition, disease, and consanguineous unions. Not surprisingly, far fewer people would have survived infancy during this time period. Aside from death by infection, children born with a malformation would have been victims of infanticide for reasons such as religious fears and pressure, and the financial hardship faced by the parents in raising a child that could not grow to contribute to the household or society in general (2). In addition, there was a lack of medical skill and knowledge that we currently use to extend the life of a newborn. For example, cleft lip and palate, considered a relatively benign affliction and easily correctable by surgery now, would have led to the infant's death in ancient Greece and Rome.

It should be noted that infanticide was not only practiced on those with physical malformations, but also during times when the population was getting too large, or when males were in higher demand, that is, female babies were subjected to infanticide, a practice that still occurs in areas such as rural India (1).

It is difficult to tell how the two societies, at different points in time, viewed specific deformities. Specific definitions for what deformities were “acceptable”, that is, could slip by the scrutiny, are rarely encountered. This makes it hard to tell whether a baby with polydactyly, which is a benign affliction, would be killed, or whether it would be allowed to live. One thing seems constant though, major deformities, say a trisomy or congenitally missing limbs, would not survive.

In Greek society, both humans and animals exhibiting gross malformations were referred to using the term *Teras*. Sadly, this is also the word used to describe mythical monsters, such as the Gorgon Medusa, which is referred to as “the teras of aegis-bearing Zeus” in Homer’s *Iliad*. This is where we get the term *teratology*. *Teras*’ were looked upon as a punishment for sins done by the forefathers of that child. For example, perhaps past family members broke an oath, robbed from temples, or failed to make the proper tributes to the Gods. Another factor that would contribute to the fate of the malformed infant was that they would not likely grow up to lead a full, active, independent existence nor contribute economically to society. (2)

Ideas and practices regarding infanticide in Greece varied between regions. Sparta was very nationalist state and because of this eugenics was strictly upheld; the abandonment of the sickly newborn was a legal requirement (2). If children did not die of their affliction within the first few days of life, they were “exposed”. As a property of the state, the fate of a newborn was determined by a group of elders. If the baby was healthy and strong, it was placed in that care of the father for raising, if it was deemed ill-born, it was taken to be exposed. Exposure required the infant to be taken outside of the city or town boundaries and left in a hole to die, or alternatively they were drowned. In the case of Sparta, the infants were taken to a specific place called the Apothetae, also referred to as the place of exposure or rejection. In Sparta boys were more susceptible to rejection than girls, which was generally more common elsewhere. I imagine that there were high standards for the men because they comprised the military, and Sparta likely wanted only the best to represent them in battle.

It was difficult to find what the guidelines were for determining what constituted defectiveness in a child. However, Soranus, a Greek physician in 1st and 2nd century A.D., did provide a description in a section of his work *Gynaecology* entitled “How to recognize a newborn worth raising” (3). He outlines that the newborn should,

“...be perfect in all its parts, limbs, and senses, and have passages that are not obstructed, including the ears, nose, throat, urethra and anus. Its natural movements should neither be slow nor feeble, its limbs should bend and stretch, its size and shape should be appropriate, and it should respond to external stimuli.”

Athens appeared to be a more forgiving state than Sparta. In addition to providing a form of welfare for those disabled by war or during work, Athens was not as heavily

influenced by the idea of racial homogeneity, and it was not a formal law to expose infants, yet was still commonly practised (2). Fortunately, the parents of afflicted children were not punished for producing undesirable offspring. However, this did not mean they received much support if they decided to go and rear the child despite the pressures.

In comparison to the Greeks, the Romans saw the birth of a deformed infant as a sign from the Gods warning of disaster (2). The word *monstrum*, often used to describe a deformed infant, is derived from the Latin term ‘monere’ meaning “to warn”.

This was not a new idea. The earliest written records of congenital malformations as birth omens comes from Babylonian clay tablets that are suspected to date back to 2000 B.C. (4). A list of sixty-two deformities was recorded, each with a corresponding consequence for the kingdom. For example, when a woman gives birth to an infant with the ears of a lion, there will be a powerful king in the country; if the infant has no penis, the master of the house will be enriched by the harvest of his fields (4).

In Republican Rome, a law was passed insisting on the killing of deformed children. Table IV of a law code called the Twelve Tables instructs the paterfamilias (head of the family) that “A dreadfully deformed child shall be quickly killed.” (5). The paterfamilias did not have to obtain witnesses to the child’s condition before the killing. However, by the first century BC, there was no longer a law demanding the death of deformed newborns.

Roman society between 300 – 92 BC saw individuals of indeterminate gender, which were termed hermaphrodites, as a particularly bad omen. These people tended to be blame for losses at war and social violence. In an effort to prevent the disaster, these people were executed by way of being burned alive, buried alive, or sent out to sea in a sealed casket (2).

In spite of the social pressures to expose them, children with congenital deformity did survive, even within the Imperial family. Claudius, nephew of Augustus, was said to have clubfoot because he walked with a limp. It has also been recorded that he suffered from a speech impediment, so historians speculate that he may have actually had cerebral palsy (6). He was treated with disdain by his own family, especially his sister and mother, who referred to him as a monstrosity that Nature had begun but not yet finished. Despite being mocked and hidden from public view by his family, he was not deprived of an education. After Caligula was assassinated, he went on to become the 4th Emperor of Rome.

Strangely, in later times, deformed and disabled people became an object of fascination to the Roman elite, who came to keep them as slaves and “toys”, using them for their own amusement (2). These people were kept in much the same way as they kept exotic

pets, but no doubt abused them to a greater extent. From fear to more of a morbid, twisted fascination, the disabled became “fashionable”.

Few ancient medical writers tackled the subject of treating congenital deformity. The best source of information pertaining to treatments came from the *Hippocratic Corpus*, a collection of books containing the various treatises I will be mentioning. Lack of interest and debate on the subject of congenital deformity was probably due in part to the inability of infants with life threatening deformities to actually survive infancy.

Secondly, the belief that deformity was a doing of the Gods likely dissuaded people from trying to interfere with what the Gods had created. Thirdly, physicians probably recognized the limits of their skill and knew they were unable to provide greater chances for survival for individuals with chronic illness (2). This last statement does not only apply to people born with congenital defects, but also to those who have acquired deformity and disease with aging, meaning the elderly were often left to fend for themselves.

In ancient times, Epilepsy was considered to be an affliction brought on by the Gods later in life (2). Earlier “practitioners” believed that many different substances should be avoided, among them a variety of herbs, such as mint, meats such as goat, sow, and dog, and fabrics such as anything black or made of goatskin. Hippocrates did not believe this nonsense of “purification and spells” and thought that epilepsy was inherited like many other diseases, but was ultimately caused by the sun the cold and the wind, and if the physician waits until the appropriate time of the year, he can wear the disease out by applying the appropriate remedies (7). It is implied that it is up to the physician to figure out exactly what those remedies are.

There were two methods described in the Hippocratic treatise *Joints*, which could be employed to eliminate a hunched back (2). In the first method, the patient would be bound to a ladder, feet down if the hump was higher up, and head down if the hump was lower down. The ladder was then suspended next to a wall and sharply, yet smoothly, released to dislodge the morbid deposit lodged in the back. This was not the recommended treatment by the author. In the second treatment, the author recommends having the patient lie down on a board covered in cloaks, which is sitting adjacent to a wall. A board is then passed crosswise over the hump, inserted into a groove in the wall, and downward pressure is applied in hopes of straightening out the curved spine.

Congenital clubfoot was treated in much the same way 2000 years ago as it is treated now. It involves the use of a wearing tight bandages infused with resin which are meant to bend the foot into a normal orientation, corrective shoes, and physiotherapy. It was noted that if the clubfoot was treated early enough, the condition is curable (2).

At the time of birth, midwives were usually present instead of physicians. If a baby was still born or aborted, the physician was not there to see it, and of course, the body would

have been disposed of quickly, as was the law in Greece. Due to a lack of human specimens to study on, animal dissections were used in order to understand more about the body's changes during disease, but not necessarily the cause of disease.

Understanding heredity was at a primitive stage 2500 years ago. Aristotle recognized that traits were likely passed from parent to child, and that there were likely natural causes for the presence of deformity, rather than simply the anger of the Gods, which was a widely held belief. He observed that,

“...deformed children came from deformed parents, and blind from blind...however, for the children of cripples are generally sound...”

which meant that if one acquired a disease, their children would not have that disease, but if they had always had that disease, so would their children (2). Pliny, who lived 400 years later, noted that sometimes people with disability would have disabled children, yet sometimes they would have normal children, and normal people would have disabled children (2). He was able to note that there is not always a black or white pattern to heredity. The variation of heredity was perplexing at the time.

Other theories on fetal development included age of the parents, climate, water quality, and the direction of prevailing winds. For example, if the parents were too young, they would produce weak or underdeveloped females, and if there is rain in the winter followed by a cold, dry spring, this can cause miscarriage or defective offspring (2).

What the expectant mother observes will influence the appearance and health of her baby (2). Women were encouraged to gaze upon strong beautiful statues in order to produce strong beautiful children. Conversely, it was bad for a woman to be intoxicated during intercourse because “...her mind can fall prey to wild imaginings.” such as the story of a woman who had visions of monkeys at conception and then gave birth to a monkey-like child (2). If there was even a flake of truth to this, it was probably that she gave birth to a baby with a caudal appendage, or perhaps the baby was microcephalic or had a larger amount of fine body hair, as newborns sometimes do.

It was also believed that forces upon the uterus could have a negative affect on the fetus. A 5th century Hippocratic treatise entitled *The Seed*, stated that a blow to the uterine wall, such as from a fall, will cause deformity to the infant. Also, a constricted uterus will misshape a baby. Expectant mothers were encouraged to do exercises that would give proper shape to the fetus (2).

The Hybrid Theory of reproduction describes the birth of infants that appear to be the product of a union between a female human and an animal. Clearly, this is not biologically possible, although it is possible to have malformations that might resemble other animal species. This type conception was widely incorporated into Greek Myth in the form of such creatures as Minotaurs and Satyrs.

Greek and Roman society had similar practices of infanticide for newborns that did not appear normal, yet Greeks seemed to be less hostile towards the presence of deformity and disability. In general, Greeks viewed those born with physical disabilities as punishment and a burden, but not something to be feared. In comparison, Romans viewed those deformed and disabled as omens warning of disaster, and later on, objects to be used for selfish purposes.

With the exception of clubfoot, few useful treatments were available to those afflicted with disability or deformity. However, in many cases, modern medical skills can now provide life, or improved quality of life, where it would previously have been lost. In addition, little understanding was gained about aetiology of congenital deformity. Perhaps because of lack of human specimens to observe, or perhaps because they saw little reason to search for a cause - if Gods will it, so shall it be.

Although we are presently limited in the medical treatment we can provide to those affected by certain disabilities and congenital diseases, we have come a long way in terms of compassion and support for those individuals not born “normal” by societal standards. However, I will conclude with some food for thought: In North America we currently live in economic prosperity. If we were forced into a time of poverty, famine, or war, might our social infrastructure change to such a degree that we would consider social practices similar to the ancient Greeks and Romans? Some acts are not about good or bad, right or wrong, but rather about a sense of desperation and perceived necessity.

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THE RISE AND FALL OF THE FRONTAL LOBOTOMY

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ABSTRACT

The Nobel Prize for Physiology or Medicine of 1949 was awarded to Egas Moniz "for his discovery of the therapeutic value of leucotomy in certain psychoses." The technique of frontal leucotomy (later frontal lobotomy) was popularized between 1948 and 1952 as the leading treatment for schizophrenia. Conceived in Portugal by Moniz and adapted for North American audiences by Walter Freeman with whose name frontal lobotomy has become synonymous, the drastic procedure was performed on tens of thousands of psychiatric patients. In hindsight, the prospect of inserting surgical instruments resembling ice picks into the frontal lobes of patients and blindly destroying neural tissue seems unduly crude, torturous, and inconsiderably unethical but physicians worldwide had adopted the frontal lobotomy with confidence, though the evidence for its inception was sparse at best and disconcert over its use was strong but surmountable.

Given present day understanding of the function of the frontal lobes in planning and anticipatory behaviors, frontal lobotomy has been virtually eliminated and the treatments for the conditions for which it was once a miracle cure are now largely pharmacologic. However, frontal lobotomy has not been forgotten and serves the current medical community as a humbling and imploringly instructive tale such that similar catastrophic consequences of our treatments shall not be suffered by our patients.

The rise and fall of the frontal lobotomy is a fascinating story of the societal milieu, support of prominent emissaries, lack of alternate means, and overwhelming lack of scientific evidence from which contemporary medical practitioners must learn valuable lessons to ensure such iatrogenic devastation does not again occur.

The study of history is not a foreign one to the medical profession. It is well recognized that the elucidation of the present condition is fundamentally dependent upon the past through which it developed – that is, upon its history. In forming diagnoses, history holds a unique role in facilitating the physician's understanding of his or her patient. Similarly, for the student who desires a deepened understanding of the current state of his or her

profession, the study of its history is equally vital. Moreover, we must study history to “gain access to the laboratory of human experience,” (American Historical Association) and of course, to learn and gain insights for ourselves in the present and future. Therefore, if we are interested in the advancement and progression our profession, we must embark on its history. The historical approach to the study of the frontal lobotomy provides a remarkable backdrop upon which to sketch the nature of the medical profession and its undeniable though often understated attachment to sociopolitical forces and powerful personalities. The history of the frontal lobotomy is a profoundly educational tale of the social, political, and intellectual influences upon the practice of medicine and the consequences when these influences lead us down regrettable paths. In this sense, this account of the tumultuous course of the frontal lobotomy is an excellent example from which we must learn important lessons and reflect upon the powerful privileges of our profession such that we can begin to appreciate our responsibility and act with integrity based upon a strong foundational knowledge of where our profession has been and both the good and bad that it is capable of so that we may maximize the good and minimize the bad.

Nevertheless, the history of psychosurgery predates modern medicine by millennia. Evidence of trephining, that is, intentionally opening the cranium, has been collected from the Stone Age (1500 B.C.). In 1996, carbon dating confirmed the age of a trepanned skull found in France at the Ensisheim Stone Age burial site to be from 5100 B.C. This skull is thought to have belonged to a male of fifty years and showed evidence of healing. Trephination as an early precursor of lobotomy was indicated for both spiritual and psychiatric turmoil thought to arise from the brain including seizures and headaches. It has been claimed that trepanned skulls exist prior to the Neolithic Period, but their validity is questioned (Alt et al. 1997) in terms of the intentionality of the cranial opening. Infection, tumor, fracture, and post mortem animal mutilation have been implicated in these very early specimens. It is important to note, however, that though trephination can be considered a grandfather of lobotomy, it involves only the skull while lobotomy truly involves nervous tissue.

Thus, a transition must have occurred from surgical procedures of the skull, to deeper incisions into the brain itself. It is commonly thought, although not without counter speculation (School of Psychology, Deakin University), that the case very familiar to psychology students of Phineas Gage was a serendipitous finding that altering (to put it lightly) brain matter could significantly alter behavior. On September 13, 1848, Gage, then a foreman working with a railway crew near the outskirts of Cavendish, Vermont, was struck in the head with a tamping iron (43 inches long, 1.25 inches in circumference). An accidental explosion of the charge he was packing sent the tamping iron through Gage's skull. The railway physician Dr. John Harlow wrote in his account of the accident that “the tamping iron had entered the cranium, passing through the anterior left lobe of the cerebrum and making its exit along the median line, at the junction of the coronal and sagittal sutures, lacerating the longitudinal sinus, fracturing the parietal and frontal bones extensively, breaking up considerable portions of brain, and protruding the

globe of the left eye from its socket, by nearly one half of its diameter . . . The patient was thrown on his back and gave a few convulsive motions of the extremities but spoke in a few minutes . . . I passed in the index finger its whole length without the least resistance in the direction of the wound in the cheek, which received the other finger in a like manner. The iron which was found at some distance, was smeared with brain . . ." (Hass 2001).

Of greatest interest is the documented change in Gage's personality: previously described as possessing a "well balanced mind . . . a shrewd, smart businessman, very energetic and persistent in executing all his plans of operation. Post injury, Harlow described Gage's changed personality in a letter to the *New England Journal of Medicine* in 1848 as "radically changed, so decidedly that his friends and acquaintances said 'he was no longer Gage.'" (Feldman and Goodrich 2001). Hence, the case of Phineas Gage served as a provoking introduction to study of the behavioral manifestations of injuries to the frontal lobes of the human brain. Brain-behaviorism had gained hype and importance in the scientific and medical communities – setting the stage for further experimentation.

In this vein, the idea that particular anatomical regions of the brain had particular functions and that increases or decreases in the brain mass of certain structures correlated to the over or under representation of particular behaviors in a subject was explored. Fritsch and Hitzig were instrumental in describing the effects of electrical stimulation of the dog cortex (essentially mapping the cortex) and later Ferrier and others contributed to the expansion of these cortical maps in primates. (Feldman and Goodrich 2001). Broca and Wernicke furthered these brain-behavior suggestions with their evidence from the localizations of lesions in autopsied brains of dysphasic patients. These thoughts were enhanced by Goltz who proposed a relationship between emotional behaviors and specific brain structures. Particularly, Goltz believed that by lesioning (as opposed to electrically stimulating) a brain structure and observing the deficiencies of the animal he could infer the lesioned structure's function in the intact brain. Hence, when he noticed a calming effect of temporal lobectomy in dogs compared to unoperated dogs he tied emotional behavior centers to the anatomical restrictions of the temporal lobe (Joanette et al. 1993).

This logic appealed to Friedrich Burckhardt. The neuroscience milieu of the time being overwhelmingly localizational and associationalist, Burckhardt conjectured that he could help patients with behavioral disturbances by either diminishing the mass of a given pathological centre or by diminishing the influence that it could have on other parts of the brain (Joanette et al. 1993). The nature of his work was pioneering and in support of these new ideas, he created an anatomical model of pathological behavior and inferred from it that cautious and thoughtful lesions should alleviate the symptoms from which his patients suffered. Today, Burckhardt is renowned as the father of psychosurgery, but the accounts of the reception of his psychosurgical attempts in the late 19th century paint a more disapproving picture. After performing temporal lobectomy (excision of a portion of temporal cortical tissue) on six severe and untreatable schizophrenic patients at Prefargen Asylum in Switzerland (of which he was superintendent), Burckhardt presented

his results in 1890 at the Berlin International Medical Congress. His presentation of his six patients is said to have caused a chill in the room. (Joanette et al. 1993) Though the localization and association theories of brain functions such as language and motor function were strong, the psychoses were seen as reflections of diffuse pathologies of the cerebral cortex. Hence was made the comment by the esteemed German psychiatrist Kraeplin, "He suggested that restless patients could be pacified by scratching away the cerebral cortex." The theoretical underpinnings of Burckhardt's early psychosurgery were disputed as contradicting the "unity of the psyche" (Stone 2001). An ironic criticism came from Walter Freeman's grandfather who would later be influential in his grandson's early career: "It is doubtful whether such operations are justifiable" (Stone 2001). Burckhardt's reactions to this immediate criticism were respectable in that he did not again perform surgery, but continued to be an outstanding superintendent of Prefarger and an excellent psychiatrist to his patients. Thus, psychosurgery had progressed from trephination and had now come as deep as the cortex and met a sudden death in the medical community. It would rest quietly for forty years while progress was made in cerebral localization and neuroscience (Feldman and Goodrich 2001). In these intervening years, the removal of tumors and abscesses lead to further observations that some patients were relieved of their mental symptoms including anxiety, depression, and hallucinations. Damage to the frontal lobes of soldiers in World War One provided a wealth of information to neuroscientists.

Thus far, then, the reader has been presented with elements of the progression of frontal lobotomy of which none are particularly jarring to our ethical frameworks. In the case of trephining, we hardly hold it against our ancient ancestors who we imagine as far too ignorant to be malicious or hurtful. In fact, we praise them for their ability even to associate the cranial region of the body with the mind. In the case of Phineas Gage, the circumstances were accidental and we do not feel critical of the medical community at the time; no more than we criticize modern day neurologists for studying patients who have suffered cerebrovascular accidents. In fact, we consider it miraculous that they were able to keep Gage alive for a post-incident fifteen years. Moreover, Dr. Harlow seems to have had true concern for Gage, following him for fifteen years and even going so far as to respectfully not publish Gage's personality deterioration until after his death. Goltz was performing experiments with dogs which we may realistically see today. In Burckhardt's case, we may wonder how he could be so inspired by an animal experiment that he would take the blade to six of his patients. But we may forgive Burckhardt for his refrain upon receiving criticism and we may respect him for continuing his work as an excellent superintendent. Here, the question arises: if we more or less agree with the actions of these preliminary characters, what is the purpose of studying them? We can criticize Gage no more than Goltz and at most we can learn from Burckhardt that attempting procedures in humans immediately after they are attempted in animals is not acceptable. The moral and ethical objections are more poignant in the history of lobotomy occurring in the twentieth century, though the early developments are important (and interesting) to understand its development.

In 1935, at the Second World Conference of Neurology in London, a presentation was made by Fulton and Jacobsen in which they captivated their audience with the research they had been conducting on chimpanzees. The experiments were delayed matching to sample tasks, in which the chimpanzees were shown a food reward hidden under one of two differently colored cups, and had to choose the correct cup after a delay of a few seconds to a few minutes with a screen blocking their view during the delay period. One particular chimpanzee, Becky, became extremely agitated when she would choose incorrectly and hence not receive the reward to the point that she dreaded performing the task at all and would have tantrums when she was brought near the cage for the experiment. Fulton and Jacobsen subsequently performed a frontal lobotomy and noticed that Becky no longer resisted partaking in the experiment. Though her performance accuracy fell to fifty percent (no better than chance), she was neither bothered nor excited by her successes or failures (Kopell and Rezai 2003).

In their audience, among many others, was Egas Moniz who is said to have risen, captured by the effects of the lobotomy on the emotional change in Becky, and said: “If frontal lobotomy prevents the development of experimental neuroses in animals and eliminates frustrational behavior, why would it not be feasible to relieve anxiety states in man by surgical means?” (Teirney 2000). It is said that Freeman had been desperate to pose an identical question and was brightened by Moniz’s courage (Adventures with an Icepick). The Fulton-Jacobsen experiment has remained distorted by Moniz’s question, as the experiments were truly studying “complex adaptive responses” and not “experimental neurosis” (Valenstein 1986, 95). In fact, Lucy, the second chimpanzee in the experiment displayed precisely the opposite results; that is, preoperatively Lucy had been minimally emotional, while once lobotomized, she threw violent tantrums.

While Moniz denied any substantial influence of the Fulton-Jacobsen experiment on his thoughts, he did cite the work of Nobel laureate Ramon y Cajal which he interpreted as support for his belief that neuroses were caused by repetitive thought patterns within anatomically fixed neural circuits (Valenstein 1986, 99). Cajal, however, had never studied the mechanism by which thoughts reside in the brain; instead, he had observed that the neurons of young mammals were capable of axonal and dendritic growth, while those of adult mammals were not. Hence, Cajal’s brilliant neuroanatomical observations were interpreted as functional truths. In Moniz’s later publications, he mentioned superficially Pavlov and other Russian physiologists without clearly defining their relevance to frontal lobotomy (Valenstein 1986, 98). Importantly, Moniz had succeeded in deluding the community that a scientific basis for lobotomy was established.

One must wonder how the ideas remained uncriticized. Truthfully, they were not entirely uncondemned – a colleague of Moniz’s referred to them as “cerebral mythology” (Valenstein 1986, 99) – but Moniz’s past rigorous political involvement and previous work in cerebral angiography built him a reputation which enabled him to remain more or less free from any insurmountable opposition. Hence, without strong opposition, Moniz had only to find a surgeon (his own hands suffered terrible gout). This was by no means a

search as his disciple Almeida Lima had performed all of the surgeries in the cerebral angiography work and would doubtlessly do the bidding of Moniz in hope of securing the position of professor of neurology in the future (Valenstein 1986, 101).

Before moving to the technicalities and outcomes of Moniz's first trials, it is necessary to pause and elaborate upon the components of this process from which lessons may be gleaned so to make the study of this history beneficial. Moniz claimed to have had been pondering lobotomy for a significant amount of time and thus downplayed the influence of the Fulton-Jacobsen experiments, though he never wrote about the idea beforehand (Valenstein 1986, 95). Regardless, medical students of today must ensure that such grave errors of narrow-mindedness (to the extreme of disregarding Lucy) do not occur. That is, all efforts must be made to examine evidence in support of and more pressingly, in opposition to our hypotheses. Though this sounds absurdly obvious, in this case Moniz's ambition blinded his scientific self-criticism. Additionally, the direct application of animal research to human subjects must be taken with exaggerated skepticism. And vital to the quality and soundness of science, a scientist's reputation should not precede him. Scientific and medical research must stand on its own merit and not upon that of its discoverer. Here, Moniz's political reputation and previous outstanding work let many others unscrutinizingly accept his ideas, procedures, and results. Moniz has been accused of hastening frontal leucotomy in hope of achieving a Nobel Prize (for which he was twice nominated for cerebral angiography). He was getting old and did not have many years left to leave his legacy (Tierney 2000). Here, we must learn that tempting as fame may be, the ceaseless pursuit of fame may ironically bring infamy.

Moniz and Lima, in 1936 – the year after the London Conference – embarked upon their first clinical trails. Originally, holes were drilled in the skull, hypodermic syringes passed through, and small volumes of absolute alcohol injected into the centrum semiovale. The centrum semiovale was chosen because it was fiber dense and the chance of rupturing major blood vessels was relatively low (Valenstein 1986, 102). There was no evidence, however, that the centrum semiovale contained fibers which housed fixed thought patterns. The amount of alcohol and the number of holes in the skull varied by patient and tended to increase as the trial of twenty patients continued. The patients had varying diagnoses (depression, schizophrenia, anxiety, etc.) (Tierney 2000) but were all thought to have recurring fixed thoughts. On the eighth patient, the leucotome was used: a probe like device was inserted into the brain after which a barrel was depressed to cause a wire to bulge from a slit near the bottom of the instrument. Hence, fibers in the path of the wire were destroyed. The leucotome was then rotated such that a one centimeter core of brain tissue was destroyed. No reason for the switch in methodology was documented, but as with the escalating alcohol injections, they began with two cores and soon moved to four (Valenstein 1986, 108).

The interval between the operations was on average four days and the procedure was changed frequently. Hence, adequate post operational observation periods were not maintained and the scientific validity of the trial was wholly underscored. Moniz

described of twenty patients seven to be cured, seven to be improved, and six to be unchanged. To the modern student, these classifications are flabbergasting as in addition to not allowing for any negative or failure category, no patient was followed longer than two months and for the majority of patients in the 'cured' group, Moniz made his final comments within eleven postoperative days (Valenstein 1986, 108). The recurrent thoughts were said to be gone, but no testing was pursued to assess this scientifically. Amazingly, neurologists and psychiatrists of the time commented that Moniz's monographs were "detailed" and "impressive" (Valenstein 1986, 108) – the common problem even today of reading only abstracts! Moniz did not waste time in securing frontal lobotomy as his own. Less than four months after the first operation, he presented his results in Paris in March 1936. By July, Walter Freeman had written a pleased review for the Archives of Neurology and Psychiatry and by 1937, Moniz had published thirteen articles and one book in six different countries (Tierney 2000).

Of course opposition was not entirely nonexistent, for instance, Cobbs reviewed the early Moniz monograph, criticizing it harshly for being vague and unjudgable. This was effectively silenced as the review was unpublished until 1940 by which time the original procedure had been drastically changed and Cobbs' criticism was uncontextual and irrelevant. The rumble of interest of the frontal lobes in the 1930s spurred Moniz's haste in securing his territory and credit, as Freeman expressed, "Moniz was taking no chance of further piracy" (Valenstein 1986, 113).

Freeman, upon crossing Moniz's first article in *Le Bulletin de l'Academie de Medecine* consulted with the neurosurgeon James Watts. Together, they agreed to perform leucotomy and promptly ordered leucotomes. Practice in formalin fixed brains was undertaken and the search for the right first patient was initiated, ending with a sixty three year old agitated and depressed woman. She was faced with a choice between surgery and institutionalization and she and her husband chose the former. Freeman asked her, postoperatively, if she recalled why she had been so upset to which she responded, "I don't know. I seem to have forgotten. It doesn't seem important now." (*Science Odyssey: People and Discoveries*) In describing their early cases, Freeman and Watts said of frontal lobotomy (which Freeman renamed from the previous, leucotomy), "indiscriminant use of this procedure could result in vast harm . . . Every patient probably loses something in this operation, some spontaneity, some sparkle, some flavor of the personality" (*Science Odyssey: People and Discoveries*) – markedly more conservative than Moniz's "cure." Freeman did, however, talk of triumphantly curing patients by this operation regularly and publicly (Feldman and Goodrich 2001). Thus, in fall 1936, Freeman and Watts performed twenty lobotomies. However, seizures and motor defects as well as too great a variability in the regions of tissue damage slowed their pace such that in 1937 the duo performed only twelve. Freeman and Watts soon developed the Freeman-Watts Standard Lobotomy, using a lateral approach as opposed to a superior one. This, of course, set them apart from Moniz in that the duo had created a procedure unto themselves. Also distancing Freeman from Moniz was the theoretical underpinning Freeman offered of lobotomy. While Moniz believed in fixed thoughts, Freeman was

convinced that “the fasciculus of fibers connecting the prefrontal region with the thalamus is unquestionably of great significance,” (Valenstein 1982, 168) based upon Herrick’s (a neuroanatomist) theory that cognition and emotion are connected by frontal lobe and medial thalamic activity. However, the Freeman-Watts Standard Lobotomy had not been meeting Freeman’s expectations in that chronic and deteriorated schizophrenics would often relapse. When more extensive attempts were made in these patients, inertia, apathy, and seizures were common (Valenstein 1986, 199). This lead Freeman to believe that deteriorated patients were unaidable and thus, the formidable happened: Freeman decided lobotomy should not be reserved as a last resort lest too much time pass and the patient’s disease progress beyond help. Hence, Freeman professed a danger in postponing his treatment, contrary to his earlier comments that discretion and alternatives must precede lobotomy.

For this to occur, however, Freeman realized that lobotomy, which required a surgical team and the funds to afford their services and the intensive postoperative patient care, required drastic change. The Italian psychiatrist Amaro Fianberti had developed transorbital lobotomy in 1937 and in 1945 Freeman decided upon it as his practicalizing modification to the Freeman Watts Standard (Valenstein 1986, 201). He altered the procedure in the following manner: as opposed to injecting alcohol or formalin to destroy the fasciculi as Fianberti had done, he chose to physically cut the fibers by moving the leucotome in medial and lateral swipes. The procedure did not require any special training and was very brief. Freeman began by administering electroconvulsive shock three times at intervals of two to three minutes. In the few minutes that the patient was unconscious secondary to the shocks, Freeman inserted his “ice pick” above the eyeball, pushed it through the roof of the orbit with the aid of a hammer, and swung the instrument medially and laterally (Feldman and Goodrich 2001). Only after the ninth such operation did Freeman invite Watts to his second floor office where he had been performing the surgeries. Watts was disgusted with the office neurosurgeries and particularly disliked electroconvulsive anesthesia. However, Freeman was convinced and progressed without the participation of Watts. The desperation of state hospitals for help and superintendents’ realizations that a visit from a prominent physician could bring media attention and possibly much needed funds allowed Freeman to gain permission to operate in some state hospitals across America (Valenstein 1986, 205). In 1947, Watts learned that Freeman was planning to suggest teaching psychiatrists the technique. He was firmly opposed and the duo split, with Watts moving from his office which had previous been directly beneath Freeman’s. Thus, Freeman required a new assistant and readily found Jonathon Williams, whom Freeman called his associate in an effort to appease Williams’ pride and in hindsight, Williams’ proud and loud personality was probably better matched with Freeman than Watts who had remained reserved and quiet (Valenstein 1986, 206).

An unfortunate incident occurred during one of Freeman’s many trips to various states on which his sons had accompanied him. In Yosemite National Park, Keen unexpectedly drowned and Freeman was overcome with grief (Valenstein 1986, 207). It was from this

incident that Freeman derived the undying perseverance that he devoted to frontal lobotomy. He toured incessantly, demonstrating his procedure, never forgetting to involve the popular media. State hospitals gained pride in having Freeman as their guest and local media reported cures with enthusiasm. “At state hospital – doctors hope for miracle in new operation” and “Brain operations on thirteen patients are success!” (Valenstein 1986, 211) were commonplace. The assistant, Williams, later recalled, “It was at this time that Freeman achieved his pinnacle of showmanship” (Valenstein 1986, 213).

In 1948, Freeman developed the “deep frontal cut” which was an additional upstroke of the leucotome which would incise deep frontal lobe tissue. This placed great mechanical stress on the transorbital leucotome (basically, an ice pick with etched gradations) such that it was not uncommon that the leucotome would break in a patient’s head and a neurosurgeon would be forced to retrieve it. This was not to be an obstacle for long as Freeman commissioned the modeling of a new extremely durable instrument, the orbitoclast (Valenstein 1986, 215). All this time, media hype had been spreading and demand for Freeman’s presence and procedure was growing. Thus, a desperate situation in state hospitals, with a lack of resources in both personnel and finances paved the way for Freeman’s crusade. Frontal lobotomy was a worldwide phenomenon by 1947 and in 1948 the First International Conference on Psychosurgery was planned in Lisbon (the location was chosen to honor Moniz’s contribution). In 1949, Moniz was awarded the Nobel Prize in Medicine for frontal leucotomy (his work on cerebral angiography was not mentioned) (Raju 1999). As such, lobotomy was flourishing and gaining ground every day. Psychosurgery, Freeman and Watts book, was published in its second edition in 1950 (albeit containing disagreement between the co-authors). Between 1949 and 1952, five thousand transorbital lobotomies were performed each year in the United States, with more than sixty thousand lobotomies transpiring between 1936 and 1956 (Feldman and Goodrich 2001).

However, time had passed since the advent of frontal lobotomy, and much criticism was amounting against psychosurgery. The positive effect of the Nobel Prize and the detrimental one of the scientific criticism seemed to balance each other. But, as the thrill of the Prize waned and the criticism in scientific and popular journals surfaced, lobotomy began its sharp decline. In response to the growing unrest, Freeman began attacking psychotherapy in an effort to promote lobotomy which had the counter anticipated effect – the psychotherapists were irritated as ever and at least one neurosurgeon exclaimed, “You can treat the brain like a piece of ice!” (Valenstein 1986, 258).

By 1954, Kline-Smith, and French’s chlorpromazine gave superintendents a novel and reversible management option for mental illness which was much preferred to the gruesome transorbital lobotomy (Sneider 2002). In the face of the new effective competition, which had hitherto been absent, lobotomy toppled more quickly than it had sprung. With it, Freeman fell to the background and media attention glazed over. Freeman continued his attempts to prove the safety and effectiveness of his procedure by

driving across America without rest in search of his former patients to conduct follow up studies. But he had effectively withered into oblivion (Valenstein 1986, 272).

Though this is a horrendous story, its main purpose is not to entertain, but to provoke. We must examine our situation in the medical profession and become aware of the forces acting upon us as we innovate, progress, and treat. Although lobotomy fell almost fifty years ago, it serves us well (having been told the story), to examine the history in terms of its relevance for the present day. In essence, frontal lobotomy was simply a possibility - a great one, in the eyes of a starved system. It is undeniable, however, that our system is also starved and that people continue to face unsolved problems and as such, the stage remains set, as it did half a century ago, for similar occurrences. As Valenstein articulates, "Although it may be comforting to believe that the forces responsible for the wide acceptance of prefrontal lobotomy . . . are all behind us, they are, in truth, part of the very bone and marrow of the practice not only of psychiatry, but of all medicine. Today there are no fewer desperate patients and desperate families; premature reports of spectacular cures with minimal risks are still accepted uncritically; the popular media promote innovative therapies even more enthusiastically; economics is no less an influence on the selection of treatment; conflicts persist within and between specialties; and ambitious physicians still strive for 'fame and name'" (Valenstein 1986, 292). The reader need not hunt far for examples in the present day.

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KORO: MEDICAL ILLNESS OR MASS HYSTERIA? A CONCEPTUAL HISTORY

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ABSTRACT

This paper concerns the history of koro, a condition defined in the latest edition of the Diagnostic and Statistical Manual of Psychiatry (DSM-IV) as an “episode of sudden and intense anxiety that the penis (or, in females, the vulva and nipples) will recede into the body and possibly cause death”^[1].

Likely derived from the Malay word meaning “head of a turtle”, koro presents in two broad patterns, epidemic and isolated. Two prototype cases, one of the epidemic type that swept through Singapore in the late 1960’s and one of the isolated subtype that happened in Ottawa around the same time, are described.

With these historic prototypes as a guide, this paper attempts to tell a short history of the ideas about koro, reaching from early concepts in traditional Chinese medicine to contemporary ideas from medicine and sociology. An analysis of the transitions between ideas along this conceptual history reveal three “big questions” about the nature of koro: is it subjectively or objectively real? Is it one condition or several? And, is it a psychiatric illness? These questions share something in common – they have important implications for the nosology of koro that is, for the way the condition is to be classified and labeled.

A conceptual approach to koro’s history can be used to answer two of these nosological questions and to clarify the third. Its success here attests to the power of this form of historiography in illuminating the past, in clarifying the present and in setting the stage for future progress.

Introduction

Defined in the latest edition of the Diagnostic and Statistical Manual of Psychiatry (DSM-IV) as an “episode of sudden and intense anxiety that the penis (or, in females, the vulva and nipples) will recede into the body and possibly cause death”^[1], the koro phenomenon is a triad of perceptual, cognitive and emotional features. First, there is the

perception that a protruding organ, most often the male genitalia, but possibly the female breasts or the tongue, is retracting into the body. Second, there is the *belief* that a complete retraction of the organ will lead to death. Finally, this experience is accompanied by emotions of *fear*, anxiety and panic.

Koro is a Malay word of uncertain origin, although several have been proposed, including “kuro”, “kerukul”, “keroh”, “keruk”^[2] the later meaning “to shrink”, gets right to the heart of the problem. Yet “kuro”, meaning tortoise, is a tantalizing possibility given that the “head of a tortoise” is old Malay slang for the glans penis and given that a tortoise can retract its head into the body of its shell.^[3] Furthermore, there are synonyms for koro in several Southeast Asian languages. It is known as shook-yang or suo-yang (“genital shrinkage”) to the Chinese, to the Thai as rokjoo (“illness of the shrinking genitalia”) and to the Indians as jhinjhini bimari (“tingling disease”).^[4]

Perhaps koro is best explained by example. In particular, two historic examples, serve as prototypes for the two basic forms of the condition. The first occurred in Singapore during the late sixties and attests to an epidemic pattern of koro, characterized by cause (cultural origin), size (hundreds of people affected) and course (acute onset and resolution). This pattern differs from isolated koro, as demonstrated by a prototype case, one that transpired in Ottawa during the seventies.

The idea that koro has these two forms, one epidemic and one isolated, is something that emerges from the conceptual history of the condition. This history of ideas, first applied to medical history by Owesi Temkin^[6], is organized not just by dates, places or people, but by major perspectives – Chinese medicine, psychoanalysis, psychiatry and sociology - that have attempted to explain the condition through the ages.

Emerging from this conceptual history are three big questions, all of which concern koro’s nosology, that is, how it should best be classified. One question asks: “is koro a real phenomenon, or a mental one?” Another asks “is koro one phenomenon or many?” The separation of koro into epidemic and isolated subtypes is one response that emerges from the tale end of the conceptual history. A third, unresolved question asks, “Is koro a mental illness?” While this question poses challenges to the current epidemic/isolated approach to the condition, the conceptual history helps to outline some of the key issues that an answer would have to address.

Koro: Historic Examples

Singapore, 1967

“A STRANGE MALADY HITS SINGAPORE MEN.”
- Headline, Straits Times Nov 5 1967^[9].

On October 29, 1967, rumors began to circulate that the consumption of pork inoculated with an anti-swine fever vaccine was causing men's genitalia to retract. It is unknown how, why or where in Singapore the rumors began. However, there is some evidence that the kosher Malays were blamed for the event^[5], an accusation in line with the background of racial tension that plagued Singapore in the nineteen sixties^[12]. While this idea was not described in the government controlled Chinese or English language media, personal accounts do give it credence.^[12, 13] Cause or scapegoat, koro in Singapore began with contaminated meat.

The first cases of koro, or at least the first of the cases to come to the attention of western trained psychiatrists, appeared on the twenty-ninth and were treated at the Thompson general hospital. From the thirty-first onwards, patients were seen in the emergency room at the Singapore General Hospital and at the MacPherson Road hospital. In total, 536 cases were treated at this site^[14]. Many more were seen by practitioners of traditional Chinese medicine, though formal statistics are not available.

On the first of November, the Ministry of Primary Production issued a statement that emphatically denied rumors of pork contamination^[16]. But instead of quenching these rumors, the statement was seen to give them substance. As a result, incidence of koro increased exponentially, reaching its nadir on November third, with up to 100 cases seen in the ER of the general hospital^[14]. An alarmed Ministry of National Development issued an immediate statement claiming that "no one in Singapore need worry over the safety of pork from pigs slaughtered at the government abattoir where every carcass is carefully examined and stamped as fit for human consumption before they are released to the market"^[17].

On November fourth, the Singapore Medical Association (SMA) issued a statement carried in all major newspapers which said that, "koro is a culturally determined form of emotional ill-health affecting primarily the Chinese...the present incidence of koro is essentially due to fear and rumors which have no foundation".^[9] The day after the announcement, the number of koro cases fell to 2/3 of the peak volume^[5].

This message of reassurance was echoed by the papers on the 5th of November. An article in the Straits Times reported that "This [koro] is not an organic disease; It will not cause death : It is due to fear based on false belief: and it has no direct relationship with the eating of pork."^[9] Another report suggested a source for the rumors. The Nanyang noted that a man "in the ministry of production...apologized for his comments about the link between the anti-swine fever vaccine and koro".^[18]

While koro was on the decline, the rumors of contaminated pork continued to persist. Pork sales tumbled. Ads for "Australian" pork appeared in the Sin Chew^[19]. So did a report detailing the murder of a butcher^[20]. In response to these ongoing financial and psychological concerns, the Ministry of Health held a televised press conference chaired by the Deputy Director of Medical services, Dr.Ho Guan Lim. The November sixth

conference reiterated that koro “is only a disease of the mind and the victim requires no medical treatment at all.” By the seventh of November, the incidence of koro cases presenting to the ER had dwindled to seventeen.

In April of 1968, a group of psychiatrists, self described as the koro study team, did a retrospective survey of patients affected by koro during the outbreak who were seen at the MacPherson Road and Singapore General hospitals.

The outbreak was later studied by a group of psychiatrists who found that anxiety (90%), genital shrinkage (74%), genital retraction (60%) and palpitation (40%) were the most common clinical findings. It is interesting to note that only 72% of cases had all three features of koro (the others did not believe that koro would cause death), that sexual activity triggered the symptoms in only two of the cases and that 44% of the patients attributed their symptoms to pork.^[5] In addition, the prognosis of the majority of patients was excellent. 80% had only one attack, and only 19% claimed the experience had an adverse effect on their well being.

From an epidemiologic standpoint, Koro tended to affect the subculture of single, Chinese men. They accounted for over 85% of the cases, even if they did account for less than 25% of the population^[21] The majority of the affected men were single (77%), Chinese educated at the primary or secondary level (50%), who knew, directly, or through rumor, of others affected by the condition^[14].

In addition to the epidemiologic and clinical features of the condition, there are important cultural, social, environmental and psychological factors that conspired to start and spread koro in Singapore. Many of these factors are shared generally by the other instances of epidemic koro in India, Thailand and China.

If many parts of South East Asia have a cultural history of Koro, why was Singapore one of few places to host a koro epidemic? Clearly, cultural predisposition cannot sufficiently explain the outbreak. In Singapore, koro occurred against a background of racial tension, in light of concern about the safety of swine vaccines. These factors contributed to social stress that was closely associated with the outbreak of koro.

Other dimensions of the social environment, including mass communication and living conditions are important features in the spread of koro. In order for rumors about pork contamination to influence hundreds of people, they had to be mongered from one community to the next. Media played a seminal role in both starting and stopping such rumors. Newspapers gave credence to early rumors, while public announcements played the critical role in slowing their spread. Yet while the population of Singapore in 1967 was edging towards 2,000,000^[21], newspaper circulation was only around 400,000. Other media, like radio and television, may have played a role, though 44% of Singapore households owned neither^[22]. On the other hand, 403,000 of Singapore’s 1,929,000 residents lived in rural “Kampungs”, village hut communities along the coast with only

limited communication to the main city^[21]. These communities, with their close quarters and reliance on word of mouth, also existed in cities and served as efficient means for the spread of koro rumors.^[23]

Yet koro does not affect every member of the population in the same way. Psychological factors, like lack of education, play a role, though not as reliably in the Singapore epidemic as they did in other outbreaks. It actually turns out that education predisposed to koro in Singapore although this could easily be an artifact of a study with limited data. Furthermore, Gwee suggests that “education engenders a bias of its own”^[11] and since media played a critical role in fostering early rumors of koro, it may have been the literate, or semi-literate, who were most at risk. That said, studies of other cases of epidemic koro, in China, India and Thailand, have consistently suggested that education and literacy are protective factors.^[24-26]

The history of koro in Singapore helps to describe a qualitative model for epidemic koro, in terms of the interaction between individual and social factors. Koro in Singapore teaches us that it is a certain subgroup – single Chinese men with some prescience of the condition – who were disproportionately affected. It shows us how social factors can initiate (rumors of contaminated pork) and propagate (mass media, living quarters) the condition, and how individual factors (education) can ultimately determine the effects of the message.

Ottawa, 1972

The case was described by Lapierre in 1972, of a fifty five year old French-Canadian man, who was born in western Quebec and who lived there most of his life,. Head no ties to South East Asia and was unfamiliar with the Koro syndrome.

The gentleman had recently received a lobectomy for a bronchogenic carcinoma. He presented at night to the emergency service of the Hopital Pierre Janet, “holding on to his penis and pulling it to prevent withdrawal into his abdomen.” After taking a bath that night, he had developed the “definite impression that his penis twisted upon itself and curved back into his abdomen.”^[6]

A few weeks later he was diagnosed with a left frontal-temporal tumor. While his fears of genital retraction never recurred, he continued to remember them, despite progressive mental deterioration, until his death three months later.

The patient’s psychiatric history included an untreated year long episode of depression at sixteen. His sexual life had “never been quite satisfactory”^[6]. This was especially true in the months leading up to his lobectomy.

The Ottawa case reveals a number of features of the so called isolated koro. It often occurs outside the east, in people unfamiliar with the diagnosis, in patients with no ties,

either by blood or by travel, to Southeast Asia. There tends to be a history of sexual repression, guilt or difficulty in the patient's past, as witnessed by the persistent sexual difficulties encountered in this case. Isolated koro often occurs in association with a primary psychiatric or general medical condition, does not present fearing death by genital retraction^[30] and is refractory to treatment^[31].

Koro: Conceptual History

Conceptual history is an approach to historiography that recalls the past not just by dates, times, people, places but by the perspectives that have been sought to account for that disease over time. An approach to the history of disease through the history of ideas evoked to explain it has been called a “conceptual history”⁰ or a “historico-intellectual record”^[32].

The conceptual history of koro can be divided in to four major perspectives: Chinese medicine, psychoanalysis, psychiatry and sociology.

Perspective from Chinese Medicine

Koro is known to as “suo-yang” in Mandarin or “shook-yang” in Cantonese. Both names have the literal translation of “shrinking penis” and both conditions trace their origin to the classic texts of Chinese medicine, foremost being the Yellow Emperor's classic text of Internal Medicine (the Nei Ching), thought to be written sometime between 476 and 221 BC^[35].

Illness due to internal pathogenic factors causes impotence...illness due to cold causes retraction of the penis^[35] Without sperm, a person will not be well, and the manifestation is one of retraction of the genitals with spasm of muscle, the bones of the chest are depressed, and the hair colour is poor. Death usually occurs in Autumn^[35].

This version of koro was modified over the writings of several generations of Chinese physicians including Zhang Zhong-Jing, of the Han period (206 BC-200AD)^[37], Hwang-fu Mi, writing in the Jin dynasty (AD 265-420)^[37], and Sun Si-Miao in the Tang dynasty (AD 618-907)^[38]. The first full description of the suo-yang condition appears in the text by Pao-Siaw-Ow in his collection of remedies of value, written in 1835^[39]. He describes that “after intercourse between the male and the female, the penis retracts with severe pain and the feeling of death...speed is essential [in treatment], for delay will mean the case cannot be saved.”

A modified version of these beliefs still exists in Chinese medicine today. Suo-yang is still described as a physical retraction of the genitalia, is treated with the pressure of a pin pick applied to the sacro-iliac joint, and is thought to arise from a depletion of the blood's glucose.^[36]

Perspective from Psychoanalysis

Koro was first introduced to the western world in 1874 with the publication of B.F. Matthes' Buginese dictionary.^[3] These early writings on koro were largely ignored until 1930 when a series of reports attempted a psychoanalytic interpretation of the condition. By far the most cited is Palthe's, who concluded that "we have here before us, therefore, a living example of Freud's castration complex"^[41].

In 1948, Kobler published the first English psychoanalytic account of koro^[42]. He reported on one case of koro seen in southern Chinese province of Kwangtung, describing it as an "acute castration fear based on superstition." Other authors echoed this description including Rin, who reported on an isolated case in 1965, describing the condition as a "form of castration fear in association with oral deprivation."^[43]

Psychoanalysis is still used today to explain the genesis of koro, though modern explanations concentrate on the epidemic subtype. Gerlach, an ethno-psychoanalyst, seeks cross cultural evidence for Freudian analysis in koro outbreaks in a recent paper, arguing that, "the epidemic is, in effect, a form of rite of passage in which a group of youngsters make the communal attempt to overcome castration anxieties which are themselves the product of convert gender identity"^[44].

The perspective from psychoanalysis explains koro in terms of unconscious fears of castration. It is the first, but not the last, of the western or "emic" (that is outsider defined) attempts to account for the koro syndrome.

Perspective from Biomedicine

A distinct perspective from medicine/psychiatry began to emerge when behaviourism came to displace psychoanalysis as the dominant approach in the field during the late forties and early fifties^[50]. With this shift came an increased focus on the operational aspects of mental illness, that is, those aspects of pathologic behaviour and cognition that were verifiable by the senses. This concentration on objectivity led to the creation of the first edition of Diagnostic and Statistical Manual of Psychiatry(DSM-1)^[51] and changed the atmosphere of the koro literature from underlying explanations to appropriate classifications.

Many labels followed. Yap made the first attempt describing koro as an "atypical culture bound psychogenic disorder"; Gwee followed with an "acute hysterical panic reaction"^[11], while Ngui, reporting on the same epidemic, referred to it as a "culture bound syndrome"^[14].

Increasingly, there were reports of medical precipitants to koro. It was reported in a British man after a heroin withdrawal in 1965^[53]. Then in 1972, Lapierre became the first to describe a case associated with a general medical condition^[6]. The connection to

medicine was strengthened by further reports of koro secondary to epilepsy, stroke and HIV.

Over the sixties, seventies and eighties, koro was described in varied and conflicting ways by psychiatrists, including “body image disturbance”, “sexual neurosis”, “culture bound psychogenic reaction”, “dissemination of castration anxiety”, “acute panic reaction with fears of social stability”, “social tensions” “hypochondrical stress response”, “genital retraction panic disorder”, “somatoform disorder”, “psychosis” and “acute anxiety reaction”^[53].

The labeling debate continues today, though only three candidates have stood the test of time. One approach is to amalgamate koro within the existing framework of the DSM, either as an anxiety disorder or as a body dysmorphic disorder. The other approach is the one taken by the latest edition of the DSM, which defines koro as a culture bound syndrome or a “recurrent, locality-specific pattern of aberrant behavior and troubling experience that may or may not be linked to a particular DSM-IV diagnostic category”^[1].

Perspective from Sociology

The anti-psychiatry movement of the sixties accused the establishment of “medicalizing” variations in behaviour in order to suppress individuality and control deviation. The most prominent anti-psychiatrist was ironically a physician, Thomas Szasz, whose 1961 book, The Myth of Mental Illness likened psychiatry to a contemporary witch hunt. Szasz argued that the profession had inappropriately labeled deviant behavior as illness, “illness” that was in fact a “sane response to an insane society”

In a series of papers published over the past two decades, Bartholomew has borrowed from the ideas of anti-psychiatry to interpret koro. He argues that:

The typification of individual koro as a medical syndrome has been inappropriately applied to collective episodes, and that based on an examination of their characteristic features koro epidemics should be reclassified as a sociological phenomenon involving mass social delusions^[96]

Koro, or at least its epidemic variety, is neither a mental illness nor a real occurrence. It is a form of collective behaviour once called mass hysteria, known today as a mass sociogenic illness. The implication is that koro is as much a sociological condition as a medical one.

While there is no generally accepted definition for what constitutes mass sociogenic illness, these outbreaks of koro share many of the features typically ascribed to the phenomenon. These include symptoms that have no organic basis, start in the old and spread to the young, come as rapidly as they go, arise from some shared cultural or social belief and respond well to simple assurance by figures of authority. Outbreaks typically

occur during times of extraordinary stress, generally affect one subgroup (i.e. men/women, young/old, ethnic minority, racial majority etc), and tend to arise spontaneously^[96]. As the sociologic perspective points out, the four known epidemics of koro – in India, Thailand, China and Singapore, largely satisfy these criteria.

Implications of Koro's conceptual history

The motivation of this work is to demonstrate that conceptual history can be a powerful tool to reveal and to organize basic issues in the development of psychiatric ideas, specifically ideas about the classification (nosology) of mental illness. The thesis of this paper is an example, focusing on the conceptual history of koro.

In moving from idea to idea along koro's conceptual record, three basic (what I will call big) questions about the condition arise: is it objectively or subjectively real? Is koro, koro's or neither? Is it an illness? The common theme to these questions is that they carry implications for the nosology of koro, that is, for the way the condition should be classified. Like all "psychiatric" conditions, koro's classification is a critical thing to determine. In addition to the practical consequences of determining whether the condition is a mental illness, a classification of koro most directly reflects our understanding about the basic nature of the behaviour.

The first big question arises in moving from the "emic" or locally defined perspective in Chinese medicine to the "etic" or outsider perspectives from the west. While Chinese medicine sees koro as a real retraction of the genitals created by a humoral imbalance between yin and yang, western perspectives approach the condition as a strictly mental phenomenon, as a misperception of the physiologic shrinkage of the penis. While Chinese medicine thinks of koro as an "objectively" real phenomenon, western perspectives see it as behaviour that is "subjectively" real, that is real in a metaphysical way to the person affected. If koro is objectively real it is best classified within the framework of Chinese medicine, or perhaps urology. As a phenomenon that is subjectively real, koro becomes subject to classification by psychiatry, psychology, sociology or an allied discipline of the social sciences.

Two other big questions emerge from transitions between the western perspectives in koro's conceptual history. In moving from psychoanalysis to biomedicine, the focus of the koro literature shifts from etiology to description. While psychoanalysis makes no formal attempt to classify the condition, it does so indirectly in defining koro by its root sexual cause: castration anxiety. This differs from biomedicine, which classifies the presenting features of koro in to epidemic and isolated subtypes and in to predefined, empirical categories of mental illness, as laid out by the DSM-IV, ICD-10 or related system. So while psychoanalysis thinks of it as koro, a solitary and unified phenomenon, biomedicine sees it as koro's, with distinct epidemic and isolated subtypes.

The final big question emerges from the tension between biomedical and sociological perspectives on koro. While both perspectives agree that there are koro's – epidemic and isolated respectively- they approach these subtypes in different ways. Biomedicine sees both as mental illness, best described with a disease model and best classified by the DSM, ICD-10 or equivalent. Sociology, on the other hand, agrees that isolated koro is the subject of psychiatry, but sees the epidemic variety as a form of “mass sociogenic illness”, best explained by ideas from sociology and social psychology and best classified by the rubrics of social science. The question at hand is then whether koro and its subtypes represent a (medical) illness. If so, they are amenable to a medical classification and if not they need to be classified elsewhere.

The three big questions revealed by koro's conceptual history have a central theme: they are all related to nosology, the “science of description or classification of diseases”. Knowing whether koro is real subjectively or objectively helps to determine what needs to be classified and what system of classification should be used. Knowing whether it is koro, koro's or neither is important in deciding how to classify the condition and what to classify it by. Finally, resolving whether koro is a disease in the first place will help decide who should classify it and where it should be classified. The three big questions about koro then become three questions about koro's nosology:

What should be classified? How should it be classified? Who should do the classification?

The conceptual history again proves imperative in helping to answer these questions. It shows us that koro is widely agreed to be subjectively real. Though the genitals do show physiologic retraction with cold, after micturition or coitus, there is no evidence that they can completely retract in to the abdomen, or that this process causes death. Hence the evidence suggests that koro is a subjectively real phenomenon and so the subject of a mental and behavioural classification. Furthermore, both modern perspectives on koro see the condition in distinct epidemic and isolated subtypes. With key differences in cause, clinical presentation, course, response to treatment and outcome between these two types, the idea that there are koro's rather than one koro is a compelling one.

Hence Koro's conceptual history can be used to derive and to answer two of three “big” questions about the nosology of koro.

Conclusion

In conclusion, koro is a disorder characterized by a triad of symptoms, the perception that the genitals are retracting and will ultimately retract into the abdomen, the belief that this retraction will cause death and the fear that accompanies these cognitions. Given that koro is a condition where little is known for sure, there is value in organizing its history according to the principal ideas that have been evoked to explain and describe the

condition through the ages. This conceptual history consists of ideas from Chinese medicine, psychoanalysis, biomedicine and sociology.

Emerging from koro's conceptual history are three "big questions" about the condition – is koro objectively or subjectively real? Is it koro, koro's or neither? Is it a (medical) illness? These three questions all relate to the classification of koro, in particular, what should be included in it, how it should look and where it should be done. Conceptual history can be used to answer the first question and part of the second, attesting to its use as a method of analysis in the history of medicine.

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ITCHY BRAIN OR UNBALANCED SKIN: A HISTORICAL PERSPECTIVE OF PSYCHODERMATOLOGY

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ABSTRACT

Psychodermatology is a relatively unexplored area which overlaps two well known, but relatively distant, specialized fields of medicine: psychiatry and dermatology. However, the history of the discipline, which is presently known as psychodermatology or psychocutaneous medicine, traces back to over 3000 years ago, when the question of the impact of one's psychological condition on the development of skin diseases was stated. According to Herman Musaph, one of the founding fathers of contemporary psychodermatology, this discipline began during the sixth plague in ancient Egypt. The establishment of scientific grounds and the practical significance of psychodermatology can be traced through the numerous advancements in both psychiatry and dermatology, which eventually led to the growing recognition of this in the second half of the twentieth century. In light of the recent advances of medicine at the beginning of the twenty-first century, this relatively new and evolving field is rapidly gaining growing significance. Therefore, the dramatic history of psychodermatology is undoubtedly useful for a better understanding of existing treatments and for the development of new approaches for dealing with psychocutaneous conditions.

Over the years, the practice of medicine and the concepts behind the theory of diseases have radically changed. There are numerous progresses that allow for better diagnosis and treatment of individual patients that present to the physician's office. However, the field of medicine remains separated into different specialties. There are good scientific grounds for such separation based on different etiology, pathogenesis, and clinical appearances of pathological conditions. On the other hand, the history of medicine has provided a number of examples of diseases that can be attributed to several medical specialties at the same time. Such diseases consist of overlapping clinical features or require joint treatment approaches that comprise methods and skills of distinct, and sometimes very distant, medical specialties.

The theory of psychodermatology represents a striking example of a medical field that is comprised of two seemingly unrelated fields of medicine: psychiatry and dermatology. What is the common bond between psychiatry, a field that deals with human thoughts,

feelings, and behaviours, and dermatology, which focuses on the external appearance of the human body by focusing on the skin? In fact, one of the researchers of the field, Dr. Wittkower, has stated that “it may seem paradoxical that this most superficial organ [skin] should be so intimately related to Man’s feelings and moods...” (Wittkower, 1953). At the same time, there are numerous historical descriptions that show coexistence and interdependence between skin conditions and the human mind. Some have speculated that one of the reasons for such an association is due to the similarity of the embryological origin for the brain and the skin, as both originate from the primitive ectoderm (Bodemer, 2001).

According to Musaph, the historical origin of the field that is presently recognized as psychodermatology begins with the story of the sixth plague (Musaph, 1974). The sixth plague describes the story of painful boils on the knees, legs, and soles of the feet that even affected the magicians of Egypt, who were considered to be very close to the Egyptian gods.

Since ancient times, there have been numerous observations that linked some skin diseases to psychological conditions. However, it was the work of French dermatologists Brocq and Jacquet that led to the first scientific evidence on the psychosomatic approach to skin in 1891. In addition, Brocq and Jacquet coined the term “neurodermite” for a cutaneous condition that was regarded as a form of chronic eczema” (Wittkower, 1953; Obermayer 1955).

Important scientific evidence that supported the psychogenic genesis of skin conditions was produced by Doswald and Kreibich in 1906 when they described the appearance of inflammatory blisters induced by hypnotic suggestion (Wittkower, 1953). This work was later followed by Kreibich’s 1909 publication on psychogenic urticaria, an event notable for establishing a correlation between emotional factors and the appearance of pathological skin conditions (Obermayer, 1955).

According to Wittkower, in 1924 Kreibich further suggested that anxiety could lead to pruritus that can subsequently trigger eczema. Furthermore, there are other important publications including, Sack (1927), Stokes (1930), and Ingram (1933) that provided different clinical examples of various psychocutaneous correlations and generally supported the concept of psychogenic dermatoses (Wittkower, 1953; Obermayer 1955).

The accumulation of clinical evidence eventually resulted in the important work of Herman Musaph, who published an article in 1974 under the title, “Psychodermatology.” In his work, Musaph offered the term psychodermatology, which later became widely accepted. He also presented his own classification of the history of this discipline. According to Musaph, all of the historical developments of psychodermatology should be divided into three phases: anecdotal phase, methodological phase, and integrative phase (Musaph 1974). During the “anecdotal phase,” which apparently continued until the mid 1950’s, “a simple relationship was sought between a certain personality structure, a

certain emotional conflict situation – which was seen as a trigger phenomenon – and a certain psychosomatosis, which might be a dermatosis” (Musaph, 1974).

The second phase, identified as the “methodological phase” was triggered by a demand for more systematic and statistically proven analyses of the relationship between psychological conditions and dermatoses. Apparently, this phase continued until the mid 1970’s, the time when Musaph offered his concept of psychodermatology and suggested the next “integrative phase.” In this phase, the greatest emphasis was on the integration of a number of fields through an interdisciplinary approach. The emphasis of this phase is on the importance of “many factors, attitudes and variables” that should be integrated in diagnosis, treatment, and prophylaxis of psychodermatological conditions (Musaph, 1974).

Musaph’s work has made an important impact on the evolution of psychodermatology, which drew the attention of many researchers and resulted in the development of various classifications. Koeblenzer, one of the contemporary contributors to the field of psychodermatology, offered a comprehensive classification of psychocutaneous diseases. According to this classification, all psychocutaneous conditions can be divided into three major groups. The first group contains “conditions with strictly psychological etiology,” such as delusions and hallucinations as they relate to skin, psychogenic pain syndromes, compulsive habits and obsessional concerns, and psychogenic purpura syndromes. Koeblenzer’s second group includes “conditions in which strong psychogenic factors are imputed,” including the urticarias, pruritus, flushing reactions and rosacea, and psychogenic disorders of sweat glands. The last group describes “conditions that are probably dependent on genetic or environmental factors,” including alopecia areata, telogen effluvium, hirsutism, psoriasis, atopic dermatitis, and acne vulgaris (Koeblenzer, 1987).

An interesting observation can be made through the formation of the recent trends in psychodermatology. The initial works on psychocutaneous conditions have emphasized the role of psychological factors on the development of cutaneous manifestations. However, recent works, including the classification proposed by Koo (2001, 2003), have demonstrated the significant counter effect of the influence of skin disorders on the psychological condition of affected individuals. In his classification, which contains three major groups, Koo proposes an important category of psychodermatologic disorders that includes secondary psychiatric disorders (e.g. the disorders that have been caused by dermatological problems). This category consists of cutaneous conditions that, for instance, can be associated with severe disfigurement. Conditions such as psoriasis, vitiligo, and cystic acne can lead to the development of depression or social phobia.

A famous writer, John Updike, gave one of the most striking descriptions of psychological suffering caused by psoriasis. Updike wrote that his “torture is skin deep” (Updike, 1989). He further stated that “the name of the disease, spiritually speaking, is Humiliation” (Updike, 1989).

The evolution of an interdisciplinary field such as psychodermatology depends on advances in both psychiatry and dermatology. Over the past decade, there have been important advances in the treatment of different psychological conditions. Through the successes of psychopharmacology it became possible to more efficiently treat mental conditions, which have been identified as triggers for the development or exacerbation of psychocutaneous disorders. Psychopharmacological agents, including SSRI and novel antipsychotic medications, which have been proven to have antidepressant and antianxiety properties, offer promising benefits for the treatment of diseases of the skin where a psychological factor plays an important role.

On the other hand, it appears that the recognition of psychiatric disorders secondary to cutaneous conditions can also offer more treatment options. By specifically targeting and treating certain skin diseases, a physician can concurrently alleviate psychological suffering of the patient. There is sufficient ground to suggest that contemporary psychodermatology has entered a new phase, which can be qualified as a therapeutic phase.

It can be concluded that this new phase offers promising advances in the treatment of pathological conditions that are related to psychodermatology. Both psychiatrists and dermatologists should be aware of numerous psychodermatoses and be able to diagnose and treat them by using close cooperation and an interdisciplinary approach. In general, one can argue that the history of psychodermatology represents a notable example of relative boundaries dividing different medical disciplines. Consequently, the importance of an interdisciplinary approach in contemporary medicine becomes more apparent.

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LEPROSY: LIFE THROUGH THE MIDDLE AGES

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ABSTRACT

Leprosy, currently a treatable disease, was once a mysterious ailment whose etiology was unknown. As a result, people speculated about the cause and course of the disease. Not surprisingly, various social and moral implications accompanied leprosy, particularly in the Middle Ages, when medical knowledge was limited.

During the Middle Ages, disease had become traditionally associated with sin, superstition, and mystery. This element of “the unknown”, in addition to the “grotesque” features of lepers, evoked fear and led to the shunning of those afflicted with the disease. What we now know to be a bacterial infection that invades the skin and peripheral nerves was then believed to be a consequence of sin and therefore, a despised and socially intolerable illness. Lepers were forced into sanitariums or leper colonies throughout Europe, where they were isolated from the rest of society. Interestingly, lepers were treated more contemptuously in the hands of political leaders than they were treated in certain institutions. Certain members of royalty blamed lepers for their nation’s economic strife and other hardships.

It is recognized that stigma associated with leprosy patients provoke certain reactions. These responses to leprosy in the Middle Ages exemplify the medical, social, and moral issues involved when faced with a disease whose pathogenesis is relatively unknown.

One could argue that we have seen similar responses towards diseases such as AIDS and more recently, SARS. What then have we learned from the implications of leprosy with respect to our response to patients infected with new and emerging illnesses?

Introduction

Throughout the years, leprosy has been a disease that has carried with it a sense of mystery. Relatively little was known about the epidemiology of the disease, and this uncertainty remains today. Variation in the epidemiology of the disease is attributed to different cultures and social customs (Badger, 1964). Traced back to the 6th century A. D. (Browne, 1970), leprosy has had, in addition to physical consequences, moral and social implications. Leprosy, therefore, has been described as being more of an affliction of the soul than a disease of the body (Brody, 1974). The course of, and responses to, leprosy throughout the Middle Ages provide us with a perspective on the marginalization of people suffering from a relatively unknown disease.

Leprosy (Hansen's disease)

What is leprosy? This is a question that continues to leave people wondering. From what is understood today, leprosy is a bacterial disease caused by *Mycobacterium leprae*, an acid-fast bacillus. It was not until 1874 that Dr. Gerhard Armauer Hansen, a Norwegian, discovered the bacterium under the microscopic lens (Dharmendra, 1967). Since then, leprosy also became known as Hansen's Disease.

The exact mode of bacterial transmission remains unclear; however, it is agreed that leprosy is a communicable disease. Therefore, it is likely that close contact of infected persons increases their chance of contracting the leprosy. One must bear in mind, however, that the incubation period could be up to several years (Badger, 1964). *M. leprae* shares similar characteristics as *Mycobacterium tuberculosis*; however, their clinical manifestations differ. Although leprosy is considered much less infectious than tuberculosis, leprosy seems to be the more socially unacceptable disease of the two diseases.

A common misconception about leprosy is the idea that results in limbs "falling off". Leprosy is a disease that affects the skin and peripheral nerves. Two main types of leprosy exist (Dharmendra, 1967). People infected with the first type, tuberculoid leprosy, also referred to as secondary tuberculosis, present with red, patchy lesions on the skin. This may or may not lead to the second type of leprosy, the lepromatous or malignant form. The dermatological changes may be followed by a gradual loss of sensation to touch, temperature, or pain. Erosion of the extremities, such as fingers and toes, may lead to claw-like hands and feet, respectively, (Covey, 2001). Those infected with the second type may also experience the loss of eyebrows, thickened and enlarged nares, ears, and cheeks. These manifestations ultimately lead to a lion-like appearance (Covey, 2001). In addition, leprosy also affects the bones by leaving imprints.

The First Cases of Leprosy

Osteoarchaeological investigations, the study of bone imprints, done by Vilhelm Moller-Christensen confirm the presence of leprous lesions on 8 of 20,000 individuals in different geographical areas (Grmek, 1989). These discoveries date leprosy, as Hansen's disease, in mummies from Egypt to the late era of the 6th century AD and 550-650 AD for specimens from France.

It is believed, however, that leprosy originated in India and may have even been present during the 1st millennium B.C. The precise descriptions of the symptoms expressed, as well as diagnosis and prognosis of the disease help to account for this (Grmek, 1989). It is also possible that leprosy spread through China in 1st millennium BC (Dharmendra, 1967).

Grön (1973) describes various art forms and literary works based on leprosy, which reveal the existence of the first cases of the disease. Artists made vases and clay figures portraying typical presenting features of leprosy, such as the thickened lips and loss of eyebrows. Examples of such sculptures have been found in Egypt. A number of artists and authors presented their leprosy-inspired work during the Middle Ages. The images and descriptions likely contributed to society's first interpretation of the disease.

Leprosy in the Middle Ages

As we look at leprosy in the medieval era, one of many questions arises. Was leprosy, as artists and physicians referred to during the Middle Ages, Hansen's disease as it is known today? In all likelihood, leprosy described during the medieval period, was in fact, a set of skin diseases such as psoriasis, and eczema (Grmek, 1989).

The association of sin and disease began in the earliest times and became conventional by the Middle Ages. Thus, leprosy was thought to reflect the sinfulness of those infected. In fact,

“leprosy produces such horrifying external effects that it was considered, especially in the Middle Ages, no less a curse than a plague” (Grmek, 1989).

Leprosy was ultimately considered a form of divine punishment (Clay, 1966). However, others felt pity towards those who had the disease and viewed it as an act of divinity which one would tend not to argue. Job, who may have actually had scabies or syphilis, and Lazarus are common figures in the Bible who are considered to have suffered from leprosy (Grön, 1973). How they actually contracted the disease is not certain. Therefore, one could assume that it was God's will for them to receive the ailment and subsequently be healed.

Interestingly, the Hebrew term Zara'at, used in the book of Leviticus to describe leprosy is not a medical term but ritual one and can be applied to a person, clothing, or house (Grmek, 1989). Nevertheless, those infected with leprosy not only suffered the physical and aesthetic effects of the disease, but also had to endure the jeers and intentional aversion of societal members. This was unavoidable as lepers, those unfortunate enough to have leprosy, were, in essence, branded.

Lepers, also known as lazars, were recognized and labelled by their distinguishing features. Their clothing, for example, was distinct. Lepers may have worn gloves and long robes, usually white, grey, or black in colour. In addition, they would be expected to make noise with a bell, rattle, or clapper as a warning of their approach (Richards, 1977). Many lepers, if they were not isolated in leprosariums, sat begging in the marketplace, with the hope that passer bys would donate alms. In some instances, priests performed religious rituals. Brody (1974) describes how some members of clergy would lay a cross and a box for alms on the door of a leper's home, and after they offered alms, the locals would follow suit. This perhaps could constitute an act of charity, despite the intentional labelling of the leper.

The Medieval Physician's Approach to Leprosy Patients

Often times, medieval doctors could not determine the difference between leprosy and other skin diseases. Similarly, medieval authors did not describe what they saw but what they thought they should see and what their readers expected them to see (Brody, 1974).

Physicians nonetheless described unobservable and/or non-existent signs and symptoms due to misconceptions and perhaps fear. In fact, lacking any knowledge about incubation time, the diagnostician believed it was enough to be "down wind from a leper in order to be infected." (Brody, 1974)

Concerned more about the obvious features, the physician would tend to overlook any potential differentiating details. This was perhaps due to traditional approaches and lack of proper training and resources. As a consequence, the physician would look for signs that he had presupposed existed. His descriptions of skin lesions are rarely more specific than "a horrible state of skin with blotches and eruptions" or "hard stony eminences are felt, on account of the cold black bile" (Brody, 1974). It is of note that the physician was the very one who, rather than providing patient care,

"helped to shape the attitudes of his society, to create an atmosphere in which a disease, sufficiently horrible in itself, was viewed with unnecessary fear, loathing, and condemnation" (Brody, 1974).

In addition, psychological characteristics of patients were noted as being characteristics of leprosy. Again, because of the connection between disease and sin, people were often

labelled as having leprosy on the basis of their choices, thoughts, and actions, particularly their sexual conduct.

Although the physician determined whether or not a person had leprosy, it was the duty of the bishop or priest to declare the person impure. After a physician diagnosed a patient as having leprosy, a clergy member would ultimately declare the person in question, impure. As a consequence, the leper would be forced into isolation.

Treatment

Isolation was a preferred method of dealing with a leprosy patient. No evidence suggests any efficacious medical cures for leprosy during the Middle Ages. There are, however, numerous descriptions of potions, concoctions, and remedies of the like. Because Hippocratic physicians feared the eruption of a leprous lesion more than the initial presentation, prescribed treatments were mild for fear of producing any ulceration (Brody, 1974). Soaking in well-water, for example, alleviated some symptoms but was not successful in curing leprosy patients (Richards, 1977). Most people would likely have preferred a miraculous healing. The Bible, as well as various art forms, depicts Christ's healing of lepers, such as in the case of Lazarus, whose wounds were licked by dogs (Clay, 1966). There is perhaps no better cure than divine healing. However, not every leprosy patient was fortunate enough to receive this treatment and was therefore forced to continue living with the disease.

The Leper and Society

What was it like to be a leper living in the Middle Ages? In addition living in fear of the physical manifestations of the disease leading up to eventual death, a leper lived in under the under scrutiny of society. Shunned by members of the community after having their fate determined by a physician and priest, lepers lived in isolation and abandonment. Because lepers were considered "incurables" and the representation of a "social canker", they were sent to leper houses, where they were isolated (Grmek, 1989). The motive, no doubt, was to localize the problem and remove them from sight, without any intention of providing any support and care. It was, however, recognized that lepers could not be completely segregated from the rest of society. Hence, stringent laws, though not consistently enforced, were in place and prohibited lepers from entering churches or homes and even from being in urban areas (Grmek, 1989).

It is of interest that some institutions may have been considered places of safety and refuge. Some people viewed hospitals as a luxury, and an expulsion from hospital could be viewed as a form of punishment (Richards, 1977). This could be attributed to the care that one could possibly receive while in hospital. In addition, wealth and rank seemingly played a role in the medieval era. Those who had enough money were able to choose to enter certain institutions other than leprosariums; those who did not, were otherwise subject to a poverty stricken life (Richards, 1977).

In other cases, the church, physicians, and lepers, themselves, acted as members of multidisciplinary groups that reviewed cases to make a proper diagnosis in some cases. (Covey, 2001) This suggests, perhaps, acceptance of a more positive response to leprosy.

Nowhere to Hide

Although some lepers were forced into isolation, others suffered under the hands of those who held political authority. Some members of royalty chose to replace religious rituals with civil ceremonies (Brody, 1974). King Henry II of England and King Philip V of France, who accused lepers of poisoning wells (Covey, 2001), ensured that lepers were tied to posts and then set on fire. Edward I, Henry II's great grandson, led lepers to a cemetery, where they were buried alive (Brody, 1974). It is difficult to imagine which the worse fate was: living in direct contact with, and under the scrutiny of, fellow members of society or to be outright tortured by the very people who ought to have been concerned about the well-being of their citizens.

Leprosy Today

Fortunately, we do not experience such drastic measures in today's society with respect to leprosy patients. A once incurable disease because of the mystery surrounding its aetiology, leprosy is now curable with a multi-drug therapy, which includes rifampicin, dapsone, and clofazamine (WHO, 2004). Leprosy is currently most prevalent in the tropical 3rd world countries, where populations are sizeable and space restrictions and crowding exist. If detected early enough, secondary lesions as a result of the disease can be prevented, and the horrible and "grotesque" features associated with leprosy may not appear.

Lessons from the past

To many of us, the way most leprosy patients were treated during the Middle Ages is considered appalling and inhumane. It would be unthinkable to ever intentionally or unintentionally marginalize a group of people the way physicians and the rest of society did in the past. But have we really learned anything from history? In retrospect, it seems unimaginable that such a disease could result in such atrocities by today's standards. However, in light of the recent outbreak of Severe Acute Respiratory Syndrome (SARS) and the first known cases of HIV/AIDS, are we in any position to criticize the actions of the past? These more recent examples force us to think about how we respond to new, emerging disease, whose aetiologies are unknown.

Conclusions

Although leprosy is considered a communicable disease, its exact aetiology remains poorly understood. As we have seen, people, regardless of whether or not they had a true

disease, were marginalized and branded as social outcasts. Not only did patients suffer from the physical manifestations of certain illnesses, they were forced to endure responses based on stereotypes and false pre-tenses. What lessons have we learned from the past, and knowing what we know now, can we really prevent history from repeating itself?

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D'ARCY ISLAND: LEPROSY, RACISM, AND BANISHMENT IN BRITISH COLUMBIA

By

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ABSTRACT

In 1891 five men were discovered hidden in a back room of Victoria's Chinatown. The men were found to have leprosy and the introduction of this disease to BC led to fear, reproach and racial segregation. Victoria city council believed it necessary to quarantine all Lepers to prevent further spread of the disease. Thus on April 21st 1891 the colony of D'Arcy Island was established.

D'Arcy is a small island just off the coast of Victoria that became the imposed home to some 49 men until its closure in 1924. Conditions on the island were poor and the men were left to fend for themselves with supply ships coming only once every three months. No medical care was provided; only empty coffins were left to bury their companions. Records of the island are sparse, both arrivals and deaths were noted but many of its inhabitants are unknown. Visits were made by medical officers and physicians but only to observe the men and document their illness.

Was the creation of D'Arcy Island a reaction to the fear of an infectious disease or was it a racially motivated political decision? The causative agent was unknown and there was no effective treatment. Some doctors of the time did not believe that it was even infectious because of its slow spread while others insisted that patients must be isolated. Unfortunately for the 49 men, of whom 43 were Chinese immigrants, their sentence was to live out their days alone on D'Arcy Island.

During a routine health inspection of Chinatown in March of 1891, Victoria sanitary officers discovered five men hidden in the back of a residence. (5) The men were Chinese immigrants and were found to be suffering from Leprosy. Although tuberculosis and small pox were often found in the Chinatowns of British Columbia, this was the first report of the dreaded leprosy. The men were quarantined while city officials decided what course of action to pursue. It was decided that since no treatment was known to be effective, the only measure that could be taken was forcible isolation to prevent the spread of the disease. On April 21, 1891 six men were shipped to D'Arcy Island off the

coast of Victoria. (3) This began a period of 33 years of isolation on the island for those unfortunates found to be infected with *mycobacterium Leprae*.

D'Arcy Island is a small piece of densely forested land in Haro Strait. It is approximately 84 hectares and has no sheltered anchorages. There was a wooden lazaretto erected on the island that had wood stoves for cooking and heat. A small bog not far from the resident's shelter supplied water. The city council sent a supply ship to the island once every three months to deliver food and provisions. The only means of communication with the mainland for the residents was via a white flag, which was to be raised if assistance was required. If they were lucky a passing ship would spot the signal or maybe someone walking the beach in Cordova Bay would notice the plea for help. No medical care was given to the residents of D'Arcy so they were forced to care for each other. (5) The men who were physically able would perform the chores and look after those that were too weak to care for themselves. Water and wood had to be gathered from the forest and the residents even tended a small cooperative garden. As the disease progressed and the men lost their strength other new arrivals would take up the duties, which were required to maintain the sick. The supply ships also delivered coffins for the residents to bury the dead. It is believed that as the remaining residents became less physically able, the gravesite moved closer and closer to the living quarters. (5)

The record regarding D'Arcy is sparse at best. The patients sent to the island are mostly unknown and all of their graves are unmarked. It is even difficult to ascertain how many residents inhabited the island at any one time. The only mention of the inhabitants was in the provincial health officers annual report that included the number of persons shipped to the island as well as the number of patients that died in that year. In all it is believed that 49 men were sent to the island. The colony was established and run by Victoria city council from 1891 to 1905. The provincial government took responsibility for the island for one year until the federal government took over the facility in 1906. Many residents never left D'Arcy while others were deported back to China once the dominion government took control. In 1924 the island was closed and the remaining six men were transferred to the Bentinck Island Quarantine station off William head. (5)

British Columbia was a young province of mainly British settlers in the late 1880's. Its economy was largely resource based and included mining, fishing and forestry. At this time there was marked racial segregation, fishing camps had separate quarters for Chinese and Natives while Europeans were housed together. Projects such as mining and the completion of the trans-Canadian railway required extensive labour and the time saw a large influx of Chinese immigration. In the first four years of the 1880's there were approximately 17,000 labourers brought over from China. (3) Attitude towards the immigrants was less than favourable and the Chinese were mainly confined to Chinatowns. While British Columbians were not thrilled to have the Chinese here to work they were more than willing to give them the most dangerous jobs in the mines and during railroad construction. Mr. Dewdney a MP in BC in 1885 commented on the general sentiment towards the immigrant workers: "I do not think that they are a desirable

class to have amongst us, but they are very useful.” (4) Most Chinese men came without their families and planned to return to China with the money that they made from their labour. This caused an animosity towards the Chinese from British Columbians and even the prime minister of the time, John McDonald who said: “...a chinaman gives us his labour and gets money, but that money does not fructify in Canada; and if he cannot, his executors or his friends will send his body back to the flowery land. But he has no British instincts or British feeling or aspirations, and therefore ought not to have a vote.” (2) The provincial government wanted to control Chinese immigration and passed 22 restrictive acts to regulate immigration between 1884 and 1904. (3) The dominion government at first resisted the exclusion of Chinese immigrants but soon after the completion of the railway in 1885 the government changed its policy. There was a Royal commission on Chinese Immigration in 1885 and a head tax was imposed of \$50 for each man coming to Canada from China. In 1901 the head tax rose to \$100 and then to \$500 in 1904. The federal government then imposed the Chinese exclusion act in 1923, which prevented Chinese immigration until its reversal in 1947. (3)

The Royal Commission on Chinese immigration in 1885 was assembled to explore concerns over the immigration of Chinese workers to Canada and the effect their arrival was having on the country's culture. It consisted of a section dedicated to the situation in British Columbia. A wide variety of witnesses were questioned before the commission. The Mayor of Victoria, police and other city officials were questioned as well as the BC Attorney general. Owners of industry such as Robert Dunsmuir and Andrew Onderdonk were interviewed as well as workers from the mines. Dr. Helmcken who was a respected surgeon in Victoria provided medical opinion. A list of 27 questions was formulated that covered subjects such as work ethic, work skills and culture. The commission was concerned that Chinese workers were not paying taxes and that the money earned was not spent in Canada. Questions were asked about Chinese servants corrupting children and smoking opium. In general answers from the witnesses describe the Chinese as a hard working, law-abiding people. Question number 27 was “what personal knowledge have you of the presence of leprosy among them and have you any personal knowledge of leprosy being communicated from them to whites, and if so, how many instances and under what circumstances?” (4) Although no evidence was found of Leprosy among the immigrants at this time it was a concern of the general public. Chief Justice Begbie commented, “It is common to attribute to Chinamen generally, that they are infected with disgusting diseases – for example leprosy. I believe that this is pure imagination, an absolutely unfounded report.” (4) Dr. Helmcken testified that he was only aware of two cases of leprosy in BC, one Native before Chinese immigration began and one Chinamen. He knew of no spread of the disease and felt that disease was not contagious. He and other physicians of the time believed that there may have been an inherited component to leprosy and that it was not infectious. Dr. Helmcken made insightful comments on the perception of the Chinese by the public and the language barriers that contributed to rift between races. “They cannot communicate their ideas to us nor we to them, therefore we are in the dark.” (4) The last question asked of Dr. Helmcken was by the Hon Mr Justice Gray. He asked, “It has been alleged in the houses of parliament that ladies are scrubbed

by Chinese whilst in their baths. Is that true?" To this Helmcken replied, "It is a lie." (4) The report of the Royal Commission is a fine example of the prevailing feeling towards the Chinese in British Columbia during the late 1800's. Whether it accomplished its mandate with its conclusions is debatable but it did serve to influence government immigration decisions and perhaps widen the rift between the two races.

The men that were banished to D'Arcy Island received no medical treatment. The medical officer visited once every three months with the supply ship to take count of the remaining residents and make observations of the progression of their disease. On one such visit Dr. Ernest Hall and John Nelson accompanied the supplies. They documented their trip in the Dominion medical monthly and Ontario medical journal. In their article they describe the poor conditions of the colony. "Those who compose it [the colony] are of a race whose affairs rarely reach the public ear." (1) The perception that leprosy was a disease related to filth and attributed to the Chinese is exemplified in this article. "Herding as they do in shacks, sheds, and even boxes, all crowded into a very small area, the race is a very difficult one with which to deal." (1) The first question asked to the residents by the health officer is "how many are there, John?" It seems that one resident had died since the last supply ship and was buried by his companions. Hall describes the poor physical condition of the residents and comments on "a thumb from which the first joint is gone." The eloquently written account of the visit includes information from the day on the debate of the infectivity of leprosy. "Experiments have been conducted in which criminals have been inoculated with the virus without contracting the disease. Some of the victims at D'Arcy Island were removed from white homes where they were employed as cooks, yet no whites in the city here ever contracted it." (1) The Medical community could not ascertain if the disease was infectious and yet the city council still felt justified in banishing those afflicted from the rest of civilization.

The colony on D'Arcy Island was created to protect the public health interests of the city of Victoria. At the time isolation was the only option as no treatment was available to cure to disease but perhaps the removal of lepers served other purposes as well. The disfigurement of sufferers, the sores and blunted appendages were a source of disgust and fear to the general public. By removing the ill from sight, the public no longer were troubled by visions of this disease. The fact that 43 of the 49 men sent to D'Arcy were Chinese and only a single white man ever inhabited the island may explain a second reason for the isolation. Racial tension between whites and Chinese may have led to the moral justification for removal of the lepers from the towns in which they lived. There are reports of Chinese lepers being shipped from the east of Canada to D'Arcy. This maintenance of racial segregation between leprosy patients is a reflection of the prevailing feelings of the day. To put the blame of this horrible disease on a group of immigrants and remove them from the community would have helped to relieve people's fear of contracting the disease themselves. Whether the risks were perceived or real to the general public had little consequence on the decision to isolate these men. In fact the residents led a lonely shunned life on their little island. Even their own relatives and companions shunned the sick. No correspondence was sent to the residents and no one

except the medical officer came to visit. Abandoned and forgotten in a foreign land the residents of D'Arcy were left to live out their final days with no hope of returning home. After his visit Ernest Hall commented that "our thoughts would unwittingly revert again and again to the little island with its lonely colony of unfortunate men who, far from home and friends, and all that makes life worth living for, are passively waiting for the coming of the night." (1)

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SCHWEITZER'S LEPROSARIUM AT LAMBARÉNÉ

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ABSTRACT

Albert Schweitzer, winner of the 1952 Nobel Peace Prize, was a gifted physician, missionary, musician, and philosopher. Born in Alsace in 1875, Schweitzer became a scholar in philosophy, theology, and music. Despite his expertise in these disciplines, at age thirty he abruptly altered the course of his life in order to dedicate himself to medicine, wishing to serve those in need in Africa. After completion of his medical degree, he went on to establish a hospital at a missionary station in Lambaréné, Gabon in 1913.

A common illness at Lambaréné at this time was leprosy, or Hansen's Disease. However, the lepers were not welcomed by other patients in the hospital due to the social stigma of this disease, as well as the fear of contagion. Leprosy was thought to be the result of a breaking a taboo, disrespecting an ancestor, or offending a spirit. When sulfonamide was discovered to be an effective leprosy treatment in the 1940s, the influx of lepers at the Lambaréné hospital, combined with disapproval of other patients, demanded the construction of a separate village for those afflicted with leprosy.

Due to the constant necessity for repair, the original leper village was replaced with a permanent leprosarium in 1952, funded in part by Schweitzer's Nobel Peace Prize. The supportive community established at the Lambaréné leprosarium was appreciated by its residents, as evidenced by the desire of many patients to live their remaining years there. Schweitzer himself spent the majority of his life after 1924 at Lambaréné, passing away there in 1965. Schweitzer's life exemplifies humanitarian contribution consistent with his famous philosophy of "Reverence for Life," and his legacy continues with the Albert Schweitzer Hospital serving the people of Gabon.

"Man's ethics must not end with man, but should extend to the universe. He must regain the consciousness of the great chain of life from which he cannot be separated. He must understand that all creation has its value."

-Albert Schweitzer

Nobel laureate Albert Schweitzer is well known for this philosophy of "Reverence for Life," upon which many of his ideas and selfless contributions revolved (Chew 1996). After becoming an accomplished philosopher, theologian and musician, he dedicated his life to medicine in order to become an African missionary physician. Schweitzer established a hospital at the mission station in Lambaréné, Gabon (Nobel Lectures 1951-1970). One of the common diseases afflicting his patients was leprosy, so he had a leprosarium built as a treatment centre and refuge for these ostracized patients (Jilek-Aall 1990). While advancing treatments have substantially improved the prevalence of leprosy, this age-old disease continues to affect people in both developing and developed countries (Picard 2004). In 1957, the Academy Award winning biography "Albert Schweitzer" captured his life and contributions on film (Fenner 2003). Schweitzer died in 1965 (Cousins 1984), but his tremendous humanitarian contributions, philosophical ideas, and the continuing care provided by the Albert Schweitzer Hospital (Borrmann 2001) remain a legacy for his life and work.

Schweitzer was born in the village of Kayersberg and raised in the nearby village of Günsbach. Both are in Alsace (Brabazon 1975), which was then a German region but alternated between German and French rule throughout Schweitzer's life. As a result of these changes, Schweitzer learned to speak both French and German, in addition to the dialect of Alsace. His father was a Lutheran pastor in the church shared by the Protestant and Catholic villagers, exposing young Albert Schweitzer to faith and tolerance (Nobel Lectures 1951-1970).

Schweitzer began studying at the University of Strasbourg in 1893, receiving a doctorate in philosophy in 1899, and a doctorate in theology in 1900. Following his father's footsteps, Albert became a pastor at St. Nicholas Church in Strasbourg in 1899. He worked in administration at the Theological College of St. Thomas at the University of Strasbourg from 1901 through 1912 (Nobel Lectures 1951-1970). By the time he was thirty years old, he had published three books (The Religious Philosophy of Kant from the "Critique of Pure Reason" to "Religion Within the Bounds of Mere Reason," The Mystery of the Kingdom of God, and J.S. Bach) (Cousins 1984) and had also become a university faculty member (AISL 2003).

In addition to his passion for philosophy and theology, Schweitzer excelled in music. He became an expert on Bach, as well as organ reconstruction (Nobel Lectures 1951-1970). His talent for performance served him throughout his life, and he often played at concerts as a means of raising money for the hospital he later founded at Lambaréné (Christen 1962).

At the age of twenty-one, Schweitzer felt that he wanted his life to reflect a more direct service to humankind. He resolved to dedicate his life until he was thirty to his current endeavours, and at that point to find a new means of contributing to the well-being of others. At this point, he was still unsure of what direction his life would take in order to fulfill this ideal. The possibility of becoming a missionary physician did not occur to

Schweitzer until he was twenty-nine, while reading an appeal for African Missionaries from the French Protestant Missionary Society (Nobel Lectures 1951-1970).

The initial announcement of his plans to enter medical school brought disapproval from family, friends and the University of Strasbourg alike. Schweitzer was leaving a well-established and successful career in Europe to enter medical school and move to Africa. One of the few people who supported his desire to become a medical missionary was Helene Bresslau, whom he later married. Schweitzer entered medical school in 1905, and finished in 1913 with a specialty in tropical medicine and surgery (AISL 2003). He explained, "I wanted to become a doctor in order to be able to work without words. For years I had used the word. My new occupation would be not to talk about the gospel of love, but to put it into practice" (Nobel Lectures 1951-1970).

Unfortunately, upon completion of his medical degree, Dr. Schweitzer's application to the Protestant Missionary Society was initially declined, and eventual acceptance only came with the promise that he would not preach as a missionary, but only practice medicine. Dr. Schweitzer and his wife, Helene, left for Lambaréné on Good Friday in 1913 (Nobel Lectures 1951-1970).

Lambaréné is in a rain forest on the River Ogooué, and has an average temperature of 27°C (Borrmann 2001). It is in on the west coast of French Equatorial Africa (Nobel Lectures 1951-1970), in the country which is now Gabon (AISL 2003). While the mission station at Lambaréné was established prior to Schweitzer's arrival, there was no hospital there, demanding a chicken coop serve as the first hospital building. The initial medical team consisted of Dr. Schweitzer, Helene and Joseph Azowani, one of the first patients in the hospital who became the medical assistant and interpreter. Within the first nine months, two thousand patients were seen, while at the same time the first real hospital building was under construction. Schweitzer expected help in maintaining the hospital, but was also very willing to work hard himself. He required some payment for his services, whether it be money, bananas or an egg. This was both in order to support the hospital, and so that patients would not forget the donations of people in Europe provided to support them (Brabazon 1975).

With the start of World War I in 1914, German citizens Albert and Helene were interned as enemies in the French colony of Gabon (Nobel Lectures 1951-1970). During this internment, Dr. Schweitzer was on a mission down Ogooué River when he came upon a herd of hippopotamuses in the river at sunset. This moment was the inspiration for his famous philosophy of "Reverence for Life." Dr. Schweitzer's later reflection on the principle upon which much of his life was based, explains, "Reverence for life affords me my fundamental principal of morality, namely, that good consists in maintaining, assisting and enhancing life, and that to destroy, to harm or to hinder life is evil" (Fenner 2003).

Later in the war, the Schweitzers were sent back to an internment camp in France. Although they were freed in 1918, they did not immediately return to Lambaréné due to Albert being ill (Nobel Lectures 1951-1970). His daughter Rhena was born the following year, and Dr. Schweitzer remained with his wife and child in Europe until 1924, when he returned to Lambaréné. As a result of Helene's illness at the time, Helene and Rhena did not accompany him (AISL 2003). From this point onward, Lambaréné remained Dr. Schweitzer's permanent home (Nobel Lectures 1951-1970), other than occasional trips to Europe to give lectures or perform organ recitals as a means of raising money for the mission hospital (Christen 1962).

As a physician in Gabon, some of the illnesses Dr. Schweitzer commonly encountered included sleeping sickness, skin diseases, elephantiasis, osteomyelitis, heart problems, tropical dysentery, malaria, and leprosy (Brabazon 1975). Leprosy is of particular interest because of its high incidence, as well as the stigma attached to it within the cultural atmosphere of the patients at Lambaréné. Disease was thought to be caused by either magic, evil spirits, or a worm eating the body from inside (Fesclotte 1954). It was suspected that a patient afflicted with leprosy must have broken some taboo, disrespected his ancestors, or insulted a spirit. As a result of the association of unacceptable behaviour with the disease, lepers were outcast. They often left the hospital prior to treatment completion, resulting in more severe sequelae of the disease (Jilek-Aall 1990).

Leprosy is also known as Hansen's disease, named after the Norwegian physician who first observed *Mycobacterium leprae* in 1871 (Bryceson and Pfaltzgraff 1990). This infectious mycobacterium is a gram-positive rod (Manson-Bahr 1945) which is acid-fast and an obligate intracellular organism. It is thought to be transmitted through aerosols from the upper respiratory tract (Cotran 1999), and is found in skin lesions, nasal mucosa, and mucous secretions. It has not been cultured except in the foot pads of mice. The only known natural hosts of *M. leprae* are humans and armadillos. Its incubation period ranges from two to twenty years, with a median of two to seven years (Rakel 2003). The incidence of leprosy increases with high rainfall, high humidity, and crowding (Manson-Bahr 1945). The cell wall of *M. leprae*, which is responsible for its virulence, is similar to that of *Mycobacterium tuberculosis*. Immunization with Calmette-Guerin for tuberculosis actually provides 50% protection against leprosy (Cotran 1999). However, there is currently no specific vaccine for *M. leprae* (Rakel 2003).

The optimal temperature for growth of *Mycobacterium leprae* is between 32 and 34°C, the temperature of human skin and extremities. This explains why skin and peripheral nerves are most commonly affected. Leprosy is categorized into the milder tuberculoid (paucibacillary) leprosy, and the more severe lepromatous (multibacillary) leprosy (Cotran 1999). While fewer than 5% of adults are susceptible to infection (Rakel 2003), the type of leprosy occurring in those affected is dependent on their immune system (Cotran 1999).

In tuberculoid leprosy, there is a T-cell mediated response with mostly CD4+ type 1 helper T cells. Most of the mycobacteria are killed, but granulomas are formed containing macrophages and giant cells. Nerves are damaged when these granulomas form within nerve sheaths. Initial skin lesions are erythematous (Cotran 1999), but later become centrally hypopigmented and hypoesthetic, although they remain well-defined (Rakel 2003). With nerve damage, the skin becomes anesthetic and wasting of peripheral muscles occurs. The anesthetic effect increases the likelihood of damaging the skin and causing the formation of ulcers (Cotran 1999).

In lepromatous leprosy, no immune response is mounted against the bacterial extract *lepromin*, and many mycobacteria remain in the host's foamy macrophages. The lesions are not well defined, and contain more CD8+ suppressor T cells than CD4+ type 1 helper T cells. Cytokines secreted from the suppressor T cells inhibit a CD4+ T cell response, and activate B cells to produce antibodies. The antigen-antibody complexes formed may cause erythema nodosum leprosum, involving vasculitis and glomerulonephritis (Cotran 1999). In contrast to tuberculoid leprosy, it is the abundant mycobacteria which invade the nervous system in lepromatous leprosy, affecting macrophages and Schwann cells. Macules, papules or nodules may form on the skin, and the distribution of skin and nerve involvement may include the hands, feet, eyes, upper airways, testes and lymph nodes. When the testes are affected, male patients may become sterile. As the disease progresses to more severe stages, the liver and spleen may also be involved. When nodules on the face coalesce, the characteristic appearance is described as "leonine" (Cotran 1999).

Before effective anti-bacterial agents became available, treatments for leprosy included surgical excision of lesions and debridement of necrotic tissue, dressing of ulcers, and the use of Chaulmoogra oil (Jilek-Aall 1990). When ulcerous, amputation of metatarsals was also recommended (Manson-Bahr 1945). Chaulmoogra oil was extracted from the seeds of Indian and Burmese trees (Manson-Bahr 1945), used for the fatty acids it contains, which are effective in killing acid-fast bacteria. Chaulmoogra oil was administered orally or intramuscularly (Gunn 1933), but could be an irritant if used after becoming stale (Manson-Bahr 1945). Promine was being used in the United States as a treatment for leprosy in the 1940s, and ulcers were being cured by French doctors with an experimental extract of the *hydrocotylus asiatica* plant (Schweitzer 1949). Exercises to reduce deformities were also recommended (Manson-Bahr 1945). Lastly, as a prophylactic measure, it was recommended that, "In no country should lepers be permitted to beg in the streets, keep shops, or handle food" (Manson-Bahr 1945).

In the 1940s, sulfonamide was discovered to be an effective treatment for leprosy. This brought a large influx of lepers to Schweitzer's hospital for treatment. As a result of the social stigma surrounding leprosy and fear of contagion, other patients did not want to be near the lepers. With the new influx of lepers to the hospital, it was necessary to build a leprosarium isolated from the main hospital (Jilek-Aall 1990).

Dr. Schweitzer had the lepers who were capable of helping aid in constructing a new village, reasoning that they should be involved in the maintenance of the hospital, hoping that their involvement in the village's creation would heighten their gratitude to the many people who made donations to the hospital (Brabazon 1975). The village was constructed of bamboo and leaves (Jilek-Aall 1990).

Dr. Schweitzer tried to avoid changing customs of the African people when it was not necessary, as evidenced in his statement, "If we have to change the existing laws and customs, let us do nothing that is not absolutely necessary" (Fesclotte 1954). However, at times Schweitzer has been accused of racism, following comments such as, "The African is my brother - but he is my younger brother by several centuries" (Andrews *et al.* 1996). While this statement is racist by current standards, it is at least in part a reflection of the time Schweitzer lived. His words suggest a racist perspective, yet Schweitzer gave up a life in which he was well-established and respected in order to help his brother Africans (AISL 2003). In deciding to become a missionary, he hoped to rectify some of the hardships endured by the African people as a result of white men (Nobel Lectures 1951-1970). Schweitzer's deeds and sacrifices attest to his compassion, as he suggested in saying, "I went to Africa to make my life my argument" (AISL 2003). Though not a perfect man, Schweitzer is remembered as compassionate and giving. A journalist coming to meet him in Lambaréné once wrote, "It may be hard to communicate that a man may be good, and testy; of legendary resolution, but frail; capable of universal tolerance and sudden superb impatience's; full of Christ and fun . . . I often forgot in the mornings that Albert Schweitzer was The World's Finest Man: I felt him merely to be one of the friendliest" (Brabazon 1975).

While the leper village constructed offered a temporary solution to the large number of lepers at the hospital, it also demanded constant repairs as a result of the weak roofs made of leaves. It was decided that a permanent leprosarium was in order, constructed with concrete foundations and roofs of corrugated iron. The funding for this project included a collection of donations from Norway (Jilek-Aall 1990) and Schweitzer's Nobel Peace Prize of \$36 000. It was constructed in memory of Albert Schweitzer's parents, and completed in 1954-55 (Cousins 1984).

The patients living at the leprosarium appreciated the respite it offered, and they created a supportive and cooperative atmosphere. Even a young boy, initially horrified at being left by his family to the leprosarium, soon came to appreciate his new home, saying "Here we are all sisters and brothers...This is a good place to be living" (Jilek-Aall 1990).

During his lifetime, Schweitzer promised the inhabitants of the leprosarium that they could live there until their death. This was often a necessity due to constant need for treatment, or the loss of their previous lives once afflicted with the ostracizing disease. However, following Schweitzer's death, the leprosarium was declared a "disgrace" by the British Leprosy Research Association, largely in response to its focus on surgery rather

than preventative medicine. This was, however, a somewhat inaccurate accusation, as the hospital was supposed to be handing over the prevention of leprosy to a government campaign in the villages. When it was suggested that the leprosarium be shut down, its inhabitants adamantly refused, saying, "This is now our village, and if you turn us out we will build a new village nearby" (Brabazon 1975).

Following Schweitzer's death, his daughter Rhena continued to manage the hospital for many years. The Albert Schweitzer Hospital continues to run in Lambaréné today, with 160 staff, 35 000 outpatient visits and 6000 hospitalizations in 2002 (Schweitzer Fellowship 2002). There is also a Medical Research Unit at the hospital, with research interests focusing on malaria (Borrmann 2001).

Although less prevalent than in the past, leprosy continues to be a global concern, with approximately 600 000 new cases of leprosy arising each year. The prevalence of leprosy is 6500 in the United States and 500 in Canada, and the annual incidence is 200 in the United States and 25 in Canada. When compared with the 5.4 million cases diagnosed in 1985, more effective treatments have drastically improved the prognosis for those infected with *Mycobacterium leprae* (Picard 2004). Most of the cases confirmed in Canadians are in immigrants or travelers (Branswell 2004). Unfortunately, it takes an average of 6 years from symptom onset to diagnosis in Canada, suggesting that we need to be more aware of leprosy in our differential diagnoses. Symptoms may include skin rash, tingling, muscle weakness, and hair loss (Picard 2004). Current treatments for leprosy include dapsone, rifampin, and clofazimine (Rakel 2003).

Schweitzer, the physician, philosopher, musician and humanitarian exemplified a spirit of compassion and service throughout his lifetime. His dedication to helping others is illustrated brilliantly through his life's work, serving as an ideal for us all. The hospital and leprosarium he founded at Lambaréné has served many people over the past century. From childhood in a small European village winner of the Nobel Peace Prize, Schweitzer's own life of generosity fulfills his reflection, "I don't know what your destiny will be, but one thing I do know: the only ones among you who will be really happy are those who have sought and found how to serve" (Moncur 2004).

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HIGH ADVENTURE, A HISTORY OF ACUTE MOUNTAIN SICKNESS

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ABSTRACT

The eighteenth, nineteenth and early twentieth centuries were exciting times for European adventurers. Mountaineers were traveling to unclimbed mountains both higher and further a field, while aviators were flying balloons over greater distances and to greater heights. These adventures exposed more and more people to the rarified atmosphere at high altitudes, and thus brought on the symptoms of mountain sickness. Mountain sickness was first described over two thousand years ago, and several detailed reports were published in the sixteenth and seventeenth centuries. Many of these reports showed an understanding not only of the causes of mountain sickness, but also the means to avoid it. As mountain sickness became more prevalent, some explorers began investigating respiration at altitude in earnest. Some made very astute observations and drew accurate conclusions, but available data was rarely analyzed in a systematic way. The freedom of roaming the hills and conquering greater heights was more compelling than the lure of scientific progress. Mountain sickness continued to plague and to fascinate. Real progress wasn't made until the turn of the century when mountaineers and aviators began collaborating with laboratory investigators. As respiratory physiology became more sophisticated, so did expedition preparations, and practical solutions to the problems of breathing at altitude were found.

Although high mountain travel was relatively uncommon until the eighteenth century, the symptoms of acute mountain sickness have been described for thousands of years. Even in ancient times, the observers of mountain sickness related the symptoms to the breathing of rarefied air. During the Renaissance, as the mechanics of the atmosphere and the physiology of ventilation and respiration were described, we established the scientific foundations for understanding mountain sickness. Through the eighteenth and nineteenth centuries high altitude travel evolved from an occasional necessity to a regular occupation and pastime. The pace of discovery quickened. This acceleration was, however, self-limiting, for the investigators were the very people drawn to the mountains for work and pleasure, so scientific observation often became the excuse to go play in the hills. Perhaps it is silly to try to uncouple the motivations of early high altitude

researchers. Were they scientists who liked to play outside, or adventurers driven to investigation by necessity? Either way, the researcher/adventurers from ancient times through the nineteenth century slowly helped us to understand acute mountain sickness, and had a great time doing it.

Today we know that acute mountain sickness (AMS, or mountain sickness) is caused by the body's inability to accommodate the rapidly decreasing oxygen available for inspiration as atmospheric pressure drops with elevation. Classic symptoms include shortness of breath, headache, nausea, malaise, loss of appetite, insomnia, and in severe cases, pulmonary and cerebral edema, leading to death. In its mildest presentation AMS is no different from exertional fatigue, which can afflict anyone traveling on foot, especially when there are hills involved. However, even early accounts show that more than fatigue was at play, and show an astute recognition that rarity of the air was to blame.

The earliest account of the symptoms of AMS is from the Chinese history Ch'ien Han Shu from 30 B.C.E. (West, 1998, 5). It tells of the emperor Ching-te sending an envoy of gifts over the mountains to the west, likely to modern day Afghanistan. A Chinese official, Too Kin, warned of bandits and difficult mountain terrain en route, and also alluded to the problems of mountain sickness:

“Again, on passing the Great Headache Mountain, the Little Headache Mountain, the Red Land, and the Fever Slope, men’s bodies become feverish, they lose colour, and are attached with headache and vomiting...”(West, 1998, 6-8)

The Ancient Greeks also reported difficulties at high elevations. St Augustine not only described difficulty in breathing, but also suggested a cause and proposed a solution:

“That mountain of Macedonia which is called Olympus is said to be of such a height that on its summit no wind is felt and no clouds gather. Because it exceeds in its heights all vapourous air in which birds fly, ...because of the rarity of the air which did not fill them with breath, they were not able to survive there unless they applied moist sponges to their noses” (West, 1998, 3)

Note how clearly St Augustine seems to understand the problem: the height of the mountain leads to a rarity in the air and thus makes it difficult to breathe. The moist sponges would not likely have helped with breathing, but they may have relieved the dry nose and lips that can accompany labored breathing at high elevations. In spite of these early appreciations of the causes and symptoms of mountain sickness, science would not begin to explain the phenomenon until the Renaissance.

Certain scientific discoveries were key to the investigation mountain sickness. The first was the invention of the Barometer by Torricelli in Florence in 1641. Evangelista Torricelli was Galileo's student and successor. Galileo had first demonstrated a vacuum

and shown that it could only support a finite column of water. He attributed this limit to the cohesive strength of water. After Galileo's death, Torricelli began experimenting with different liquids and made the conceptual leap that the liquid was not supported by the vacuum above it in the tube, but by the weight of atmosphere pushing down all around it. In 1644 he wrote: "We live submerged at the bottom of an ocean of the element air, which by unquestionable experiments is known to have weight..."(West, 1998, 20-21).

Once the barometer was invented and the principle of atmospheric pressure described, someone had to show that atmospheric pressure changes with altitude. This was done by Blaise Pascal on February 19, 1648. On Pascal's suggestion, his brother-in-law Florin Perier carried a barometer up and down a local hill to see if the pressure would change. Multiple readings and careful use of controls confirmed that it did. (West, 1998, 22-25)

It was also important to understand the composition of the atmosphere and the role the different gases play in respiration. Although there was considerable experimentation in combustion and respiration, an elegant but incorrect theory would hamper understanding for over a hundred years. This theory, proposed by the German chemist and physician Johann Joachim Becher, suggested that all combustible material was composed of ash and *phlogiston* (Greek for inflammable). According to this theory, a material could burn until either all the phlogiston was released, or until the air around it became saturated with phlogiston. Phlogiston was essentially the opposite of oxygen; it was even said to have negative mass. The mirror image of reality, the phlogiston theory almost made good sense, and could explain the details of combustion and respiration quite effectively. It is thus not surprising that scientists held on to the theory for so long. (West, 1998, 41-42). As we shall see, latter day mountaineer/scientists also held on to good ideas without the evidence to support them.

Ironically, the discoverer of oxygen was a firm believer in the phlogiston theory until his death. Joseph Priestly, a minister and sundry experimental scientist, heated mercury oxide in 1774 and was intrigued by the gas that evolved. He found that it could invigorate a candle's flame and help sustain a mouse trapped in a sealed container. Priestly breathed the evolved gas and offered this description: "The feeling of it to my lungs was not sensibly different from that of common air; but I fancied that my breath felt particularly light and easy for some time afterwards." We must imagine this feeling was similar to that which his successors would feel upon returning from a good day's climb. Priestly experimented further and found that green plants could improve the air and sustain a trapped mouse in the same manner as oxygen gas. However, a student of the phlogiston theory, Priestly did not come to realize the true nature of the gas he had discovered. Over dinner in 1774, Priestly described his findings to Antoine Lavoisier who was interested in combustion and had been experimenting with the heating of diamonds under different conditions. Lavoisier performed further experiments with oxygen and ultimately found it to be: "nothing else but the pure portion of the air that surrounds us and which we breathe." Lavoisier's work also uncovered the role of carbon

dioxide and nitrogen gases in respiration, and the composition of the atmosphere. (West, 1998, 42-47).

At the end of the eighteenth century, just as science had laid the foundations for the understanding of mountain sickness, travelers were beginning to reach high elevations frequently enough that mountain sickness became a common problem. These mountain travelers often returned with volumes of detailed observations, some showing good insight into the problem of mountain sickness. In 1802, German naturalist Alexander Von Humbolt spent considerable time at high elevations in South America. At 5500m on the volcano Chimborazo he reported feeling: “a discomfort, a weakness, a desire to vomit, which certainly arises as much from the lack of oxygen in these regions as from the rarity of the air.” His experimentation showed the air to consist of 20% oxygen, which he thought was less than normal (West, 1998, 58). None the less, Humbolt was clearly observing AMS and attributing it to rarified air and lack of oxygen.

In 1787, Swiss physicist and geologist Horace-Benedict de Saussure made the second ascent of Mt Blanc (4807m), the highest summit in Europe. High on the mountain he complained; “I was already out of breath from the rarity of the air... the rarity of the air gave me more trouble than I could have believed. At last I was obliged to stop for breath every fifteen or sixteen steps.” When trying to make scientific observations on the summit he noted: “When I had to get to work to set out the instruments and observe them, I was constantly forced to interrupt my work and devote myself entirely to breathing”. And in reference to his guides and porters: “They were attacked, some by palpitations, others by vomiting, others by faints, others by a violent fever, and all these symptoms disappeared as soon as they breathed a denser air” (West, 1998n 59-60). Similar to Humbolt, Saussure was observing the classic symptoms of AMS (though fevers and palpitations are a bit unusual), and correctly attributing them to the rarefied air. These early ascents set the stage for the explosion of mountain travel that would follow, and set a precedent for making scientific observations en route. However, as we will see, not all adventurers were disciplined scientists, and some of their observations proved to be a hindrance to progress.

By the mid 1800s, mountain travel became more popular and mountaineer/scientists more prolific. In 1857 the Alpine Club was formed to offer a forum for discussion between mountain enthusiasts. At club meetings members would read ‘papers’, that is to say stories of their exploits, and then submit them for publication in the *Alpine Journal*. This journal was a source of entertainment for the club, a record of new mountain routes, first ascents and the like, and a record of scientific findings. Much of the science therein was devoted to acute mountain sickness. In reading the *Alpine Journal*, the distinction between the science and the tall tales is quite blurred. Even the scientific papers were to be read aloud, and thus had to be entertaining. Furthermore, the scientists were themselves mountaineers first, researchers second. Consider this passage by William Marcet, published in the *Alpine journal* in 1886:

“There is a fourth class of climber who combine a love of alpine existence with some other pursuit to be carried on in mountains only.... The author of this paper may perhaps be considered one of this class...inquiring into the state of the body in the cold and frosty light atmosphere of the upper regions, where food is scanty, limbs tired, and sleep insufficient.” (Marcet, 1886, 2)

This paper is the culmination of several years on work oxygen consumption at, and acclimatization to, high altitudes. Marcet quotes the work of other investigators, presents his methods, materials, and data in a systematic fashion, and acknowledges the limitations of his work. There is no doubt this is intended to be a scientific paper. However, he acknowledges himself a climber first, and demonstrates the importance in telling a good story.

The distinction between entertainment and science is further blurred in another paper by Marcet: “On the Use of Alcoholic Stimulants in Mountaineering” published the next year. The paper begins with a mention of the money spent by the club on spirits and that: “nobody can take exception from the fact that the money was well spent”. Furthermore, “A flaskful of brandy, kirsh, or liqueur...not unusually forms part of the climber’s kit”. Marcet then explores the uses of alcohol in mountaineering. Various anecdotes regarding injuries, severe cold, high altitude, and lack of courage are shared, showing the role that alcohol plays in the club. From these anecdotes Marcet concludes:

“It is hoped that the present paper has made it clearly understood that strong drinks do not give strength, and, as a means of keeping the body warm, they go on the opposite tack, doing away with the natural power man possesses of resisting cold, and thus acting as a delusion and a snare” (Marcet, 1887, 327)

In spite of being grounded in anecdote and speculation, this may be a reasonable conclusion. Furthermore, this paper was clearly intended to be light and fun, and perhaps not deserving of a critical reading. None the less, it is typical of the bad science published by the Alpine Club. As another example, consider the final conclusion Marcet makes in the paper discussed above:

“I have but one word to add as to the inhalation of oxygen gas at great altitudes. This has been shown to relieve breathlessness very materially in balloon ascents.... There appears, however, to be a substitute for the inhalation of oxygen gas-that is the ingestion of a substance called potassium chlorate.” (Marcet, 1886, 12)

To Marcet’s credit, potassium chlorate does evolve oxygen when heated. However, he had neither good evidence nor good reasoning that it could be useful when taken orally. None the less, the suggestion was made, and at least one subsequent expedition to a 6400m peak carried this salt for relief of mountain sickness. In the spirit of the phlogiston theory, the understanding of AMS takes a step backward.

It seems that some mountaineers of the day were themselves skeptical of the ‘science’ carried out by their colleagues. In 1871 the Alpine Club published a paper with the passage:

“...some of the greatest authorities in the Alpine Club have gone the length of utterly denying any such thing as the painful phenomenon known in all lands by the name of “mountain-sickness,” or, at least, of calling it an exception, or mere fatigue and exhaustion.” (Russell, 1871, 244)

Another trait of the mountaineer/scientist led to confusion surrounding acute mountain sickness: the tendency to observe and document prolifically without critical thought. In 1902, M. L. Hepburn of the Alpine Club blamed this “excess of observation” for the lack of progress in understanding AMS. Consider the long list of symptoms attributed to mountain sickness: general malaise, fatigue, especially in the legs, accelerated respiration (sometimes deep, sometimes shallow), breathlessness, accelerated heart’s action, throbbing of vessels in the neck, oppression of the chest, rise in blood pressure, fall in blood pressure, bleeding from eyes, nose and lips, loss of appetite, salivation, vomiting, colic, diarrhea, giddiness, loss of intellectual faculties, indifference to personal appearance, somnolence, and hallucinations. With such diverse and sometimes contradictory symptoms, how was anyone to make sense of anything? Consider also what was reported by a physiologist to be “one of the most characteristic cases of mountain sickness which I have observed:”

“ A climber described as ‘a fairly robust healthy individual in good training, without any cardiac defect’...suffered at an altitude of 2500m from tiredness, headache, malaise, nausea with retching, violent attack of sickness... and dyspnea. We learn also that this sufferer had partaken of a very heavy meal with too much wine the night before, followed by a very late retirement, thus procuring only a few hours sleep” (Hepburn, 1902, 167)

Hepburn is right in concluding that undisciplined research by mountaineers was doing more harm than good to the advancement of high altitude medicine. He suggests that:

“by narrowing down our investigations to one or two definite objects, we may place ourselves in a better position for experimental research and within reasonable distance of conquering the highest peaks of the world” (Hepburn, 1902, 162)

Indeed, a dedicated scientist had already taken stock of the science of mountain sickness and filled in the many of the gaps with laboratory research. The results were published twenty-four years before Hepburn’s paper criticizing the climber’s approach to AMS. We must assume that both he and his colleagues in the Alpine Club were having too much fun climbing to have noticed.

Paul Bert is arguably the father of modern high altitude medicine and physiology. His landmark 1878 publication “La Pression Barometrique: Recherches de Physiologie Experimentale” (Barometric Pressure: Researches in Experimental Physiology) marks the transition from an anecdotal approach to mountain sickness to the rigorous application of the scientific method. Bert, a zoologist with interest in the physiology of asphyxiation, reviewed all he could find previously written on mountain sickness, and designed proper experiments to advance the knowledge. In experimenting with steel decompression chambers and collaborating with mountaineers and balloonists, Bert described the blood-oxygen saturation curve and demonstrated what travelers had been alluding to for centuries: low partial pressure of oxygen in inspired air is the determinant of acute mountain sickness. (West, 1998, 62-68).

It is worth noting that while Bert may have been a modern scientist, some of his collaborators were themselves cavalier adventurers. In 1875 three Frenchmen, Gaston Tissandier, Joseph Croce-Spinelli, and Theodore Sivel, consulted with Bert before attempting to set an altitude record by balloon. They worked with Bert’s decompression chambers and became familiar with the symptoms of acute mountain sickness, as well as the relative relief found in breathing pure oxygen. On April 15 they piloted their balloon to over 8500m. Two of the three aviators perished. Bert had sent a letter suggesting the oxygen they were planning to take was inadequate, but it arrived too late. (West, 1998, 55-57)

Through the twentieth century, scientists, mountaineers and aviators continued to collaborate to uncover the secrets of respiratory physiology and acute mountain sickness. This has led to the ascent of the world’s highest mountains, both with and without supplemental oxygen, and to the advancement of science and the breadth of human knowledge. To this day, conferences in respiratory physiology are populated by both the pale, sickly lab rat, and the rugged, sunburned mountaineer. Rumor has it that the former group contributes more than the latter (Whitelaw, 2003), but the latter group may be having more fun, and thus be the better for their efforts. As Russell wrote in 1871, “I say boldly that there is no passion more innocent, more indisputable and more manly, than that of scaling peaks, even if science gains nothing by it”.

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EXPLORING THE VAST UNIVERSE: MEDICAL ISSUES PAST AND PRESENT OF SPACE TRAVEL

By

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ABSTRACT

On August 6, 1961, the Soviet Academy of Sciences launched the Vostok II, the third rocket with an astronaut to be launched in space since April of the same year. The cosmonaut in the rocket, Gherman Titov, was one of the original twenty fighter pilots chosen to be among the first group of cosmonauts in the USSR; he had trained vigorously for the launch for the past year. He would be the first man in outer space for longer than twenty-four hours; as such, he was also the first to experience space sickness. As soon as he was above the atmosphere of the Earth and away from its gravitational pull, he began to feel nauseous. Over the course of the twenty-five hours and eighteen minutes he spent in space, he recorded feeling disorientation, nausea, and an irregular heart beat.

Such information was important as the primary scientific purpose of the lift-off had been to document the physiological effects of prolonged weightlessness on the human being. Further studies conducted by the National Aeronautics and Space Administration, which had formed in 1958 in the United States and had began a space travel mission known as “Project Mercury”, would demonstrate that human beings could survive up to thirty-four hours in space without any deleterious physiological effects from weightlessness.

Today, more than 240 human space flights have been completed with over 450 astronauts from various countries. The prolonged weightlessness associated with space travel has been linked to bone demineralization, muscle deconditioning, space motion sickness and changes in immune function. The records of astronauts in space travel as well as recent investigations reveal hints as to how the human being can modify his living habits to adapt to living in a space environment.

An ancient Greek myth tells the tale of a father and son, Daedulus and Icarus, who attempt to escape King Minos' Crete by flight. In order to do so, the two fashioned together wings made of feather bound by wax. All would have gone as planned if

rebellious young Icarus had not disobeyed his father's instructions, flying too close to the sun. As a result, the wax binding his feather wings melted, the wings fell apart, and Icarus fell to his death in the sea (Davis, 2002.). Like Icarus, many human beings, perhaps encouraged by the sight of flying birds and comets, have yearned to explore the realm beyond our Earth's atmosphere. Albeit a simple tale, it is a telling reminder of the many hazards that prevent those would-be voyagers from fulfilling their dreams of space travel. With the advent of rocket and satellite technology, however, the Twentieth Century has seen a rapid growth in the understanding of medical and physiological considerations of space exploration, a specialized branch of aerospace medicine known as space medicine. Through careful use of experimental models and simulation technology, humankind continues to advance its medical and physiological knowledge of living and travelling in outer space.

Needless to say, the space environment differs greatly from the Earth environment. Therefore, a transition from one to the other presents unique challenges. Dangers of living in or exploring the space environment include the lack of an atmosphere, thermal instability, exposure to ionizing or nonionizing radiation, space debris, and isolation. Therefore, in order to make a spacecraft habitable for humans, care must be taken to ensure the maintenance of a breathable environment, temperature regulation, a potable water supply, the minimization of radiation exposure, nutritional support and waste management. (Davis, 2002.).

In 1898, a Russian, Konstantin Ziolkowski, first gave serious thought to the idea of space flight. In 1903, he suggested the use of the rocket as a means of obtaining the propulsion necessary for space travel. Little consideration was given, however, to the physiological effects of space travel on the human being. It wasn't until World War II, however, and the development of the V-2 rocket that serious consideration was given to the possibility of space flight and the need for a branch of specialized space medicine was foreseen (Slager, 1962.).

Major General H.G. Armstrong in the United States foresaw the need for the development of space medicine as a preventative discipline, concerned with the avoidance of illness or trauma during space flight and exploration. For this reason, in 1948, at the USAF School of Aviation Medicine, he organized a panel meeting on the topic of "Aeromedical Problems of Space Travel." Unclassified government reports on the subject such as the "Epitome of Space Medicine" by the U.S. Air Force were produced. The "Journal of Aviation Medicine" (known from 1959 as "Aerospace Medicine") published its first issue. Articles on space medicine began to appear in reputable medical journals including the Journal of the American Medical Association, the Scottish Medical Journal, the American Journal of Pathology, and other such publications (Slager, 1962.).

Through the use of animals for research purposes, rockets were confirmed to be good vehicles for short-term exposure at high altitudes in space. In 1948, the monkey Albert

was launched on a U.S. rocket called 'Blossom'. On October 13, 1960, Sally, Amy and Moe, three black mice, returned alive after reaching 700 miles above the Earth in an Atlas nose cone. They were the first returning space travellers to have experienced the fringe radiation of the Van Allen belt. Scientists in the Soviet Union began their programme in space with launches of nine dogs in 1951-1952 before the historic flight of the dog Laika which survived one week in orbit in 1957. Thus, although not all of the animals survived, physiological effects of space travel could be observed on these animal models (Nicogossian, 1989.).

Moreover, many research studies simulating an environmental condition of space flight were conducted on animals. For example, studies conducted on rats in the late 1960s in France by M-V. Strumza in the Faculty of Medicine in Paris showed that acclimatization to high altitudes, as demonstrated by polycythemia and the increase in circulating haemoglobin, only lasted for a finite period after return to a lower altitude. Moreover, the rats did not show any marked improvement in their muscular endurance at lower altitudes even though their muscular endurance at higher altitudes improved after the period of acclimatization. Through such experiments, scientists were able to deepen their understanding of the physiological effects of prolonged hypoxia (Strumza, 1969.). The results of Strumza's research was presented at an international symposium on space travel held in Oslo in 1968.

In addition to Strumza's studies, other studies were conducted on the effects of hypoxia on muscular deconditioning and endocrine function in lab animals. In terms of the effects of hypoxia on endocrine function, it was found that hypoxia tended to increase circulating epinephrine levels but had no effect on norepinephrine levels on the animals tested (Hannisdahl, 1969.).

Nothing compared to actual space flight as a means of obtaining information on its effect on the physiological function of humans. In Russia, about four major missions took place: the Vostok, the Soyuz, the Voshtok and the Salyut. On August 6, 1961, the Soviet Academy of Sciences launched the Vostok II, the third rocket with an astronaut to be launched in space since April of the same year. The cosmonaut in the rocket, Gherman Titov, was one of the original twenty fighter pilots chosen to be among the first group of cosmonauts in the USSR; he had trained vigorously for the launch for the past year. He would be the first man in outer space for longer than twenty-four hours; as such, he was also the first to experience space sickness. As soon as he was above the atmosphere of the Earth and away from its gravitational pull, he began to feel nauseous. Over the course of the twenty-five hours and eighteen minutes he spent in space, he recorded feeling disorientation, nausea, and an irregular heart beat (Nicogossian, 1989.).

In 1975, during the Russian mission of Salyut 4, the two astronauts on-board, Klimuk and Sevastyanov, conducted several studies to test human endurance in conditions of weightlessness. The "Chibis" lower body negative pressure suit was used to reduce the volume of rostral fluid shifts. A swivel chair was later installed to test vestibular effects.

The use of electrical stimulation to muscle groups was used as a means of physical conditioning. Moreover, during the final ten days of the flight of Soyuz-18 mission after docking at Salyut 4, the crew members subjected themselves to the intake of a high-salt diet and an increase of water intake to combat the effect of decreased body fluid volume post-flight. Such an innovation was the first of its kind to be instituted; the prescription was later deemed to be successful and thus was continued on later flight (Nicogossian, 1989.).

Further studies conducted by the National Aeronautics and Space Administration, which had formed in 1958 in the United States would demonstrate that human beings could survive up to thirty-four hours in space without any deleterious effects from weightlessness.

Around the era of the 1960s, the United States co-coordinated four major space missions almost simultaneously: Project Mercury, Project Gemini, Project Apollo and the Space Labs project. The principal findings of Project Mercury were that the crew members experienced weight loss due primarily to dehydration, and some impairment of cardiovascular function post-flight. The last and longest Mercury flight demonstrated orthostatic intolerance and dizziness on standing in crew members. For the most part, however, it was found that astronauts could function fairly well under condition of weightlessness (Nicogossian, 1989.).

The latter conclusion was reinforced by Project Gemini, which began in May 1961, shortly after completion of the first suborbital Mercury mission. Particularly, Gemini 4, 5 and 7 which lasted 4, 8 and 14 days, respectively, involved a number of in-flight experiments. The significant biomedical findings of the Gemini program included the loss of red cell mass (ranging 5-20 % from baseline), the loss of exercise capacity compared with pre-flight baseline, the loss of bone density, the sustained loss of bone calcium and muscle nitrogen. In addition to the same biomedical findings as the Gemini program, the Apollo program also found that prolonged space travel lead to vestibular disturbances, possible post flight dehydration, weight loss (which may be associated with the reduced plasma volume) and cardiac arrhythmias found in Apollo 15 (Nicogossian, 1989.).

Finally, the development of Biosphere 2, a massive closed ecosystem, in Tucson, Arizona, has provided a large facility for a hundred years of testing nature, technology and human endurance. So far, since 1991, two human survival missions of two years and six months respectively have been sent to stay in the confined environment. The advantage of such a system is that it mimics possible future space stations in Mars or other planets. Thus, one may study the psychological effects of confinement on the human subjects (Biosphere 2, 2004.).

Today, more than 240 human space flights have been completed with over 450 astronauts from various countries. The prolonged weightlessness associated with space travel has

been linked to bone demineralization, muscle deconditioning, space motion sickness and changes in immune function. The records of astronauts in space travel as well as recent investigations reveal hints as to how the human being can modify his living habits to adapt to living in a space environment. Whether it be through innovations in space medicine or more advances in the engineering design of spacecraft, space travel will continue to challenge man to surmount his physiological limitations, to truly go where “no man has gone before.”

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A SHORT HISTORY OF ANTHRAX

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ASBTRACT

Anthrax is a potentially fatal bacterial infection caused by *Bacillus anthracis*, a large Gram-positive, spore forming encapsulated rod. Human infection occurs through contact with infected animals or through occupational exposure to contaminated animal products. Three forms of the anthrax illness occur in humans: cutaneous, pulmonary, gastrointestinal tract anthrax. All three forms of the illness are potentially fatal if not appropriately treated.

Anthrax was a major threat to human and animal life long before it came to public attention as an agent of biological warfare. One of the earliest references to anthrax is found in the Book of Exodus as the fifth and sixth plagues of Egypt. Descriptions of the disease are also found in the writings of the Roman poet Virgil approximately 2000 years ago. In the early 1900's, inhalation anthrax became an occupational disease among the tanning and textile industries. This deadly disease has re-emerged today as an instrument of bioterrorism, with cases reported in the United States among postal workers and others in contact with contaminated mail. This paper will examine the history of this deadly disease, from biblical times to the current threat of biological warfare.

Introduction

Prior to the events of September 11th, anthrax was primarily known as an occupational disease among textile and tanning workers and was relatively unheard of among the general public. Anthrax attracted national media attention as an agent of bioterrorism after cases were reported among media and government employees who acquired the disease through contact with contaminated mail. However, anthrax is not a new disease. References can be found in the book of Exodus of the bible and among the writings of the Roman poet Virgil approximately 2000 years ago. The disease became known as an occupational disease during the eighteenth century among tanning and textile workers due to the processing of animal products in enclosed spaces. Anthrax served as the prototype for Koch's postulates for the transmission of disease in 1871. It emerged as a biological weapon during World War I, but its used in warfare has been limited.

Following the attacks on the World Trade Centre, there were 22 confirmed cases of anthrax in the United States in the fall of 2001.

Anthrax is a potentially fatal bacterial infection caused by *Bacillus anthracis*, a large Gram-positive, spore-forming encapsulated rod. Anthrax spores are resistant to heat, drying, ultraviolet light, and many disinfectants. The spores exist in soil throughout the world and can survive for decades. Animal infection occurs through ingestion of contaminated feed or through grazing in contaminated areas. Human infection is a result of contact with infected animals or occupational exposure to contaminated animal products, such as hides, wool, or hair. There are no known cases of human-to-human transmission (Swartz, 2001).

Bacillus anthracis has three main virulence factors: an anti-phagocytic capsule and two exotoxins contained within a toxin complex (Beatty et al, 2003). Infection occurs when endospores enter the body through inhalation, skin abrasions, or rarely ingestion. Once inside the body, the endospores are ingested by macrophages and carried to lymph nodes. The bacteria multiply in the lymph nodes and are released into the bloodstream. The bacteria release toxins that cause hemorrhage, edema, and necrosis. If untreated, the infection usually leads to death of the host (Dixon et al, 1999).

Clinical Manifestations

Three forms of the anthrax illness occur in humans: cutaneous anthrax, which occurs when a spore enters the body through an abrasion in the skin; pulmonary anthrax, acquired by inhalation of anthrax spores; and gastrointestinal tract anthrax, contracted through eating contaminated meat. All three forms of the illness can be fatal if not appropriately treated.

The cutaneous form of the illness accounts for more than 95% of naturally occurring cases in humans worldwide. Most cases of cutaneous anthrax have a history of occupational exposure to animals or animal products. The infection occurs when spores are introduced at the site of a cut or an abrasion. The most common sites of exposure are the head, neck, and extremities. The primary lesion is a small painless, pruritic, red papule that appears one to five days after exposure. Within one to two days, a vesicle forms that subsequently ruptures, undergoes central necrosis, and leaves a characteristic black eschar. The lesion evolves and the eschar falls off over a period of two weeks. In 80 to 90 percent of cases, the lesion resolves without scarring or systemic complications. Rare complications include multiple bullae, severe edema, and shock (Swartz, 2001).

Pulmonary anthrax, also known as woolsorter's disease and Bradford disease, occurs after inhalation of anthrax spores from contaminated animal products. It is classically a biphasic illness. The initial symptoms occur one to six days following exposure and include mild fever, fatigue, myalgia, non-productive cough and precordial chest discomfort. These symptoms are often indistinguishable from a common cold or

influenza. The second phase occurs within one to three days and is characterized by acute onset of shortness of breath, fever, stridor, and cyanosis. Pleural effusion occurs in many patients. Chest x-ray frequently classically shows mediastinal widening due to hemorrhagic mediastinitis. Death typically occurs within 24 hours of onset of the second phase (Swartz, 2001), (Witkowski, Parish, 2002).

Gastrointestinal tract anthrax is common in animals, but rarely occurs in humans. The disease occurs after ingestion of contaminated meat containing anthrax spores. The intestinal form of the disease results from ulceration of the ileum or cecum. Symptoms include abdominal pain, fever, nausea, and vomiting and rapidly progress to severe bloody diarrhea. It is associated with severe ascites and enlargement of the spleen. In addition, there is an oropharyngeal form of the disease characterized by posterior pharynx ulceration, sore throat, fever, and cervical lymphadenopathy with neck swelling (Beatty et al., 2003).

Pulmonary anthrax has the highest mortality rate among the three major forms (97% without treatment and greater than 40% with treatment). Gastrointestinal anthrax has less than 40% mortality rate with antibiotic treatment. Finally, cutaneous anthrax has the lowest mortality rate: 1% with treatment and 10%-20% without treatment. Anthrax meningitis is a rare complication of the three major forms. It occurs by lymphatic or hematogenous from the primary site of infection and is almost always fatal (Beatty et al, 2003).

History

One of the earliest references to anthrax may be found in the Book of Exodus in the Old Testament of the bible in the description of the ten plagues of Egypt. It is believed that the fifth and sixth plagues may have been caused by anthrax.

The fifth plague of Egypt, the plague of murrain, resulted in high mortality among the cattle of Egypt, while sparing the Hebrew's cattle. The disease only affected herbivores, was transmitted between animals and to humans, and was highly fatal. These features suggest that this plague was a result of anthrax, which had been known in Egypt for centuries (Witkowski, Parish, 2002).

The sixth plague was the plague of boils and blains. This outbreak may have been the result of cutaneous anthrax. It is described as boils and pustules erupting on man and beast. These lesions could spread from animals to humans, but did not result in a large number of fatalities. These features are consistent with cutaneous anthrax (Witkowski, Parish, 2002).

The best ancient account of anthrax is found in the writings of the Roman poet Virgil approximately 2000 years ago. Virgil, best known for his *Aeneid*, wrote four *Georgics*, which were writings on agriculture. The third *Georgic* is devoted to animal husbandry

and contains a description of an outbreak that occurred in the eastern Alps in the region of Noricum:

“A terrible plague once sprang up there and raged on through the warmer part of autumn, not only destroying one flock after another, but killing animals of all kinds. Nor did the victims die an easy and uncomplicated death.” (Dirckx, 1981).

The disease described by Virgil was highly fatal. It occurred in cows, sheep and horses and could be transmitted between animals. He later describes the transmission of the disease:

“The pelts of diseased animals were useless, and neither water or fire could cleanse the taint from their flesh. The sheepman could not shear the fleece, which was riddled with disease and corruption, nor did they dare even touch the rotting strands. If anyone wore garments made from tainted wool, his limbs were soon attacked by inflamed papules and a foul exudate, and if he delayed too long to remove the material, a violent inflammation consumed the parts it had touched.” (Dirckx, 1981)

This account describes a disease that could be transmitted from animals to humans. If humans were to come in contact with the infected animal or contaminated animal material, they would develop exudative blisters. This description is consistent with cutaneous anthrax.

Recent History

Anthrax has continued to be a major threat to human and animal life in recent times. In the mid-eighteenth century, an outbreak of anthrax resulted in the death of approximately half the sheep in Europe. One hundred years later, anthrax killed approximately 72,000 horses in Russia (Witkowski, Parish, 2002).

Anthrax became known as an occupational disease during the nineteenth century. Outbreaks occurred in tanning and textile workers through inhalation of anthrax spores from contaminated animal products. This typically occurred due to processing of hides and wool in enclosed areas. As a result, the disease was known as woolsorter's disease in England and ragpicker's disease in Germany and Austria. The disease became such a problem in England that disinfection station was built in Liverpool in 1919. All imported wools were disinfected with formaldehyde before processing in the country, which led to a large reduction in the incidence of anthrax in England (Brachman, 2002).

In 1876, Robert Koch used *Bacillus anthracis* as the prototype for his postulates for the transmission of disease. Koch detected *Bacillus anthracis* in samples of blood from cattle that had died of anthrax. He then cultured the bacteria and injected it into healthy cattle, reproducing the disease. He found the same bacteria in blood samples from the

cattle that he had infected. Thus, anthrax served as a model for the theory of disease transmission (Sternbach, 2003).

In 1881, Louis Pasteur developed the first anthrax vaccine. He inoculated 25 cattle with his vaccine containing live attenuated organisms. He then injected the vaccinated cattle and healthy controls with a culture of virulent anthrax. Only the vaccinated animals survived (Sternbach, 2003).

The incidence of anthrax has decreased dramatically during the twentieth century. The reduction is largely due to human and animal vaccination. The largest recent natural outbreak of anthrax occurred in Zimbabwe between 1978 and 1985. More than 10,000 cases of anthrax were reported in the area during this period, most of which were cutaneous anthrax. In 1979, accidental release of anthrax spores into the atmosphere from a bioweapons facility in Sverdlovsk in the former Soviet Union resulted in 79 cases of pulmonary anthrax and the death of 68 people (Chensue, 2003).

Anthrax as an Agent of Bioterrorism

Prior to the events of September 11th, anthrax had been primarily an occupational disease among tanning and textile workers. Anthrax emerged as an agent of bioterrorism during World War I, but it has had limited use in biological warfare (CNN.com/Health, 2001). On October 2, 2001 a 63-year-old male working as a photo editor for the *National Enquirer* presented to a local Florida emergency room with confusion, nausea, and vomiting. He had a five-day history of fatigue, fever, diaphoresis, and anorexia. A chest x-ray showed mediastinal widening and a small left pleural effusion. *Bacillus anthracis* was subsequently isolated from CSF and later blood cultures. Despite treatment with a variety of antibiotics, his condition deteriorated and he died three days after initial presentation. Autopsy revealed hemorrhagic mediastinal lymphadenitis. A week prior to the death of the photo editor, a mailroom clerk, also working for the Florida office of the *National Enquirer*, became ill with similar symptoms. A nasal swab later confirmed the presence of *Bacillus anthracis*. No mediastinal widening was present on chest x-ray. His course was not as severe and he was discharged from hospital three weeks later. *Bacillus anthracis* spores were later found in contaminated mail in the workplace of both patients. These were the first in a series of bioterrorism related cases of anthrax reported in the United States (Jernigan, 2001).

Following the initial case reports, anthrax captured the attention of the national media. Fear spread among government agencies and media personnel. Emergency rooms were flooded with cases of suspected anthrax and law enforcement was received hundreds of reports of suspicious white powder. In total, there were 22 confirmed cases of anthrax in the United States in the fall of 2001. Eight of the cases were due to inhalation anthrax and five fatalities were reported among these cases (Chensue, 2003). No cases were reported after 2001.

Diagnosis

History of occupational and environmental exposure is important in suspected cases of anthrax. Samples for analysis can be taken from skin lesions, sputum, throat swabs or cerebrospinal fluid. Gram stained smears show large, encapsulated, Gram-positive bacilli. Non-hemolytic colonies are formed on sheep's blood agar cultures. No growth occurs on MacConkey agar. Polymerase chain reaction may also be used if blood samples are available (Merck Manual, 2001).

Diagnosis of gastrointestinal tract anthrax is achieved primarily through clinical history. Rarely, the organism can be isolated from feces.

Current Treatment

The current recommended treatment for pulmonary anthrax is 400 mg q12 hours intravenous of ciprofloxacin. Alternatively, 100 mg of doxycycline q12 hours intravenous can also be used. Recommended prophylactic treatment for those exposed to pulmonary anthrax is oral ciprofloxacin 500 mg bid or doxycycline 100 mg bid for 60 days (Inglesby et al, 1999).

For cases for mild cutaneous anthrax, the recommended treatment is oral ciprofloxacin 500 mg q12 hours or oral deoxycycline 100 mg q12 hours for seven days. If significant systemic symptoms are present, the treatment could be the same as pulmonary anthrax (Inglesby et al, 1999).

Prevention

A vaccine is available for high risk groups. Current CDC guidelines recommend vaccination for lab workers in direct contact with anthrax, people who work with imported animal hides or handle potentially infected animal products in high-incidence areas, and military personnel working in high risk areas (CDC website, 2004).

The vaccine consists of an attenuated strain of *Bacillus anthracis* along with an aluminum hydroxide adjuvant. It is given as a 0.5 ml dose at 0, 2, and 4 weeks and at 6, 12, and 18 months. Annual boosters are required to maintain immunity. A live attenuated vaccine is available for use in animals (Swartz, 2001).

Conclusion

Anthrax has been a known threat for centuries, which references found in the bible and in the writings of the Roman poet Virgil. This deadly disease has re-emerged today as an instrument of biological warfare. Despite a variety of available medical treatments, anthrax continues to be a major threat to animal and human life. Prompt recognition of symptoms and identification of cause is essential to successful treatment due to the rapid

progression of the disease. Despite early recognition and treatment, the fatality rate remains high.

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THE BLACK DEATH: CATASTROPHE OR NEW START?

By

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ABSTRACT

The Black Death struck Europe at the end of 1347, and raged through 4 centuries in multiple waves until the plague of Marseilles in 1720. Since then there have been smaller breakouts, but none as severe as the earlier ones. In Europe, the Black plague began in Crimea (along the Black Sea) in early 1347, and spread to other parts of Europe via the Mediterranean trade routes.

This paper is going to illuminate on the history of the Black Death, its transmission, pathophysiology, symptomology, various medicines proposed, how the medical theories present at that time justify the medicines/ingredients used, the disparity in what was available for the rich and poor and health initiatives that progression of the disease (examples quarantine, preventative health and public health measures).

Even though the Black Death is associated with a lot of negative, there were a lot of good things that came from it retrospectively. It affected widespread changes in many areas, like medicine (education and clinical practice), the study of epidemiology, public health, economy, the church, and social customs. There were a lot of social and economic changes happening prior to the plague (e.g., public authorities were ordering the cleaning of the town ditches and streets as early as 1309), so the occurrence of the plague accelerated the forces already at work. Only a few can be discussed in detail within this paper.

The Black Death shattered decaying institutions and strengthened new tendencies. These changes exhibit the extent to which this disease altered the manner in which society would govern itself. One could almost say that the Black Dead began a new era in medieval life.

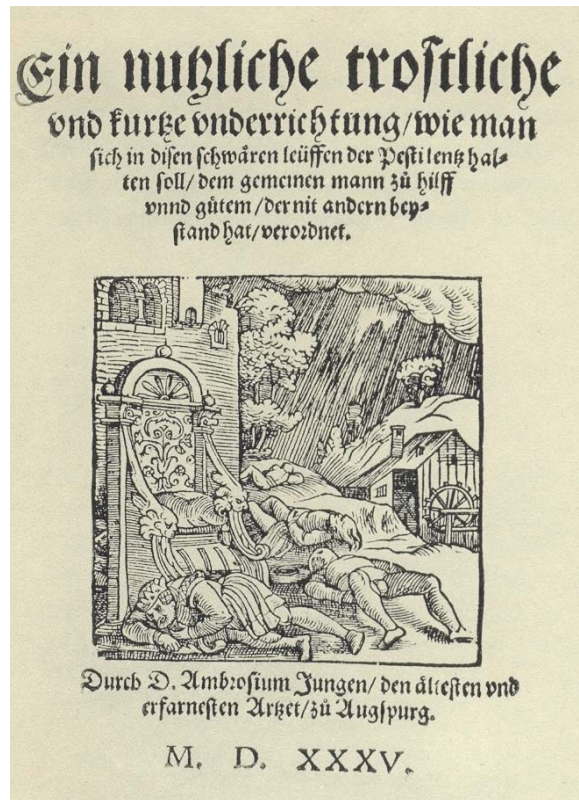


Figure 1: Pestilence: title page of ‘a brief, practical and comforting treatise’ (1535) by Ambrosius Jung (from Smith, 1948)

Introduction

On the Foster scale (which measure disasters), designed by Harold D. Foster, The Black Death of 1347-1350 is the second biggest disaster to afflict humankind. The scale not only ranks the number of lives lost but also considers the physical damage and emotional stress the disasters create (Lerner, 1982). For comparison, the worst disaster in history is World War II, and third biggest disaster is World War I (Lerner, 1982). According to the calculations made by Pope Clement VI in 1351, 23 million people out of the total 75 million pre-plague populations perished. Thus the Black Death wiped away a third of the western world’s population (Gottfried, 1983).

Where did the plague come from?

To this day, Central Asia is a permanent reservoir of the plague (Palazzotto, 1973). Specifically for the 14th century, it was postulated that the plague was endemic near the borders between India, China and Burma in the Himalayan foothills (McNeill, 1976). As part of their history, the people living in these regions altered their behaviors and ways of living to minimize the chances of getting infected. Thus, they were capable of curbing the cost of lives.

A likely hypothesis for the spread to Europe is that this pattern of life was disrupted by Mongolian invasion during the second half of the 13th century (around 1252-53), when they came through Yunnan and Burma. It is suggested that the Mongolians probably disregarded all the rules the locals had in place to insulate themselves from the bubonic plague (McNeill, 1976). Thus the invaders likely got infected and inadvertently allowed the disease to break through its former geographic limits. Since Mongolians relied on horses to get from point A to B, it is likely that the fleas and rats responsible for the spread of the plague hitched a ride (e.g. in their saddle bags stuffed with grain) to the Mongolian homeland, where they flourished (McNeill, 1976). Once they were in sufficient quantities, they spread out to other lands the Mongolians were conquering. With this theory, it would take a century before it would enter the European region, since the bacillus would need time to proliferate in its newly infected region, before it would disseminate any further (McNeill, 1976).

Another likely hypothesis is that the bacillus invaded China in 1331 (likely spreading from the Yunnan-Burma border) and rapidly increased their numbers here. The infection then spread throughout Asia via the Silk Road trade routes and eventually reached Crimea around 1346. There the bacillus spread to other major European centers via the sea (trade-routes). It is important to recognize that areas with limited sea trade or that were landlocked had low rates of infection by the plague, strongly supporting this hypothesis (McNeill, 1976). As well, when mortality due to the plague reached high levels, people would flee these regions, taking the cause with them.

With either hypothesis, it was the globalization of trade and increased contact with various regions that allowed the plague to propagate across Eurasia from its source.



Figure 2: Gilles li Muisis, Burial of Plague victims in *Antiquitates Flandriae ab anno 1298 and annum 1352*. Brussels, Bibliotheque Royale, MS no. 13076, fol. 24v (Polzer, 1982)

Pathology

Etiology, Pathophysiology and Transmission

The Black Death is caused by *Yersinia pestis*, also referred to as the plague bacillus. It relies on rat fleas like *Xenopsylla cheopis* (the one most implicated in the plague), for its survival highly and is unlikely to be contracted through fomites (Palazzotto, 1973). If available, the bacillus can also reside within the human flea *Pulex irritans* (Gottfried, 1983). Even though the flea can inhabit all kinds of rats, in the Black Death the black rat, *Rattus rattus* is mostly implicated (Palazzotto, 1973). This is because it bred, lived and depended on man more than other rats (Palazzotto, 1973). Its close relationship with man was especially common in 14th century Europe where it easily hid under the straw in the house and lived in the garbage found strewn on the streets. One of the factors that helped eradicate plague was the replacement of the black rat for brown rat.

Thus for the growth, proliferation and dissemination of the plague, four key elements are needed: man, the rodent host (rat), a vector (the flea), and the microorganism itself. This ecological relationship is influenced by human conditions, such as exposure to the rat, sanitation, hygiene, environmental conditions conducive for the proliferation of the flea, crowded populations so a mass of people can be affected, etc (Palazzotto, 1973).

There are three types of plagues- bubonic, pneumonic and septicemic. Out of these three the bubonic was the most common kind and septicemic the most fatal.

When bitten by the flea, the bacillus proliferates within the blood of the rat (principal transmitter of bubonic plague) causing septicemia. Man would not survive the level of septicemia required by the flea to propagate the infection, and thus rat is the only way for the flea to acquire the bacteria for dissemination (Palazzotto, 1973). Septicemic plague is always fatal but very rare. Since it is present in the blood in very large quantities, it can even be transmitted from one human to the other by the human louse! (Gottfried, 1983). Like bubonic, this kind of plague is insect borne (Gottfried, 1983).

The bubonic plague is the most common type (Gottfried, 1983). When the flea bites an infected rat for its blood, the blood full of bacteria will enter the flea's stomach. The flea has two stomachs and the bacteria in the first stomach start to proliferate. It is necessary for the second stomach to accumulate with bacteria to 'block' the stomach completely. This causes the flea to starve since it cannot hold down any new blood it ingests (the dammed stomach prevents any blood to be retained). This also causes the flea to seek another rat or animal (like man) for food. As the blood ingested is regurgitated, it carries a load of bacteria with it. So the infected blood is regurgitated into the newly bitten animal (e.g. man). Mortality with this kind of plague is estimated to be 60% (Gottfried, 1983). It is also the kind that was most prevalent during the spring and summer months, when the weather was warm (15-20C) and humid (90-95%); ideal conditions for the flea

(Gottfried, 1983). The rat also proliferated mostly during the summer months (Palazzotto, 1973)

The second most common form of the plague was the pneumonic form. This was transmitted from man to man and did not require contact with fleas or rats. Pathophysiologically, the bacillus adapted itself to reside in the lungs, and spread via droplets like the common cold (Smith, 1948). Since it infected a new person via the nose and lungs, it could be spread by talking, sneezing, coughing and spit. This type was especially common in the winter months when the flea and rat populations were low. The flea did not reproduce well in the winter months, even though it can survive for about 6 months to a year without a rodent host (Gottfried, 1983). This type of plague was the most contagious and infectious form of the disease, because it was now transmissible like the common cold. Mortality was almost 100% within one to three days with this type of plague (Palazzotto, 1973).

Symptomology

Bubonic plague is the most common type of plague. It has an incubation period (from the time of bite to the presentation of symptoms) of about 6 days (Gottfried, 1983). One of the first symptoms is a blackish, often gangrenous pustule at the point of the bite (Gottfried, 1983). This is often followed by an enlargement of the lymph nodes in the groin, armpit and neck area (depending on site of the bite) (Gottfried, 1983). Next, subcutaneous hemorrhaging occurs, causing purplish blotches called buboes to appear (thus the name bubonic plague) (Gottfried, 1983). The hemorrhaging causes cell necrosis (especially of the nervous system), leading to neurological and psychological disorders (Gottfried, 1983). Autopsy results also suggest cerebral meningitis (Pollitzer, 1954)

Pneumonic plague has an incubation period of about 3 days. It is a deadly version of the plague because it is highly infectious. Following the incubation period, a severe drop in body temperature occurs followed by severe cough, consolidation of the lungs, cyanosis and production of bloody sputum. Neurological deficits and coma often follow the infection. Cough and sputum generated are primary ways of propagation.

Septicemic plague resulted in mortality within a day of infection, thus buboes are not visible before the person dies. The only sign of the infection is a rash that forms within hours of the infection (Gottfried, 1983).

Factors that helped accelerate the spread of the Black Death

As mentioned, conditions that fostered human contact with the rat (and inadvertently the flea) increased susceptibility to the plague. It is well known that rats lived beside man in medieval times and it was mostly the unsanitary ways of living that fostered its presence (McNeill, 1976). This included usage of straw that were filthy (desirable to the rat) in the house, usage of thatch roofs (black rats are climbers), infestation of granaries by rats and

streets infested with human/animal wastes, garbage and butchered animal remains. Crowded living conditions as well as poor construction of houses (using wood instead of brick) increased susceptibility to an infection. By the time 15th century rolled around, sanitary measures (e.g. decreased filth on the street) had been carefully implemented and were showing their effectiveness.



Figure 3: Francesco Traini, The Sick and Lame Yearning for Death. (Polzer, 1982)

Medicine and the Plague

Medicine in the 14th century

In 1347, Europe's medical practice heavily relied on ideas by Hippocrates, Galen, Aristotle and Arabic commentators like Avicenna (Gottfried, 1983). Even though these men had written about infectious diseases, none had first hand experienced the plague (Gottfried, 1983). Their ancient ideas could not equip the physicians of 14th century with the means to deal with newly emerging infections. Also, medieval education stressed debating skills, making the physicians poor anatomists, pathologists and epidemiologists (Gottfried, 1983). So in the end it was the inability of the system to treat new unidentified diseases that led to its breakdown, and subsequent emergence of the new system.

The medical community was composed of five classes: Physicians, Surgeons, Barber-surgeons, Apothecaries and Unlicensed/non professional practitioners (Gottfried, 1983). At the top were physicians, who were university trained and usually members of the

clergy. The surgeons were second and not considered physicians. They learnt mostly from experience and had some textbook training. They were mostly in charge of setting fractures, blood letting and cautery. Barber Surgeons were third and not elite like the surgeons. Most were illiterate, did not go to university, and their training came from apprenticeship. Fourth were the apothecaries, who were the pharmacists (similar knowledge as herbalists) and the physicians (they could prescribe drugs). Albeit ranked third in the list, they could charge as much as a physician and therefore earn just as much as the highest ranking physician (Gottfried, 1983). The last group, the unlicensed, mostly worked in the rural villages where physicians were unlikely to practice. They practiced everything, mostly learned through trial and error and charged the lowest (thus they were the most popular) (Gottfried, 1983). As well, a high proportion of them in England were women (Gottfried, 1973)!

Medicine before the plague was based on the theory of humors (Sigerist, 1943). The human body was thought to have four humors-blood, phlegm, yellow bile and black bile. All these in turn were associated with particular organs. Blood came from the heart and was considered hot and moist (like air), phlegm came from the brain and was considered cold and moist (water), yellow bile came from the liver and was considered hot and dry (like fire), while black bile from the spleen was considered cold and dry (like earth). Therefore the body was considered the microcosm of the larger world (Gottfried, 1983). When any of these humors were not in balance, the body's "innate curative powers" (Gottfried, 1983) were heightened to correct the problem. This included rest, change in diet, etc. When this was unsuccessful, the physician tried to restore the proper balance with herbs, phlebotomy, etc (Gottfried, 1983).

The Plague and Medical Reasoning

One of the most important legacies of the Black Death was the absolute destruction of the archaic methods of the ancients and its replacements with the beginnings of the modern version currently in practice (Talbot, 1967). When the plague came to Europe and the inadequacy of the medical system was revealed, it led to the development of hospitals, changes in the education system and better laws on sanitation and public health (Gottfried, 1983).

When the Pope asked the University of Paris (the most prestigious medical school at the time) for an explanation to the plague, they used Avicenna's theory and claimed that on 20th March 1345 at 1:00pm, the combined presence of three planets (Saturn, Jupiter and Mars) in the sign of Aquarius corrupted the surrounding air, resulting in the countless deaths. It was usually believed that anything with Saturn was not a good omen (Palazzotto, 1973). The corruption of air leading to pestilence, high mortality and famine fit very well with the accepted miasmatic theories of that time (Gottfried, 1983). Miasma is a vaporous smell (e.g. putrid stench) formerly thought to cause disease.

The rival school (Montpellier) suggested deadly vapors causing the illness came from the south and were multiplied within the air of a given city due to the way the three planets had been lined (Palazzotto, 1973). Thus they advised that doors and windows facing the north be opened (Gottfried, 1983). A common belief of the time was that warm air, common in the summer, caused the pores on the skin to open (the season coincides with the reproductive cycle of the flea). Open pores on the skin increased access of corrupted air to the internal organs, and were to be avoided. Baths were also thought to open up pores (Gottfried, 1983).



Figure 4: Giovanni Sercambi, The Black Death of 1348 in his *Chronicle*, fol. 49v (Polzer, 1982)

Treatments

There were two main treatment options available: curative and preventative. As can be ascertained, the physicians of that time had no clue as to what they were dealing with and how to treat it. Thus their best efforts lay in trying to prevent the disease from presenting in the human population, which led to the birth of modern preventative medicine (Palazzotto, 1973).

Methods of curing an actual infection were limited and some of the possible treatments were deeply rooted in the discussions by Galen. Some treatment options include blood letting, cutting the buboes and applying ointment made of Armenian clay (an iron oxide whose healing processes were praised by Galen) and application of poultices made from violets while the patient drank fruit juices. Pharmaceuticals were rarely used because most physicians believed its use was best served in preventative measures (Gottfried, 1983). Alchemic processes were used to make potable gold (from mineral gold)

ingestible so that it could release its 'nature and quintessence'. This remedy healed not by opposing humoral effects but by boosting the balance of humors already present (Bagliani and Santi, 1998). It was widely believed that the fourth day after the infection was a crucial day. Most medications were designed to carry the patient until that day, when the "person's natural restorative powers would take over", a belief recurrent in the humoral theories (Gottfried, 1983).

Many treatments were also biased depending on the demographics it was meant for. For example, the poor were told to substitute many exotic ingredients only the rich were likely to secure with everyday cooking spices. Recipes that suggest such changes do not hint at the efficacy of the potion decreasing (Palazzotto, 1973). An example is the usage of rosewater by the rich but of barley water to the same effect by the poor (Bagliani and Santi, 1998). Another is the aromatic globe, a favorite of many kings and queens. Both parties used the same recipe, but the ingredients were changed. The rich were to acquire exotic herbs to make theriac (also called treacle, theriacle), whereas the poor were told to acquire a 'confection of herbs'. Theriac is an ancient composition esteemed useful against poisons (Encyclopedia Britannica). It is composed of sixty-four drugs- prepared, pulverized, and reduced by means of honey to an electuary (medical remedy in syrup).

Preventative Measures

Some of the prophylactic treatments suggested were aimed against the contaminated atmosphere and relied on Galen suggestions (the humors) (Palazzotto, 1973). This included changes in food and drink, fasting and eating, bathing and chastity, sleeping and waking, quality of the air, maintenance of emotional states, living accommodations and preventive pharmaceuticals (Palazzotto, 1973).

Diet was altered so that meals were light and eaten slowly with each bite well chewed. Meat, dairy products and fish were avoided since they went bad quicker and added to the putrid air of the plague. Desserts were also avoided since they delayed digestion and nuts were eaten instead (Gottfried, 1983).

It was believed that sexual activity and bathing were bad for the body because they resulted in overabundance of the humors which caused excessive opening of the pores (Palazzotto, 1973).

Too much sleep right after eating or in the middle of the day was unhealthy. Sleeping on the back was also not good since it gave pestilent air easy access to the nostrils and lungs. Instead, it was recommended that they sleep on their side and shift back and forth, aiding digestion and excretory processes, which are necessary to maintain the proper balance of humors (and therefore fight off the plague) (Gottfried, 1983).

Pleasant smells were considered important in driving away noxious plague fumes (miasma) and so burning aromatic softwoods like juniper, ash, oak, pine, rosemary, aloe,

amber and musk was very common and even encouraged (Gottfried, 1983). Washing hands and feet regularly in rosemary water and vinegar was also thought to help (Gottfried, 1983).

Control of emotions was required to maintain normal health. This included moderation of joyous activities and reduction of anger, anxiety and sadness. Even though these are rational reasons we understand in today's age, there is also a humoral reason for maintaining this balance. Gentile da Foligno (prominent 14th century physician who died in the plague) relying on Galen's writings, believed that anger overthrew reason by boiling the heart while sadness cooled and dried the body resulting in obscured judgment and reduced memory (Palazzotto, 1973).

In terms of preventative medicines, before breakfast (on an empty stomach) it was recommended that figs, rue and filberts be eaten. Then later in the day, spices such as myrrh, saffron, and pepper along with onions, leeks and garlic were to be taken. All these remedies affected the humors, but if taken in excess could make the humors too hot (Gottfried, 1983). It was also believed that the body could be readied to fight the plague by cleansing it with diuretics, laxatives, cautery and phlebotomy. Phlebotomy was done to maintain the humor balance, which is important to fight off the plague. Powders, potions (especially antidotes for poisons- e.g. theriac) and pastes were also given to diminish over abundance of the humors (Palazzotto, 1973)

In terms of locations, towns that were surrounded by stagnant waters, surrounded by high trees or located in low areas between mountains were particularly susceptible to pestilence because of poor ventilation to these sites. Humidity (desirable for flea growth) was considered a particular evil avoided. Fire (which made the air dry albeit warm) was often used to reduce the chances of infection (Palazzotto, 1973). It was also believed that filth and littered areas increased susceptibility to the plague, due to miasma (Palazzotto, 1973).

It should be understood that one of the reasons physicians were unable to effectively treat the plague was due to the desperate nature of the situation (Palazzotto, 1973). The plague had managed to decimate a third of the population within 4 years (1347-1351), and such a rapid acting epidemic had not been experienced in history. Thus it propelled them to try anything and everything contained in their medical traditions, without fully understanding or observing the ramifications of their suggested treatments (Palazzotto, 1973). The desire to investigate possible treatments would eventually lead to the birth of modern scientific method (see under 'changes in medicine').

Changes within the Field of Medicine

Some of the changes that occurred within medicine were the translation of medical knowledge into the vernacular, rise of the surgeons, increase in medical knowledge, new roles for hospitals and changes in the education system.

Changing the medical language from Latin to the colloquial, everyday speech was done because the educated laymen wanted to take charge of their own health (Gottfried, 1983). The inefficacy of medicine and physicians during the plague disillusioned the populace with regards to physician ability to treat diseases (Gottfried, 1983).

There was also the development of the new roles of hospitals. Before the Black Death, hospitals were used to isolate the infected rather than cure the sick (Gottfried, 1983). When a sick person entered the hospital he was treated as if he was dead: all his possessions were disposed of (Gottfried, 1983). After the Black Death, however, all this changed. During the plague the hospitals were still being used as isolation chambers, but many tried to cure the ill. Even though the cure itself might have been worse than the disease (Gottfried, 1983), it indicated a shift in the purpose of hospitals. Lastly, many began to add or create medical libraries, which helped to make new knowledge (see below) more accessible to practicing physicians (Gottfried, 1983).

As theoretical university-based medicine failed to cure or even predict the true causes of the plague, many people turned to surgery for more practical solutions (Gottfried, 1983). Many more dissections were undertaken and the anatomy texts of 1380's are comparatively accurate (Gottfried, 1983). The increase in knowledge garnered surgeons more respect and soon they were just as revered as physicians had been pre-plague (Gottfried, 1983).

Thanks to the expansion of surgical knowledge, the information on anatomy had risen significantly and added immensely to knowledge of medicine (Gottfried, 1983). Several hospitals even developed relationships with doctors and respective universities (Gottfried, 1983). For example, by 1450 Cambridge University had its medical students do an internship at the Bury St. Edmunds hospital (Gottfried, 1983). Thus medical education had been refined by the increased involvement with patients at the education stage, rather than at the practicing level as before. Lastly, increased knowledge of anatomy by the increased involvement of surgeons in the medical curriculum changed the learning system from that of philosophy to that of practical physical sciences (Gottfried, 1983). Hypotheses were made, observations were noted and results were being compiled, all suggesting the beginnings of the scientific method (Gottfried, 1983).

Public Health Measures

The idea of quarantine had been present before 1346 because of the biblical treatments of lepers (McNeill, 1976). Initially such measures were haphazardly implemented by communities against ships, goods and immigrants (Palazzotto, 1973). After repeated use by many centers however it eventually became a standard practice (McNeill, 1976).

The most thorough and systematic efforts at isolating the ill was seen in Venice. In 1348, with the Black Death raging in the city, three noblemen were appointed by the city and

authorized to isolate infected ships, people and goods on an island in the lagoon (Palazzotto, 1973). The board appointed was repeatedly terminated with the end of a plague and resuscitated with the onset of the new wave (Gottfried, 1983). Once the cyclic pandemic nature of the plague was recognized in late 15th century, a permanent board was set up to warn of impending plague outbreaks. Their mandate was to supervise the city's doctors, appoint full time subordinate health officials that would watch over every district of Venice. This later on served as a model for other European governments in the next century (Mullett, 1956).

Milan had a similar layout as the Venetian health board, except that they added more people, such as a surgeon, physician, barber-surgeon, notary, officer in charge of bills of mortality, carter to take away the bodies, two horsemen (as messengers), two gravediggers and three footmen (Gottfried, 1983). The addition of more people helped to make implementation of a quarantine and disposal of infected dead bodies more efficient.

The system established was executed in a very methodological fashion, and upheld by the community. Given an infected area, once it was identified, it was isolated from the healthy, and any movement of persons or good within that area was restricted. They were technically placed under a ban. A special pass issued by the board of public health was needed to move in and out of the banned areas (Gottfried, 1983). The rules of the ban were applied to all locals, and they had to carry passes in order to move about their own town (Gottfried, 1983).

After the quarantine was established, the health board recorded the names, ages and causes of deaths of the victims, so that the disease could be isolated quicker (Gottfried, 1983). So the public boards started keeping vital statistics on the occurrence, recurrence and spread of diseases. They also recorded the efficacy of isolating the disease, furthering the study of epidemiology (Mullett, 1956).

By late 15th century, the boards were so successful that they were given powers similar to today's public health officials, and started looking after sanitation, hospitals, burials, manufacture and sale of drugs, etc. (Gottfried, 1983).

Sanitation

Early 14th century London, municipal governments began considering sanitation problems seriously and were ordering the cleaning of town ditches and streets (Mullett, 1956). Other orders were issued that prohibited the presence of swine on the streets, cleanliness of their homes and the Thames River, employment of a sweeper to clean the streets and bylaws that prohibited littering of streets (Mullett, 1956). Fines and punishments were even put into place: in 1349, dumping filth into the Thames River could get you a 20 pound fine! (Mullett, 1956). Guilds and other trade organizations started taking more responsibility for keeping the town and surrounding areas clean and therefore reduce the incidence of sickness (Mullett, 1956).

Economy

Most of this paper has emphasized the medical aspect of the plague. But is also important to understand how people were socially affected by the plague, and how it was not a negative influence in that area either. The Black Death forever altered the course of history and the manner in which people would govern themselves. Here only the impacts of economy will be discussed, and it is hoped that this paper will stimulate the reader to seek out more about the Black Death's ramifications.

Due to the large amounts of deaths that occurred, fewer laborers were available to work the land. This meant that the market had shifted in favor of the workers, which put the nobility in a critical position. The situation was so bad that a laborer could leave one manor in the middle of night for a neighboring one and expect to be welcomed! Many of the laborers started asking for golden ale and meat-pies on top of their income whereas before the plague such a request was unheard of (Gottfried, 1983). Thus the workers could ask for any set amount as their wage, while the nobility could no longer coerce free laborers into working at minimum pre-plague wages. Lords were willing to lower rents and provide commuting services (when laborer lived off of the land) to keep themselves in business (Mullett, 1956).

With regards to wages, laborers were getting paid five times as much by 1350 (e.g. in Cuxham manor in England, a ploughman's value jumped from 2 shillings in 1347 to 7 shillings in 1349 and then to 10 shillings and 6 pence in 1350! (Harvey, 1965). Since few lords could keep their laborers, vast amounts of land become available on the market and this made the price of land drop significantly. The drop in prices with increased wages allowed laborers to acquire large amounts of land at a cheap price. Where no one was left to enforce the royal decree, many people took up land without the normal court approval (Mullett, 1956).

Before 1347, emancipation of the worker had proceeded slowly and unevenly. But the Black Death accelerated this process (Mullett, 1956). The lords were made helpless by the situation, but still had the strength to fight back. They attempted to have legislations freeze the wages (as early as 1349 in England), but all attempts failed (Gottfried, 1983). Also, the laborers started organizing themselves into unions, which helped maintain the high wages (Mullett, 1956). Prices for virtually everything were up for bargain and were subject to change as the times got worse. A horse that was worth 40 shillings could be sold for as low as 6 shillings, as long as a buyer was available (Gottfried, 1983). In attempts to regulate something, medieval authorities set out to regulate the kinds of fur each social class could attain. For example, only those with an income of 1000 pounds could wear white muscalid furs on their hoods, while those earning less than 200 pounds wore lambskin (Gottfried, 1983).

In most parts of Europe, all these changes helped replace serfdom with a 'copyhold', where both the peasant and lord held onto a tenure agreement. It was equivalent to a

business deal between the peasant and the lord, where the peasant got use of the land and the lord got a fixed annual payment (Gottfried, 1983).

The limited availability of laborers also pushed many lords to convert from grain farming to animal husbandry. The increases in living standards (due to the surplus of jobs compared to people) meant a greater demand for meat, therefore securing an adequate market. As well, the animal provided many other resources (fur, wool, and leather) further increasing revenue (although still lower than pre-plague) (Gottfried, 1983).

No matter how these changes came about, they left a lasting impression and forever changed the direction of capitalism and agriculture. Some regions did well with the changes but some did not: villages disappeared and mills and forges were left empty because of the lack of revenue. Thus, there was no sudden collapse in the hierarchy, but rather disintegration and reorganization of it from within (Mullett, 1956).

Factors that Helped Eradicate the Plague

Some of the tangible factors that helped with the disappearance of the plague include the use of cotton in place of wool, greater personal cleanliness, disuse of straw for floors and bedding, better care of streets, and the substitution of brick for wood as building material (Mullett, 1956). The latter was especially pertinent to London after The Great Fire of 1666. The replacement of thatch roofs for tiles and limited availability of wood helped propagated this shift (McNeill, 1976). Another important factor that might have affected the presence of the plague is the replacement of the black rat for the brown field rat. The brown rats beat the black to the food supplies, forcing the latter back down. The brown rats were not home loving types like the black rats, therefore reducing contact (of the fleas and of themselves) with humans (Mullett, 1956). The usage of brick houses also helped increase the distance between man and rat (Mullett, 1956).

Conclusion

The first wave of the plague started the wheels of change turning, and it was not until the last wave in the late 18th century that the above mentioned changes were truly recognized as being different from their predecessors. A lot of other areas of life were dramatically yet positively affected by the devastating intensity of the Black Death, and all of them cannot be fully and appreciatively discussed in this paper. This paper presents a sampling of aspects the Black Death touched. The plague changed the way medicine was structured and studied, stimulated preventative medicine, led to creation of public health, raised the standards of medical education and practice, increased the amount of knowledge known in medicine, encouraged better housing, sanitation and hygiene, initiated the practice of epidemiology, altered economy, created a unique sense of self in literature and lastly, greater acceptance of death in art (e.g. iconography).

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THE BIG WHOOP? PERTUSSIS, VACCINATION, AND PUBLIC OPINION

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ABSTRACT

With the decline of vaccine-preventable diseases such as pertussis, the focus of popular apprehension has moved from the prevented disease itself to potential side effects of the preventative agent.

After the 1906 identification of *Bordetella pertussis*, the causative agent of “whooping cough,” efforts began to develop and employ a vaccine for this bacterium. By the 1950s, with trials from Michigan to Illinois to Britain to the Faroe Islands demonstrating the efficacy of pertussis vaccination, the vaccine soon gained professional and popular acceptance, due in no small part to enthusiastic media support.

However, immunization programs combating pertussis would come to be challenged. Speculation associating the vaccine with autism and sudden infant death syndrome spread from the 1970s through to the 1990s, again in no small part to the media, whose overall enthusiasm for the vaccine had reversed – “Vaccine Roulette” was the title of one highly publicized television special on the topic. Litigation against manufacturers of the vaccine, as well as physicians, became commonplace, which compounded public trepidation.

Reported causative relationships between the pertussis vaccine and outcomes such as autism and SIDS have largely been debunked, and potential risks associated with vaccination have been shown to be far smaller than the risks associated with pertussis itself. Furthermore, the popular concerns eliciting fear of the vaccine were related to the previously utilized whole-cell vaccine, which has since been replaced by an acellular vaccine.

It is perhaps the very success of pertussis immunization that has fueled the recent and ongoing resistance to the vaccine. As suggested by a 2002 article in one popular parenting magazine, “Chances are we’ve heard more about possible adverse reactions to vaccines that we’ve ever heard about the diseases they were designed to prevent.”

Per has been recognized since the Middle Ages, with a Paris epidemic in 1578 described by Guillaume de Baillou. Known as “the kink” to the Scottish of the era, and commonly as whooping cough in more recent times, pertussis is a bacterial disease of the upper respiratory tract, causing a violent cough accompanied by the distinctive noise that gives the disease its nickname. Complications of the disease include pneumonia, encephalopathies, coma and death. The causative agent of the disease, the bacteria *Bordetella pertussis*, was identified and isolated by Jules Bordet and Octave Gengou of Belgium in 1906.

Early efforts to develop a whole-cell vaccine for pertussis were shaky. The American Medical Association’s Council on Pharmacy and Chemistry (whose regulatory authority would later be absorbed by the Food and Drug Administration) refused endorsement of the earliest whole cell pertussis vaccine in 1931, largely due to the lack of a method to confirm immunity.

Meanwhile, however, investigators were putting whole-cell vaccination to acid tests around the world. In the Faroe Islands, isolated in the North Sea, epidemics of pertussis were known to occur every five or six years. Prior to epidemics in 1924 and 1929, Thorvald Madsen of Denmark administered the vaccine to the Islands’ population, and demonstrated a decreased mortality rate. In 1933, American Physician Louis Sauer performed an experiment of a smaller scale but with greater control. He vaccinated two out of a set of four brothers in Evanston, Illinois, and inoculated the noses and throats of all four with the pertussis bacteria. While the two who did not receive the vaccine developed whooping cough as expected, the more fortunate pair avoided the illness.

In the first mass public application of a pertussis vaccine, Sauer proceeded to vaccinate over 1300 subjects before the end of the 1930s. Over this time, only ten of these patients became ill with pertussis. Furthermore, the vaccinations appeared to confer some degree of herd immunity upon the population, with the yearly number of whooping cough cases in Evanston diminishing to 131 in 1937, from an average of 334 over the years 1923 to 1933.

While Sauer’s findings were impressive in the number of subjects involved, these investigations lacked experimental control. Microbiologists Pearl Kendrick and Grace Elderling, however, carried out studies from 1934 to 1939 in which immunized children in Grand Rapids, Michigan were compared with age and sex matched controls of the same community. Of the 4512 subjects of the study, those who received the vaccine were found to be far less likely to contract whooping cough than those who did not. The results of Kendrick and Elderling’s study were almost immediately challenged, though, by those of a similar controlled trial, carried out in Cleveland, Ohio, where epidemiologist J.A. Doull found that the vaccine had little to no effect in preventing whooping cough. Debate over the vaccine’s merits was heated and drawn-out, but its proponents gradually gained public and professional sway, with the American Academy of Pediatrics calling for regular immunization against pertussis in 1943.

In the United States, the pertussis vaccine took popular hold quite rapidly. Sauer was a major public advocate for immunization against whooping cough, and several influential media outlets fell in step, encouraging public enthusiasm for the vaccine with such buoyant themes and titles as “We Can Wipe Out Whooping Cough,” seen in a 1943 issue of Reader’s Digest. A combined vaccine for diphtheria, tetanus and pertussis was developed in the 1940s, and DTP immunization was routine in the United States by the early 1950s.

While Britain was not as quick to accept the pertussis vaccine, the caution exercised by British authorities would eventually prove to lend much legitimacy to the vaccine. In 1945, the British Medical Journal published not only an editorial lambasting the findings of Sauer and Kendrick, but a study showing the vaccine to be devoid of protective effect. The British Medical Research Council set out to answer questions of the vaccine’s efficacy with large-scale randomized, blinded, placebo-controlled trials. These studies represented the first application of this gold standard of clinical investigation to study of the pertussis vaccine, and would involve some 36,000 children. Early results from this extensive study showed the vaccine to be effective in preventing whooping cough, increasing the immunization’s popularity in Britain during the late 1950s. The eventual publication of the final results in 1959 by the British Medical Council would stand as a thorough assessment of the vaccine’s efficacy, but immunization programs would not go unchallenged for long.

Deaths caused by whole-cell pertussis vaccine were reported as early as 1933, and in 1948, encephalopathy was reported to be associated with the vaccine. Perhaps the greatest catalysts of public distress were reports in the late 1970s that the DPT vaccine was a cause of Sudden Infant Death Syndrome. Again, the mass media proved to be influential upon public perception: between the dramatically titled 1982 television special “DPT: Vaccine Roulette” and the 1986 publication of “DPT: A Shot in the Dark,” litigation against manufacturers and distributors of the vaccine increased sharply. 1994 reports that pertussis vaccination caused deafness in “Miss America” Heather Whitestone were notable for both their public sway and their inaccuracy (Whitestone’s deafness was in fact caused by *Haemophilus influenzae* meningitis). In response to the shifts in public opinion, many companies ceased producing the vaccine, which the American Centers for Disease Control, fearing a shortage, started to stockpile. (Interestingly, the reports linking DPT with SIDS were found to be fundamentally flawed. Suggestions had been made that SIDS deaths in Japan decreased when the national vaccination age was raised from three months to two years, in 1975. The truth is that SIDS mortality figures remained constant after the policy change; it was damage claims specifically for DPT-related SIDS that decreased – not surprisingly, since SIDS-age children were no longer receiving the vaccine.)

In the 1990s, public attention turned to reports associating pertussis vaccination with autism. Large-scale epidemiological investigations have largely rebuffed this claim, though. Perhaps most notably, the CDC carried out a multicenter study of over 600,000

children, though its Vaccine Safety Datalink project. Completed in 2001, this investigation found no relationship between DPT vaccination and developmental disorders. While an association was found between pertussis immunization and febrile seizures, it should be noted that this study examined the effects of whole-cell vaccination. Acellular pertussis vaccination, which causes fewer seizures, supplanted the whole-cell vaccine as the immunization of choice in the late 1990s. Whole-cell vaccination has not been administered in Canada since 1997.

In 1998, *The Lancet* published a study which analyzed the basis and effects of anti-vaccination movements in several countries. The study examined the vaccine coverage rates and incidence of pertussis in countries where anti-vaccination movements were present, and made comparisons with the rates observed in countries where no such movements existed. Specific attention was directed to comparisons between neighbouring countries where a large cross-border difference in vaccine coverage existed. Grouping of selected nations was carried out through analysis of news stories, television interviews, books and popular magazines. Sweden, the United Kingdom and the former Soviet Union were found to have experienced substantial resistance to vaccination programs; Hungary, Poland, the United States and former East Germany were judged not to have experienced such resistance.

The study found that the presence of anti-vaccination campaigns was associated with decreased vaccination coverage, and that this decreased coverage led to increased incidence of pertussis in every country examined. Furthermore, the study found that population health risks associated with decreased vaccine coverage were far greater than any risks posed by pertussis immunization, including the use of the whole cell vaccine. "Given the safety and cost-effectiveness of whole-cell vaccines," the authors stated, "far from being obsolete, these vaccines continue to have an important role in global immunization."

It is perhaps the very success of pertussis immunization that has fueled the recent and ongoing resistance to the vaccine. With the decline of vaccine-preventable diseases such as pertussis, the focus of popular apprehension has moved from the prevented disease itself to potential side effects of the preventative agent. As suggested by a 2002 article published in *Today's Parent* magazine, "Chances are we've heard more about possible adverse reactions to vaccines than we've ever heard about the diseases they were designed to prevent...The very fact we're engaged in this debate is arguably a luxury of living in a society where vaccinations have erased the memory of these dreadful illnesses."

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IGNAZ SEMMELWEIS AND INFECTIOUS COCCI HANDWASHING IN THE 19TH CENTURY AND TODAY

By

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ABSTACT

After attending a dissection lab, how long do you think you could go before washing your hands? If you chose not to wear gloves of any type, how long might you last? As late as the 19th Century, it was not an uncommon medical practice for medical students and doctors to go straight from an autopsy to the examination of living patients, without even looking at a bar of soap.

Childbirth in developed countries today carries with it a relatively low mortality rate. Looking back to the days when washing hands was little more than a social courtesy, it is easy to see why this was not always the case. The Puerperal Fever, as it was called, was an often fatal illness that took the lives of post-partum mothers in their first month after birth. Today we can deduce that these fevers were caused by the bacteria Group A *Streptococcus*, transferred by the hands of MDs fresh from the autopsy room, while performing vaginal exams.

Enter Ignaz Semmelweis, assistant lecturer in obstetrics at Vienna General Hospital. He found himself confounded by the disparity in the rates of puerperal fever between deliveries performed by Obstetricians and Midwives in his hospital. When a pathologist and close friend to Semmelweis died of the same illness after cutting his finger in an autopsy, he mandated that any doctor or medical student must wash their hands before seeing patients.

In today's medicine, the advent and spread of antibiotics have led to a growing laxness in the very practice of hand-washing that Semmelweis ardently defended over a century ago. With the emergence of resistant strains of bacteria such as methicillin-resistant *Staphylococcus aureus* and vancomycin-resistant *Enterococci*, the story of the Vienna General Hospital is today of much more than purely historical interest.

Often in medicine, new clinical findings give rise to new standards of care that revolutionize the treatment of patients. Other times, these lessons are not fully learned the first time around, and needs be revisited many years later. Puerperal fever, which was

often fatal to women giving birth, is caused by the bacteria *Streptococcus pyogenes*. Although it first became a major problem in the seventeenth century, it was not until the mid-nineteenth century that Philip Ignaz Semmelweis found that the practice of hand-washing prior to seeing a patient drastically reduced the number of childbed deaths. His discovery was, at first, met with disbelief and dismissal by the medical community at large. Today, despite drastic advances in our understanding of infectious transmission, the practice of washing hands before and after seeing any patient is not practiced as often as it should be. The emergence of multi-drug resistant organisms, such as methicillin-resistant *Staphylococcus aureus* (MRSA), have been linked to noncompliance with handwashing in the clinical setting. Examination of the parallel between Streptococcal spread 150 years ago and that of Staphylococcus today may help clarify what can be done in modern medicine to halt the transmission of MRSA. (Daniels 1998)



An artists rendering of L'Hôtel Dieu. Paris. in 1646 (Adriaanse 2000)

A puerperal infection is defined as any bacterial infection of the genital tract after delivery. Often, this infection generates fever; most postpartum fevers are caused by infection of the pelvis. Bacterial invasion of the endometrium and surrounding lymph and blood structures to eventually leads to septicemia (Cunningham *et al* 2001). The term puerperal fever was first introduced and described by Strother in 1716 as an acute febrile illness that attacked lying-in women (Daniels 1998). For thousands of years, people have known that women giving birth were in danger of developing a fever that could be fatal: the Hippocratic writings made reference to childbed fever, as did Hindu texts as ancient as 1500 BC. The incidence of puerperal fever increased drastically with the advent of 'lying in' hospitals, where vaginal inspection of patients with contaminated

instruments and hands was common. The first reported epidemic of puerperal fever was in 1646 at the Hôtel Dieu in Paris (De Costa, 2002). The origins of the disease were hotly debated in the years proceeding and during Semmelweis' work. Theories of the day were wide-ranging, and posited anything from an environmental 'miasma' to the emotional state of the patient as causing childbed fever. Although Semmelweis had no idea that puerperal fever was caused by a bacteria we now know to be *Streptococcus pyogenes*, his discovery, as we will see, proved that infection was the etiologic agent (Daniels 1998).

Semmelweis was born, to Joseph and Therese Muller Semmelweis, in 1818. He was born and raised in Buda, Hungary, where he learned to speak Hungarian and German. Before entering the field of medicine, he studied classics at the University of Pest, and Law at the University of Vienna. He graduated in 1844 from the University of Vienna, at 26 years of age, with a Medical Doctorate. He also completed examinations for a Master of Midwifery not three months out of becoming a physician. Interestingly, Semmelweis was never recognized as an exceptional student: he held an initial aversion for anything involving writing, and later spent a good deal of time and money on his social life. It may have been for these reasons that he delayed formal publication of his work until many years afterwards. This is unfortunate, for the late publication resulted by in large in professional dismissal of a truly monumental work until many years later (Daniels 1998).

In 1844 Semmelweis was appointed to the position of assistant lecturer at the Medical School in Vienna. There he worked in the obstetrics department, which had been divided in two: one half was overseen by medical students, the other by midwives. Despite the fact that the two parts were identical in every other way, there was a significant difference in the mortality of mothers giving birth between the divisions. Semmelweis was amazed by mortality rates of women in the two divisions over 1841-1843: sixteen percent in the medical student's side, compared with about two percent in the midwife's division. In addition, he noticed that puerperal fever was quite rare in mothers who delivered before reaching the hospital. Semmelweis did notice that although medical students performed autopsies on women who had died of puerperal fever each morning before seeing patients, midwives were not required to perform these autopsies. However, he initially failed to make the connection between this observation and the cause of childbed fever. (Daniels 1998; Adriaanse *et al* 2000; De Costa 2002; Raju 1999)

It took the accidental death of a friend of Semmelweis', Jakob Kolletschka in March 1847, to elucidate the cause of the fever. Kolletschka was a pathologist, and died as a result of sustaining an accidental cut during an autopsy. Semmelweis read the report of an autopsy on his friend, and was impressed upon by the similarity between the pathology of Kolletschka and the many women who died at the bedside. Wrote Semmelweis: "Suddenly a thought crossed my mind: childbed fever and the death of Professor Kolletschka were one and the same. His sepsis and childbed fever must originate from the same source . . . the fingers and hands of students and doctors, soiled by recent dissections, carry those death-dealing cadavers' poisons into the genital organs

of women in childbirth . . .”(Raju 1999) The reason for the disparity in mortality rates between the two wards seemed to fall into place for Semmelweis: it was the practice of performing autopsies on the infected dead that contaminated the hands of medical students and physicians.

This prompted him to start looking for prevention of the fever. If it was the hands of caregivers that gave the disease, Semmelweis reasoned that the scrubbing of hands before seeing patients would eliminate whatever was being transferred. In May 1847 he ordered all doctors on the medical student’s side to start washing their hands with a chlorinated lime solution before the start of a shift on the ward. Later, after realizing that infection could be spread from between live patients, he decreed that hand-washing be mandatory before every vaginal examination. This saw a shift in the mortality rate from around eighteen percent in May to less than three percent from June to November (Raju 1999). This drastic reduction in mortality proved the cause of puerperal fever to Semmelweis to be a nosocomial acquisition of infectious material.

Ignaz Semmelweis’ discovery was met with great contention among his colleagues in the medical community, who held all number of different theories as to the origin of puerperal fever. His attempts to spread news of his discovery were blocked by his superiors; in 1848, he found himself unemployed. He vowed never to return to Vienna, and left for Pest to eventually become a Professor. Nevertheless, Semmelweis maintained that the truth would emerge in time. In 1861, he finally wrote his dissertation, *Die aetiologie, der begriff und die Prophylaxis des Puerperal Fiebers von Prof Dr Semmelweis*. His profession largely failed to accept his work until many years after his death in 1865. Ironically, an autopsy revealed he had probably died of septicemia, the very condition that killed his friend Kolletschka and sparked his discovery. (Daniels 1998)

While puerperal fever is no longer an acute problem in developed countries today, the emergence of methicillin-resistant strains of *Staphylococcus aureus* presents a serious concern for the health community today. In 1961, shortly after the introduction of methicillin, the first case of MRSA occurred in the United Kingdom. The first important outbreak of MRSA in the United States did not surface until 1968 (Ailiffe 1997). The rate of MRSA cases has more or less increased until, at present, twenty to twenty five percent of *S. aureus* isolates from patients in the United States are resistant to methicillin. Control of MRSA is important because these organisms are multi-drug resistant, and are associated with significant morbidity and mortality (Herwaldt 1999). A newer drug, vancomycin, which has been used to treat cases of MRSA, is essentially the end of the line for treatment against these multi-drug resistant organisms. Most recently, the first case of vancomycin-resistant *Staphylococcus aureus* was reported in the United States in 2002 (Pearson 2002).

In the past few years a number of studies have inexorably linked the practice of handwashing to methicillin-resistant *Staphylococcus aureus* contamination. In one study,

MRSA contamination of computer terminals located in hospital wards was used as a surrogate marker for the nosocomial spread of MRSA. It was shown that as handwashing compliance increased, MRSA transmission decreased significantly (Devine *et al* 2001). As Semmelweis suggested for puerperal fever, the most common route of MRSA spread is via direct contact with contaminated hospital personnel hands (Bradley 1999).

While the development of new antibiotics to treat MRSA is a clinically worthwhile endeavor, the first line of defense should be to prevent the further spread of resistant strains. This can be done through controlling prescribing patterns, not prescribing antibiotics to treat antiviral infections, promoting adherence to treatment, and importantly, hand washing in between patient visits. Today, handwashing guidelines among the medical community are more consistent with appropriate infection-control practices. The University of Geneva Hospitals guidelines, widely accepted among infectious disease specialists, recommend that hands be washed or disinfected (Pittet *et al* 1999, 129):

1. Before and after patient contact
2. After contact with a source of microorganisms
3. After removing gloves

These guidelines, and the principles behind them, are simple enough to be understood by all those involved in health care. With the widespread dissemination of antibiotic resistance, such as that seen in MRSA, the problem today is not primarily one of a misunderstanding of disease process.

Nevertheless, noncompliance with proper infectious disease control procedures persists: handwashing, a seemingly easy yet essential task, is still practiced infrequently. Work in the 1980's suggested that this simple exercise is not practiced in clinical situations nearly as often as it should be (Bryan 1986). A recent study examined rates handwashing noncompliance among health care workers in a teaching hospital. The average observed compliance with handwashing was 48 percent; in other words, 52 percent of all opportunities for handwashing were missed. In general, physicians were less compliant than nurses. Of particular concern in this study was the observation that as hospital staff workload increased, so did noncompliance with handwashing (Pittet *et al* 1999). When health care workers are pressed for time, it seems that the simple precaution of handwashing is the first to suffer. In another study published several years later, evidence indicated that MRSA spread increased when the hospital became understaffed and overcrowded (Andersen *et al* 2002). This last is especially disconcerting, for it is during local epidemics of MRSA, when hospitals will be crowded and likely short-staffed, that infection control procedures should be at their very best. What is more, as the strain on our health care system increases, the greater demands placed on physicians and nurses may lead to drastic reductions in the already inadequate amount of times hands are washed. This would result in an alarming breach in infection control and most likely put further strain on already overworked health care workers.

Nearly one hundred and fifty years ago, Ignaz Semmelweis proved that spread of puerperal fever, caused by Streptococcal infection, could be prevented by a vigorous handwashing regime. Today, methicillin resistant *Staphylococcus aureus* presents a serious threat to the treatment of infectious diseases. Medical staff have grown lax when it comes to the basics in the prevention of the spread of infectious disease, and would do well to relearn the teachings of Semmelweis. The washing of hands is not merely a courtesy, it is also a very basic element to the practice of good patient care. Each health care worker must work to make handwashing an ingrained, automatic task that is done fastidiously at every opportunity. If this is done, Semmelweis' efforts to convince his colleagues of his discovery will not be in vain, and we will have the opportunity to prevent many new cases of methicillin-resistant *Staphylococcus aureus*.

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RACE OR PLACE: THE EVOLUTION OF OUR UNDERSTANDING OF THE GENETICS OF MULTIPLE SCLEROSIS

By

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ABSTRACT

The history of the genetics of multiple sclerosis is best understood in the context of the evolution of medical science and opinion over the past century. Although it is now generally accepted that genetics plays at least a partial role in the aetiology of MS, genetic factors were largely ignored by the medical establishment until the 1950s and later. This delay in acceptance of genetic factors may have been due to relative lack of progress in medical genetics in the first half of the twentieth century. Research into the genetics of MS was further compromised by the historical connection between genetics and the controversial field of eugenics. In contrast, as knowledge of infectious diseases accumulated at an astounding rate, research into infectious causes of MS flourished. With the major discoveries in genetics of the 1950s and 1960s came a resurgent interest in the genetics of MS. The discovery of the human leukocyte antigen (HLA) system led to increased interest in the molecular basis of MS. Through collaborative studies such as the Human Genome project, this research continues to gain momentum. Large epidemiological studies have contributed to this momentum by providing strong evidence for the role of heredity in MS. The history of medicine is reflected in the history of multiple sclerosis, and it is likely that as new concepts in medicine are developed, new theories about the aetiology of MS will emerge.

Introduction

It has been less than two hundred years since multiple sclerosis was formally described in the medical literature (Murray 2000, 5-8). The major discoveries in human genetics were made even more recently. It is therefore not surprising that the history of the genetics of multiple sclerosis (MS) is relatively brief, spanning just over a century. Although familial cases of MS were identified very early in the history of MS, it is not until recently that there has been general acceptance that genetics play a role in the aetiology of the disease. There are a number of historical factors that help to explain the delay in acceptance of a genetic component of MS. In order to better understand the evolution of

our understanding of the genetics of MS, it is important to approach the topic in the context of major discoveries in medical history.

Early Reports of the Hereditary Characteristics of MS (1896-1940)

Although multiple sclerosis had been described by Carswell, Cruveilhier and others as early as 1838, much of the credit for framing the disease and bringing into the general medical consciousness must go to Jean-Marie Charcot (Murray 2000, 9-10). In 1868, Charcot correlated the pathological and clinical information gleaned from his predecessors to create a comprehensive clinical picture of *sclérose en plaque*, as he named it. This made it possible for other physicians to recognize and diagnose the disorder. His observations were spread throughout the world with the publication of his *Leçons* in 1872-1873 and an English translation, *Lectures on the Diseases of the Nervous System*, in 1877.

Armed with Charcot's observations on how to recognize the disease, other physicians were able to study epidemiological patterns of the disease. Although most of the early authors on MS had observed familial cases, each thought it was rare, and did not give much support for the idea of a hereditary component (Murray 2000, 17). In 1896, the German neurologist, Eichorst described a mother-son pair with multiple sclerosis based on findings at autopsy. This is likely the first published report suggesting a familial link in MS (Eichorst 1896). Case reports of family clusters of patients with MS were published throughout the first decades of the twentieth century, but were largely disregarded by experts.

In addition to these case reports, several epidemiological studies pointed to a possible genetic aetiology. One of the earliest epidemiological studies was published in 1922 by Charles Davenport, an American zoologist and geneticist. Davenport conducted a review of all men drafted into the United States army, and showed that the maximum rate of MS was among men from the states of Michigan and Minnesota, followed by Wisconsin (Davenport 1922). He theorized that MS may be related to other disorders, such as goitre and chorea, clustered in these states, and particularly among those of Scandinavian ancestry. Davenport concluded that perhaps Scandinavians had a particular genetic susceptibility to MS. In his conclusion, he states that

“. . . whatever may eventually prove to be the endogenous cause of multiple sclerosis, the factor of heredity cannot be left out of consideration. . . It seems most probable that the geographic, ethnologic and familial distributions shown by multiple sclerosis depend in part on one or more hereditary factors.”

Despite the genetic influences suggested by Davenport, most of his contemporaries believed that MS was caused by an infection. Russell Brain published an astoundingly comprehensive review of the literature pertaining to MS in the American Journal of Medicine in 1930 (Brain 1930). He cited several epidemiological studies, particularly

those of Davenport and Allison (North Wales), but downplayed the genetic factors. Brain summarized research that led to an improved understanding that the plaques of MS were secondary to an inflammatory process. He stated definitively that the inflammation must be triggered by a pathologic agent, and that this knowledge has “re-established disseminated sclerosis as an infective disease.” In the same paper, Brain reviewed the reports of familial MS by Eichorst and others, but concluded that these cases were extremely rare, and wrote that “the occasional occurrence of multiple cases in a family is due either to chance, exposure to a common environment or mutual infection.” In 1933, in the first edition of his hugely influential *Diseases of the Nervous System*, Brain reiterates his opinion that “there is no conclusive evidence that heredity, occupation, precedent trauma or disease are aetiological factors, though multiple cases occasionally occur in one sibship” (Brain 1933, 389-90).

In the same year, Curtius, a German neurologist, published a review of 84 reports in the literature of familial multiple sclerosis (Curtius 1933). He also included his own study of 3129 relatives of 106 patients living in Bonn and Heidelberg. He reported that first-degree relatives of a person with MS had a relative risk of 40 of developing the disease. This study was criticized by some because of lack of evidence of MS in many of the relatives on which he based his conclusions. Regardless, Curtius performed a repeat study in 1937 and obtained the same result (Curtius 1937). An expanded discussion of MS appears in the second edition of Brain’s *Diseases*, and includes a reference to Curtius’ works (Brain 1940, 489-91). Although Brain still does not subscribe to the idea of a hereditary component of MS, he concedes that there may be a general “neuropathic tendency” that occurs in families and may lead to a higher incidence of neurological diseases, including MS.

Genetics Prior to 1950

To understand the general reluctance of early MS scholars to accept the aetiological role of heredity, it is helpful to explore the contemporary understanding of genetics. As early as 400 BC, it was understood that certain attributes of humans were inherited. Hippocrates believed that the genetic material was contained in the semen, and was produced by the whole body “healthy by healthy parts and sick by sick parts” (Vogel and Motulsky 1997, 11). He also sows the seeds for the field of eugenics—application of genetic principles to improve the quality of the human population—by concluding that “when as a rule, baldheaded beget baldheaded, blue-eyed beget blue-eyed, and squinting, squinting; and for when other maladies, the same law prevails, what should hinder that longheaded are begotten by longheaded” (Vogel and Motulsky 1997, 11).

While the Greeks had an intuitive understanding of heredity, almost two thousand years would pass before any major advancements were made in the world of genetics. The discovery of sperm and ova using the techniques of microscopy developed by Leeuwenhoek in the mid-seventeenth century were important, as was work by Joseph Adams, an English physician who in 1814 first introduced the concept of “familial”

(recessive) and “hereditary” (dominant) conditions (Vogel and Motulsky 1997, 12-13). However, the most significant contributions to the development of modern genetics were made by two men who published seminal works in 1865: Charles Darwin and Gregor Mendel. Darwin’s theory of natural selection provided an explanation for evolution: individuals with characteristics that allowed them to best adapt to their environment would win the “struggle for survival” and pass these favourable characteristics to their offspring (Ridley 1996). The implication of this theory in human genetics is that modern humans represent the culmination of the inheritance of favourable characteristics over millions of generations. Mendel’s work on the pea established the modern understanding of dominant and recessive traits. Though it was published in the same year as Darwin’s *On the Origin of Species*, it went largely unnoticed for over thirty-five years before it was rediscovered by a number of researchers at the turn of the twentieth century (Vogel and Motulsky 1997, 14-15).

Also published in 1865 were two essays by Francis Galton, entitled “Hereditary Talent and Character.” Galton, often referred to as the “father of eugenics,” evaluated collections of biographies of outstanding men and noted how frequently persons included in these works were related to each other. He noted that the frequency was much higher than due to pure chance. He suggests a Utopian society in which the best men would be provided with brides who had excelled at state-run intelligence tests and the education of their children would be provided free of charge. Galton’s second essay is particularly disturbing, and attributes extremely unfavourable characteristics to the “less noble” races of the world. He confidently proclaims that “the feeble nations of the world are necessarily giving way before the nobler varieties of mankind; and even the best of these, so far as we know them, seem unequal to their work.” (Galton 1865).

Because genetic diseases were seen by most to be rare and only of academic interest, much of the early research into human genetics was performed with a focus on eugenics, and was of little scientific merit. One of the most influential eugenics researchers was Charles Davenport, who described the geographic distribution of MS. Davenport was born in Stamford, Connecticut in 1866. He had studied civil engineering at the Polytechnic Institute of Brooklyn and earned a PhD in zoology from Harvard College in 1892 (Largent 2002). Davenport was extremely ambitious, and was possibly the most successful American biologist of his time, holding the title of President or Vice-President of ten of the sixty-four societies in which he was a member, and sitting on the editorial boards of at least eight scientific journals.

Davenport’s reputation as a scientist was greatly compromised by his involvement in eugenics. In 1904, he became the director of the newly created and immediately prestigious Station for Experimental Evolution of the Carnegie Institution of Washington (Neel 1976). The SEE, located in Cold Spring Harbour, Long Island, was one of the America’s largest and best-run biological research stations. Davenport started the Eugenics Record Office at the SEE in 1910. Over the next 12 years, he was responsible for training 258 eugenics field workers who collected extensive pedigree material on a

variety of human traits. Davenport's group produced papers which imposed simple Mendelian inheritance on such characteristics as "shiftlessness, nomadism, laziness, bodily energy and artistic and musical ability" (Neel 1976). It is not clear how exactly Davenport's field workers were able to measure these traits reliably. It is likely that Davenport's more legitimate work, such as his epidemiological studies of MS, were taken less seriously because of his less-than-scientific approach to eugenics.

In the first half of the twentieth century, the eugenics movement cast a long shadow over genetics research. Well into the 1960s, research into genetic diseases carried a very negative stigma. It is possible that for this reason, the 1963 annual report of the British MS Society declared that "MS is not hereditary, it is not infectious or contagious and it is not a mental disease" (Murray 2004). A major discovery was needed to give new life to the study of the genetics of MS.

The Age of Infectious Diseases

Another major reason for the early lack of acceptance of the genetic factors in multiple sclerosis was the enormous increase in knowledge about infectious diseases in the nineteenth and twentieth centuries. Infectious diseases were preventable and, in some cases, treatable, and therefore of greater interest than genetic diseases, which were presumed to be rare and untreatable. In the case of MS, if an infectious aetiology could be found, then the disease could be prevented, and steps toward cure could be taken. In contrast, if the disease was genetic, then the opportunities for treatment were far more limited.

The discovery of vaccines, and later of antibiotics, had an immediate, dramatic effect on world medicine. In 1798, Edward Jenner, a British physician, demonstrated empirically how inoculation with cowpox produced immunity against smallpox. This was the first demonstration that inoculation with an attenuated infectious organism can lead to tolerance of more virulent strains of the organism (Waterson and Wilkinson 1978, 53). Fifty years later, Pasteur used a more methodological approach to cultivate and attenuate several species of bacteria. He developed vaccines to a variety of infectious diseases, including anthrax, fowl cholera, and, most notably, rabies (Waterson and Wilkinson 1978, 58). Over the next century, vaccines to some of the most lethal viral and infectious diseases were developed.

The development of vaccines owes much to the field of bacteriology, which emerged at the end of the nineteenth century. In the 1880s, German Robert Koch developed techniques to culture bacteria on solid media. By streaking out samples onto these media, he was able to sort out mixed cultures and obtain pure single species cultures. Koch's work led to a tremendous surge in the identification of bacterial causes for disease in the last two decades of the nineteenth century. According to one author, "between 1882 and 1900 the causal organisms of almost all of the bacterial diseases were isolated and effective preventative measures became possible" (Collard 1976, 5). These preventative

measures, such as the concept of surgical antisepsis, developed in the 1860s by Lister, had an immediate and huge effect on the incidence of bacterial illness. The discovery of penicillin by Fleming in 1928, and its purification by a team of chemists led by Sir Howard Florey had an additional effect in reducing illness and death caused by bacteria (Chain et al. 1939).

The search for an infectious cause of multiple sclerosis intensified with the discoveries of Pasteur, Koch and others. If a bacterial or viral cause could be identified, then a vaccine could be developed, and the disease could be eradicated. In contrast, if MS was caused by an inherited factor, there was very little to be done about treatment, and prevention would be difficult. There were promising results from experiments performed in 1913 and 1921 by Bullock (who later changed his name to Gye). He claimed to have inoculated several rabbits with the CSF of patients with MS, resulting in a clinical syndrome similar to MS and characteristic pathologic changes on autopsy. He suggested that the CSF contained the causative infectious agent of MS. These results could not be reliably reproduced, however, and in 1950, Innes and Kurland declared that “the etiology of multiple sclerosis remains as vague today as it was in Charcot’s era.”

One of the works cited by Innes and Kurland was that of Georg Schaltenbrand, a German neurologist. In 1940, Schaltenbrand inoculated monkeys with CSF from patients with MS and then infected 45 human subjects with material from these primates. He claimed to have produced autopsy-proven demyelination in several cases. His human subjects included children with psychiatric disease from an institute in Werneck (Shewell and Bradley 1944). Schaltenbrand’s story illustrates that research of questionable ethics was not limited to the realm of eugenics.

Another episode of great promise followed by even greater disappointment occurred in the 1970s. Carp and others injected specimens from patients with multiple sclerosis into mice and observed a decrease in the number of circulating polymorphonuclear leukocytes. They found a responsible agent in various tissues of inoculated mice, which they described as a “small virus with unusual properties” (Carp et al. 1972). This multiple sclerosis-associated agent (MSAA) or “Carp agent” was hailed as a “Milestone in Multiple Sclerosis.” Other researchers obtained inconsistent results in attempts to isolate this agent, and by the end of the decade, research on this agent was largely abandoned. Carp bemoaned the “unwarranted publicity” which had “raised false hopes and brought forth numerous letters from patients in many parts of the world which required answers to state the unfortunate truth that even if MSAA [MS-associated agent] were the cause of MS, this fact would almost certainly not affect the treatment of the disease” (Carp et al. 1977).

While investigations into infectious causes of MS are ongoing, reproducible results have not yet been obtained, and many MS researchers have turned to other lines of investigation in the search for a cause.

The Rebirth of Genetics in MS

In 1950, Roland McKay revisited the work of Curtius and reviewed 177 familial cases in 79 pedigrees from reports published between 1896 and 1948. McKay used much more rigid diagnostic criteria to identify familial cases (perhaps a lesson learned from Curtius' experience) and accepted only the cases which had a consistent clinical description. This research suggested undeniably higher rates of MS in those with family members who were also affected. The most common relationship was sibship; parental and more distant relations each accounted for about fifteen percent of cases. McKay's research led to a renewed interest in the genetics of MS.

Another factor in this increased interest was a general increase in research in genetics in the 1940s and 1950s. This increase coincided with the discovery by Avery, MacLeod and McCarty that DNA was the material of inheritance (Portugal and Cohen 1977), and the subsequent development of a double-helix model of DNA by Watson and Crick in 1953.

A greater understanding of the mechanism of inheritance coincided with new discoveries in medical genetics. Although Garrod had identified alcaptonuria as a condition with undeniable Mendelian inheritance as early as 1908, the general opinion for many years was that genetic conditions were rare and of little consequence. Things began to change, however, after a landmark study by Aird and others in 1953 that explored the relationship between stomach cancer and blood group. They noted a higher frequency of blood group A in those with stomach cancer and a lower frequency of blood group O. In 1954, they found the exact opposite relationship between blood group and peptic ulcer disease: the incidence of peptic ulcer disease among those with blood group O was higher than the control population. A huge number of studies linking ABO antigens to a variety of diseases followed. Most of these were not as successful as Aird's studies, but there were some researchers who believed that ABO antigens were related to almost every disease (Vogel and Motulsky 1997, 219-22).

In 1965, McAlpine et al. reported a slight excess of group O blood type in a study of patients from six English cities. Simpson et al. (1965) did a larger-scale study with 507 patients and 94,419 controls and found a slight (but statistically insignificant) increase in group O blood type. Further studies through the 1970s did not support this conclusion, and the relationship between MS and ABO antigens is no longer considered very important.

Research into ABO blood groups and MS was dropped just in time for another, more enticing blood-borne antigen. In 1954, Dausset observed that the blood of patients who had received multiple transfusions contained agglutinins against leukocytes. These isoantigens were said to be genetically determined and were named Human Leukocyte Antigens (Vogel and Motulsky 1997, 180-87). Over the next decade, the number of

leukocyte antigens being discovered increased rapidly, and it was suggested that most of these antigens were components of the same genetic system.

Although the major thrust of early research into the HLA system was for transplantation research, other intriguing correlations were made. Inspired by the work of Aird and others in proving associations between ABO antigens and disease, Patel et al (1969) ventured to “inquire whether a similar association exists between certain diseases and the antigens of the white cell series.” The authors showed a weak association between chronic glomerulonephritis and HL-A2 (now HLA-A2). A huge number of studies relating the HLA system to disease would follow, including studies linking certain HLA alleles to MS.

The HLA system was interesting for a number of reasons. It was noted from the beginning that some HLA alleles tend to occur more frequently together than expected by chance. These combinations are called haplotypes, and the fact that they occur together more often than expected is called *linkage disequilibrium*. Researchers postulated that these haplotypes are maintained because of some selective advantage not yet understood (Vogel and Motulsky 1997, 183). It is also of interest that the HLA system, and in particular MHC Types I and II play an important role in the immune response. Therefore, it is natural to explore the relationships between this system and diseases in which the immune system is inappropriately targeting self tissues, autoimmune diseases.

In 1972, Danish researchers confirmed a significantly higher frequency of the HL-A3 (now HLA-A3) antigen in MS patients compared to control (Jersild et al. 1972). Other studies published that year confirmed the association between HL-A3 and MS (Naito et al 1972; Bertrams et al 1972). Over the next 30 years, the HLA system would be reclassified several times, and the links between certain HLA alleles and MS would be outlined in almost agonizing detail and will not be discussed here. It will suffice to say that although in certain populations there is an association between certain HLA alleles and MS, the nature of this association is variable, and no explanation for this association has been universally accepted.

MS: Race or Place?

In the last twenty years, it has been generally accepted that multiple sclerosis is caused by a combination of both genetic and environmental factors (Sadovnick 2002; Compston and Sadovnick 1992). The tenth edition of *Brain's Diseases of the Nervous System*, published in 1993, has three pages of discussion about the possible aetiology of MS. The discussion is divided into sections entitled “genetic susceptibility” and “environmental triggers.” While the first objective evidence of the role of genetics in MS came from the HLA studies of the early 1970s, modern studies of the epidemiology of MS have added weight to the argument that genetics is important to the aetiology of MS.

That there is a significant environmental component to MS can be seen in numerous epidemiological studies. Immigration studies, such as the 1962 study of the Israeli population performed by Alter et al, showed that the prevalence of multiple sclerosis among immigrants correlated well with the latitude of the country of origin. Israeli-born offspring of immigrants were likely to have the same risk of developing MS as native Israelis, strengthening the argument for environmental factors. A more recent study of UK children born of immigrants from India, Africa and the West Indies showed that the prevalence of MS in UK-born children of immigrants from tropical countries is approximately the same as that seen in the white population, confirming the conclusions of the Israeli study (Elian and Dean 1990).

The Canadian Collaborative Study Group, led by George Ebers and Dessa Sadovnick, has published a number of influential articles on the genetic epidemiology of MS. The first study, published in 1986, examined MS susceptibility in 27 monozygotic and 43 dizygotic twin pairs with MS from ten clinics across Canada (Ebers et al. 1986). This was one of the largest and most convincing population-based studies to date. The concordance rate in monozygotic twins was 25.9%, compared with 2.3% in dizygotic twins, suggesting a strong genetic component. Additional evidence came from a study of “adoptees,” or first-degree non-biological relatives living with individuals who had MS. These people had the same risk of developing MS as the general Canadian population; a much lower risk than that of biological relatives. These findings indicated that familial aggregation of MS is genetically determined: no effect of shared environment was detectable (Ebers et al. 1985). Additional studies have further elucidated the familial connections in MS. In general, the conclusion remains the same: MS is only partially genetic, and the mode of inheritance is complex, and likely due to multiple genes.

In addition to the genetic epidemiology studies, research into the molecular biology of MS is ongoing. This research has gained momentum with the birth of the Human Genome Project, which effectively began in 1988 (Olson 1993). In addition to increasingly sophisticated studies of the HLA system, researchers are exploring the connection of other genes to MS. There is also some suggestion that there may be a relationship between MS and components of the neuroendocrine system, as well as components of mitochondrial DNA (Herrera and Ebers 2003). These studies have not been consistently reproduced, and further studies are required to elucidate the meaning of these results.

Conclusion

Our understanding of the aetiology of multiple sclerosis has changed many times in the past one hundred and fifty years. The extent to which genetics was accepted as an aetiological factor in MS depended strongly on many historical factors. As long ago as 1896, evidence began to mount that genetics played a role in MS. Yet genetic factors were largely ignored by the medical establishment until the 1950s and later. There are several reasons for the lack of acceptance of genetic factors. Firstly, the genetics of MS

does not follow patterns of Mendelian inheritance. The genetic link is much less clear-cut, and the nature of this link is still not well understood. In order for this link to be universally accepted, it was necessary for our understanding of genetics to evolve. Also, in the first half of the twentieth century, many people shied away from genetic research because of the strong links between genetics and eugenics. Understandably, researchers desired to remain at arm's length from anything related to a field with such potential for evil. Another reason for the delay in acceptance of genetic factors was that in the late nineteenth century – at the same time that multiple sclerosis became universally recognized – many of the major medical discoveries were in infectious diseases. Caught up in the excitement of these discoveries, researchers sought an infectious etiology for MS, which would render the condition treatable, or at least preventable. In contrast, acceptance of a genetic aetiology was akin to acceptance that the disease was untreatable.

Even as it has become clear that genetics plays a role in MS, the extent and nature of this role is still unclear. Large-scale epidemiological studies such as the Canadian Collaborative Study have provided strong evidence that MS has a familial link, but the results have not clarified exactly what this link is. Although recent studies into the molecular biology have been somewhat promising, a definite “MS gene” has not been identified. Judging from the history, as new concepts are developed, new theories about the aetiology of MS will emerge. Until then, the general statement that MS is caused by a combination of genetic susceptibility and environmental triggers must suffice.

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NUTRITION AS THERAPY FOR DIARRHOEA: ANCIENT AND MODERN PRACTICES CONTRASTED

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ABSTRACT

When studying ancient medicine, it is difficult to evaluate how effective ancient therapies were because the ancient physician lacked many of the tools that modern medicine takes for granted. So it is hard to contrast ancient and modern therapeutics because of the vast differences in medical theory, practice and technology.

An area of ancient and modern medicine that can be compared is the area of patient care which includes such things as bed rest, fresh air and nutrition. Nutrition can be thought of as simply a part of the “passive” aspect of supportive patient care, but it can also be thought of as a more active therapeutic tool. In modern medicine, a significant amount of research is devoted to finding which foods cause, prevent or help treat certain diseases. In ancient medicine, proper nutrition would have been a potentially powerful tool in the battle against disease.

Diarrhea is an excellent disease to look at to compare nutrition as therapy in ancient and modern medicine. Nutrition played an important role in ancient medicine in the treatment of diarrhea and it still is very important in modern medicine as many current treatment practices for diarrhea are based on supportive therapy which includes proper nutrition and rehydration. Examples of ancient treatment practices for diarrhea can be found in the works of ancient medical authors such as Hippocrates and Caelius Aurelianus. When compared to current theory and practice guidelines, ancient use of nutrition in the treatment of diarrhea would overall be judged to be poor because of the use of emetics and restriction of food and water. However, these treatments were for the most part consistent with the ancient ideas of the pathogenesis of diarrhea, and when nutrition was in fact used as therapy, it probably would have helped the patient based on our current knowledge.

When studying ancient medicine, it is difficult to evaluate how effective ancient therapeutics were because the ancient physician lacked many of the tools that modern medicine takes for granted. Dissection of cadavers was rarely done so internal anatomy could only be guessed at. Surgery was limited to simple procedures like setting fractures and drainage of superficial abscesses and cysts. There were no antimicrobial drugs because microbes were not even a concept. The few pharmacological drugs they did use produced obvious results such as vomiting. Therefore, it is hard to contrast ancient and modern therapeutics because of the vast differences in medical theory, practice and technology.

An area of ancient and modern medicine that can be compared is the area of patient care. Things such as bed rest, exercise, fresh air and physiotherapy, are generally meant to help the body regain and maintain strength to help the body's innate recovery processes take place. Nutrition can be thought of as simply a part of the passive aspect of patient care, but it can also be thought of as a more active therapeutic tool. In modern medicine, a significant amount of research is devoted to finding which foods cause, prevent or help treat certain diseases. In ancient medicine, proper nutrition would have been a potentially powerful tool in the battle against disease.

Diarrhea is an excellent disease to look at to compare nutrition as therapy in ancient and modern medical practice. Nutrition played an important role in ancient medicine in the treatment of diarrhea and it still is very important in modern medicine as many current treatment practices for diarrhea involve supportive therapy including nutrition and rehydration. Diarrhea, especially in the developing world, is usually caused by an infectious agent. Surgery is not a treatment option for infectious diarrhea and antibiotics may be superfluous. Often all that is required is for the patient to let the infectious process to take its course, let the body's defense systems eliminate the microorganism and replace the lost water and electrolytes. In developing countries this may be the only option available and is often effective. In developed countries, where non-infectious causes of diarrhea are more of a concern, such as irritable bowel syndrome and inflammatory bowel disease, nutrition still plays a central role in therapy (Burden 2001, Goh and O'Morain 2003).

To compare nutrition as therapy for diarrhea in ancient medicine and modern medicine, we will examine the works of two ancient medical writers, Hippocrates and Caelius Aurelianus, and compare their treatment of diarrhea with nutrition to current medical practice. Hippocrates of Cos lived about 460-370 BC and many ancient medical writings written in the fourth and fifth centuries BC are attributed to him but it is uncertain whether Hippocrates is the actual author of any of them. Caelius Aurelianus lived in the fifth century AD and translated the works of Soranus, a physician of the Methodist school who lived in the first and second centuries AD, from Greek to Latin.

The four words used by Hippocrates and Caelius Aurelianus for diarrhea including cholera, dysentery, lientery, and of course diarrhea can be classified together as so called

diarrheas because they are often compared and contrasted to each other. Dysentery and lientery are directly compared by Hippocrates: "these diseases, lientery and dysentery, are similar" (Potter 1988, 47). In book VII of the Aphorisms Hippocrates says dysentery is a progression of diarrhea. Caelius Aurelianus says dysentery arises "after an antecedent flux (Greek *diarrhea*), or after cholera" (Drabkin 1950, 869). While the ancient authors used several different words for diarrhea, they considered the differences to be in the severity and/or chronology, not in etiology or treatment. So for the purposes of this paper, diarrhea, cholera, dysentery, lientery, etc. will be considered together under the term *diarrheas*.

In examining the treatment of diarrhea by Hippocrates and Caelius the first thing that must be investigated is whether they did anything to worsen the condition. The physician can improve the nutritional and fluid status of the patient or make it worse. As stated in the Hippocratic oath (Clendening 1942), the goal of the physician is to help the patient and not willingly harm him. In both Hippocrates and Caelius we find many therapies such as baths, enemas, bloodletting, cupping, massages, exercises, rests etc. to treat diarrhea. From a modern standpoint, some of these treatments would seem like good supportive care while others might seem arbitrary and capricious, but they probably did little to help or harm the patient. In both Hippocrates and Caelius, the patient with diarrhea was often induced to vomit, and from a modern medical standpoint, this would have done more harm to the patient than good.

It is generally admitted in Hippocrates that diarrhea is dangerous. It is stated that if "diarrhea attack a consumptive patient it is a fatal symptom" and "in the case of a patient suffering from pleurisy or pneumonia, diarrhea supervening is a bad sign" (Jones 1931, 161, 183). Pleurisy and pneumonia, but especially consumption, are debilitating diseases and it is clear from the association with them that diarrhea must also be considered such a disease. In addition, it is also said that a patient with "long-standing diarrhea...because of his excretions, becomes weak and thin" (Potter 1988, 45). Dysentery is called a difficult and dangerous disease, and described as "long, painful, and usually mortal; if it is treated while the body is still strong, there is hope of recovery" (Potter 1988, 43-45), and "if a patient suffering from dysentery discharge from the bowels as it were pieces of flesh, it is a mortal sign" (Jones 1931, 141). It is clear that Hippocrates saw the diarrheas as debilitating, life-threatening diseases. Caelius also sees these diseases as being dangerous (Drabkin 1950, 423).

As the diarrheas were generally regarded as debilitating and potentially life-threatening, it is surprising that in both Hippocrates and Caelius vomiting is often a treatment that is prescribed because vomiting itself is debilitating. Nevertheless, vomiting was prescribed in the Hippocratic texts as a treatment for diarrhea: "Vomiting in a patient suffering from severe diarrhea is good" (Potter 1988, 115). The main reason for this is the idea that by inducing vomiting, the impurity causing an excess escape of material downward by diarrhea will be redirected upward by the vomiting and balance will be restored: "If the diarrhea does not go away, but you want it to, induce vomiting by means of foods or a

decoction of lentils; the downward movement will at once be drawn upward" (Potter 1988, 49). The direction to "clean bile upwards" (Potter 1988, 43) to treat dysentery and lientery is meant to restore the displaced and misdirected bile. For cholera, drinks are prescribed not to replenish the patient but to make vomiting easier so that "the offending substances are vomited upwards" (Potter 1988, 49). Caelius also recommends vomiting as a treatment for the diarrheas. With regards to cholera, warm water is prescribed "so that the decomposed food may be purged as a poison, by vomiting" (Drabkin 1950, 425). Caelius also reports that Diocles, Erasistratus, and Asclepiades prescribe vomiting in their treatments as well (Drabkin 1950, 431-435).

Patients with diarrhea lose a lot of water and electrolytes and this can potentially be fatal. It is imperative from the modern medical standpoint to rehydrate the patient and also replace the lost electrolytes. A classical physician would not have known anything regarding the nutritional content of food. Therefore before examining what foods and fluids were given to the patient with diarrhea, it must be examined whether this was part of their treatment for diarrheas at all. Hippocrates acknowledges the value of food as a treatment by saying that each food "has some faculty by which it helps or harms, although some are more evident in doing what they do, while others are more obscure" (Potter 1988, 71). Similar to prescribing vomiting as a cure for diarrhea though, the ancients also probably did more harm than good when it came to rehydration, replacing electrolytes and the nutritional status of those suffering with diarrhea.

In Hippocrates, the patient with diarrhea is directed to reduce his food intake (Jones 1931, 55, 397-411). For dysentery, lunch is omitted and dinner is lessened by one-third. For lientery, food is also reduced by one-third and for diarrhea the same thing is prescribed. In addition, sufferers of diarrhea are also told to "reduce...their food by one half", "drink...as little as possible", and "take only one meal a day". There is no clear indication of why this is done though. The reason though can be elicited by looking at what foods were prescribed. Fish can be eaten but only those "of the driest kinds". Vegetables too, must only be those that are *cooling* and the wine should be dark and *dry*. Meat has to be preserved in salt and wine cannot be diluted. Taken together this would suggest that the foods prescribed were meant to cool and dry the patient from a disease which is hot and moist and that adding too much food would further heat the body and aggravate the disease.

Caelius Aurelianus is inconsistent in his use of food and drink in the treatment of the diarrheas. For instance, on the one hand, he suggests to "give the patient cold water to sip at intervals" and to "give him food during a period of remission, without waiting...this must be done because of the danger of collapse" and "if, however, he is too weak, give him food during a remission" (Drabkin 1950, 427-429). Steps are also taken so that what food is eaten is retained. This would suggest that Caelius saw that a patient suffering from diarrhea was weak because of the loss of food and fluids from the diarrhea and that if given food and drink, strength could be restored. On the other hand, Caelius suggests to withhold food and wine from the patient. Like Hippocrates, what Caelius

believes to be the cause of the diarrhea will influence his treatment of it. He says that “the patient must not be permitted to drink too much, since unsatisfied thirst will help dry up the moist condition” and excessive food should be avoided to “prevent a recurrence of the disease” (Drabkin 1950, 429).

In modern medicine the use of food and drink as a form of treatment in patients with diarrhea is fundamental. No matter what the cause or treatment of a particular diarrhea is, it is necessary to replenish those things essential to the body which are lost because of the diarrhea. In certain diseases such as cholera which is produced by a toxin from the water-borne or food-borne bacterium *Vibrio cholerae*, all that is usually required as treatment is to replenish the patient with all the water, electrolytes and nutrients that he/she is losing because of the copious diarrhea. The *V. cholerae* toxin does no harm to the intestinal epithelial cells and patients who are not immunocompromised will usually be able to overcome the disease within a few days.

The World Health Organization has some recommendations for oral rehydration for those in developing areas who do not have access to antibiotics or other treatments for diarrhea (WHO, 1990). An extra meal should be given each day until the diarrhea stops. Foods that are easy to digest and readily absorbed by the body are very important because often in diarrhea the food is evacuated before proper digestive processes, most importantly absorption, take place. These foods include fats, yogurt, cereal, sugary and salty foods, rice, and bread. Other foods are important for the replenishing of potassium which include bananas, mangoes, pineapples, coconut milk, and citrus fruits. Some foods should be avoided when one has diarrhea such as those containing a lot of fibre such as coarse fruits and vegetables and whole grain cereals and also very spicy foods which themselves promote diarrhea. The W.H.O. also suggests an oral rehydration solution that includes 3.5g of sodium chloride, 2.5g of sodium bicarbonate or sodium citrate, 1.5g of potassium chloride, and 20g of glucose dissolved in one liter of water. The most important losses during diarrhea are potassium, sodium, and chlorine ions, glucose, and water.

There is little direction in either Hippocrates or Caelius to give water to the patient suffering from diarrhea. Only once does Caelius write “give the patient cold water to sip at intervals” (Drabkin 1950, 427). From a modern standpoint this is where Hippocrates and Caelius are seriously lacking. Probably the most important thing that could be done would be to replenish the lost water so that the patient would not die of dehydration. It is strange to see baths and enemas prescribed so often with little mention of drinking.

In Hippocrates, there are references to nutrition as therapy for diarrheas in book III of Regimen (Jones 1931). For dysentery: bread, wine, pork broth, fish, leeks, and onions are recommended. For lientery: bread, wine, dog, and pigeon are recommended. For diarrhea: bread, fish, pork, fat meats, birds, doves, pigeons, vegetables, and wine. The use of these foods is consistent with the properties that these foods have according to Hippocrates as found elsewhere in the Regimen books. Wine is “hot and dry” and dark

wines are “more dry” and wines are “dry by reason of their heat, consuming the moisture out of the body”. Fowl is included because birds are “drier than beasts” and “those which feed on seed are drier than the others” (i.e. pigeons and doves). Bread is prescribed because “hot bread dries”. Meat (i.e. beef) is binding, pork “affords more strength to the body”, and dogs’ flesh “dries, heats, and affords strength, but does not pass by stool”. Fish is generally considered dry. Onion is mentioned because it is “hot and burning, and does not lead to stool; for without giving nourishment or help to the body it warms and dries on account of its juice” and leeks contain a “purgative quality”. It is clear then from these examples that the reasons for giving these various foods was to dry and bind rather than to nourish. As far as nourishment goes though these foods are fairly good. Bread has relatively high levels of sodium and carbohydrates, and meat and vegetables have quite high levels of potassium (Sizer and Whitney 1997).

Caelius prescribes foods such as bread, spelt groats, rice, soft eggs and dry porridge for the treatment of cholera (Drabkin 1950, 427). Breads and grains are very high in complex carbohydrates which is both good and bad. They are good because they provide a source of potential glucose but this may be of no benefit in a disease where the food is not being absorbed by the body properly because time has to be spent first breaking down the carbohydrates into glucose so that they can be absorbed by the intestinal epithelial cells. In patients with diarrhea this may not have a chance to take place and the nutrients would be lost. Breads and grains also have moderate to high levels of sodium and they have moderate levels of potassium. Eggs also have moderately high levels of both sodium and potassium but have low levels of carbohydrates. When vomiting and diarrhea are minimal, Caelius also prescribes fruit and fowl. Fruit provide very high levels of potassium while providing very low levels of sodium. Although sugar levels are also not high, what sugar there is present is in a simple form such as glucose and more commonly fructose, which is easily absorbed by the body and does not require digestion. Fowl has moderately high levels of potassium and moderate levels of sodium but contains very few carbohydrates.

Caelius Aurelianus also mentions what other ancient medical authors suggested for treating diarrhea (Drabkin 1950, 427-437, 873). Diocles prescribes cow’s or goat’s milk and fruit juices for the treatment of cholera. Milk contains moderate levels of potassium and sodium and contains low levels of carbohydrates but the main sugars present are galactose which are easily absorbed and do not need to be digested. Praxagoras prescribes “a great deal of oxymel” for cholera and also prescribes barley and lentils. Because oxymel consists largely of honey and water, it would be an excellent rehydration therapy. Honey is primarily made up of glucose and fructose which can be easily adsorbed by the body. Lentils have high levels of potassium but have low levels of both sodium and carbohydrates. Erasistratus prescribes a mixture of water with a little wine “after each vomiting and after each outpouring from the bowels”. He also prescribes fruit and fruit juices which are high in potassium and simple sugars. Erasistratus is the first one to correlate the drinking of water with the loss of water by both vomiting and diarrhea. Serapion prescribes a potion which contains among other things, henbane in

order to “check the outflow of liquid matter” and because it “has a binding effect on the bowels”. Henbane contains the chemical hyoscyamine which is an antispasmodic. Diocles prescribes milk, honey, eggs, and barley for dysentery. Milk and honey are great sources of simple sugars and milk has high levels of potassium. Praxagoras prescribes milk, vegetable juices, bread, fish, meat, and gruels consisting of spelt, wheat, bran. Taken together these are of excellent nutritional value. He also prescribes the drinking salt water which would be very good because in addition to water it has sodium chloride in a very easily absorbable form.

Modern Western medicine has a vast array of treatments in its battle against disease. Many of these treatments though rely on technologies, even relatively simple ones that the ancient physician did not have. It is hard therefore to compare and contrast ancient and modern medical treatments. The ancient and modern treatments of diarrhea can be contrasted because even now, most patients with diarrhea are treated with supportive care, rehydration and proper nutrition. Did the ancient physicians do a good job in using nutrition to help treat the diarrheas? The evidence found in authors such as Hippocrates and Caelius Aurelianus would say no. In a general sense, the ancients did a very poor job treating the diarrheas with nutrition. They caused more nutritional deficiencies by inducing vomiting and restricting food and water intake. When food was given though, it generally had the required components to replace the lost electrolytes and properly nourish the patient with diarrhea.

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LIGHT: FRIEND OR FOE?

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ABSTRACT

Historically, the use of sunlight as a medical therapy, or heliotherapy, is first attributed anecdotally to the Egyptian Sun God Aton Ra (2750 BCE). In 525 BCE Herodotus related the strength of the skull to sunlight exposure, and the Egyptians used a combination of plants and sunlight to cure vitiligo.

Fast forward to the 19th century, where individuals, particularly women of the upper social classes, were encouraged to avoid sunlight and maintain unblemished, sunburn-free complexions. Two things would change popular perception. First, sun tanning became cosmetically attractive and achieved mass acceptance in the 1920s. Second, the medical community began witnessing sun-specific healing powers. Most notably, Niels Finsen used ultraviolet (UV) rays to cure tuberculosis and earned a Nobel Prize for his work in 1903. Subsequently, heliotherapy clinics gained international popularity. In Switzerland, Dr. A. Rollier opened clinics to treat tuberculosis and rickets and then began advocating heliotherapy as good preventative medicine. In Calgary, the Children's Hospital constructed a "sun therapy" tent and a solarium where in-patients could play under the sun. Medical textbooks of the time describe over two hundred conditions where UV light was indicated therapeutically, including everything from pneumonia and psoriasis, to obesity and heart disease. As a result, preventative UV light exposure became a public health goal! People were encouraged to observe practices that would maximize UV exposure and UV lights were advertised for use in peoples' homes and installed in schools and universities.

It was not until the 1930's that the association between skin cancer and excessive sun exposure emerged in the public, and was substantiated in experimental studies. In response, the public was now encouraged to avoid UV exposure. Currently, protected personal sun exposure is advocated in moderation. Medically, light therapy is pursued in limited, justified circumstances, including seasonal affective disorder and neonatal jaundice.

Very Historical Light Therapy

It is extremely difficult to pinpoint when the therapeutic use of sunlight began. A plethora of anecdotal evidence exists to suggest that many ancient cultures, beginning perhaps with the Egyptians, correlated sun exposure with improved health. For example, in 2750 BCE the Egyptian Sun God Aton Ra (from whom the term “radiation” and its derivatives originate) was said to dispense vital force and health. In fact, many ancient civilizations appear to have worshipped the sun or sun gods for beneficial health reasons. These include the Greek Sun God Helios (800 BCE), Apollo – the Greek Sun God and God of Healing, and Ásculapius – the mythical physician whose temple included a southern exposure aspect for apparent sun therapy purposes (Rollier 1927, 3). The Greeks seemed to have developed sun baths, a treatment termed “Heliosis”, where they would purposefully expose themselves to sunrays on their house terrace for therapeutic and improved general health reasons (Rollier 1927, 3). During the first century, some ancient Chinese men would stand in early morning sunshine holding a green piece of paper in their right hand with the character of the sun written in red and circumscribed by a red rectangle (McDonagh 2001, S7). In an attempt to consume some of the sun’s essence, the paper was then shredded in water and eaten. Interestingly, women followed a similar ritual but under moonlight.

This use of sunlight for medical purposes, or heliotherapy, is first attributed by many to Herodotus in approximately 525 BCE. On his journeys he related the strength of the skull to sun exposure, predating the understanding of vitamin D metabolism by some 2400 years. He wrote:

I found the skulls of the Persians so tender that even with a small stone I could break holes in them; whereas the skulls of the Egyptians were so hard that it was almost impossible to smash them with a large stone....the Egyptians are in the habit of cutting their hair short from their youth, and that consequently their skulls became hardened in the sun; on the other hand, the Persians have tender skulls because they keep the sun off their heads from childhood, inasmuch as they wear their tiara hats (Rollier 1927, 1).

However, while Herodotus is considered to have “discovered” heliotherapy, both the Hindus in 1400 BCE and Egyptians 525 BCE, used a combination of plant extracts (psoralens) and sun exposure to apparently cure vitiligo (Roelandts 2002, 926 and Hönigsman and Stingl 1986, 1). Interestingly, current photochemotherapy employs a similar combination to treat skin diseases including psoriasis (Regan and Parrish 1982, 595).

These are only a few examples that highlight the very correlative association between the sun and improved health that appears to have been observed since ancient times. In fact Rollier (1927, 3), speculates that this relationship was perhaps recognized even in prehistoric times, since cavemen appear to have employed only eastern or southern

aspects to their “homes”, potentially serving some hygienic purpose. While these examples cannot be used as direct evidence that our ancestors were aware of the sun’s healing powers, they do demonstrate the sense of well-being and enjoyment that to this day many of us experience from being outdoors under the sun.

Phototherapy Emerges

It was not until the 17th century that the scientific foundations for phototherapy, or the treatment of disease by means of light rays, were established. Specifically, Newton (1666) used a prism to refract sunlight into its component colors; Huygens (1678) recognized the wave nature of light, and the discovery that the infrared (IR) and ultraviolet (UV) components of sunlight are invisible to the naked eye by Herschel (1800) and Ritter (1801) (McDonagh 2001, S7). Perhaps the first scientific evidence for a direct therapeutic effect of light rays came towards the end of the 19th century when Arthur Downes and Thomas Blunt (1877) demonstrated that UV light can destroy bacteria, specifically the anthrax bacilli (Roelandts 2002, 926). This observation formed the scientific basis for phototherapy and the medical community would subsequently begin to witness certain sun-specific healing powers.

Most notably, the “Father of Modern Phototherapy” Niels Ryberg Finsen, a Danish physician received the Nobel Prize in 1903. Of secondary importance was Finsen’s use of red light to facilitate the healing of skin lesions and prevent the subsequent scarring associated with smallpox. His most important discovery was the use of UV rays via his carbon-arc ultraviolet lamp to cure tubercular infections of the skin (lupus vulgaris), which when left untreated, resulted in gradual skin erosion (particularly the face) sometimes leaving the patient very disfigured. By 1900, Finsen had reportedly cured 311 of 462 cases of lupus vulgaris at the Copenhagen Finsen Light Institute (Albert and Oshteimer 2002, 932). Around the same time, König healed 107 of 131 patients with peritoneal tuberculosis by opening and exposing the peritoneum to sunlight (Roelandts 2002, 927).

It was not until the development of anti-tubercular antibiotics in 1946 that the use of phototherapy to treat tuberculosis became less popular and eventually ceased altogether (Roelandts 2002, 927).

Light Therapy Gains Popularity

In the early 1900’s, light therapy clinics began to open throughout the world. By receiving the Nobel Prize and demonstrating success at his clinic, the Copenhagen Light Institute, Niels Finsen played an enormous role in the increased interest in light therapy. For example, Sir Henry Gauvain opened clinics in Alton and Hayling Island and the Alberta Children’s Hospital in Calgary, constructed a sun therapy tent and a solarium for patients. However, it was Dr. Auguste Rollier in Leysin Switzerland who perhaps deserves the most credit. His clinics first opened in 1903 to treat tuberculosis and rickets.

He offered light therapy at varying altitudes and had 1200 beds at 34 different clinics. Emphasizing the importance of gradual light exposure, Dr. Rollier documented guidelines for light therapy and recorded numerous success stories. He then began advocating heliotherapy as a preventative measure against tuberculosis and other disease. As such, children at his clinics would attend class and play games including hockey and skiing outdoors, while wearing only shorts in order to maximize their exposure (Rollier 1927).

Light therapy, particularly UV light exposure became indicated in a myriad of diseases. Krusen's 1937 phototherapy textbook describes 176 nondermatologic and 73 dermatologic diseases, including everything from psoriasis and pneumonia, to obesity and heart disease where UV light was thought to be beneficial (Albert and Ostheimer 2003, 910). Sir Henry Gauvain even believed that angina pectoris patients could dispense with nitro-glycerine if treated with UV light (Albert and Ostheimer 2003, 911).

UV Light Exposure Becomes a Public Health Goal

Interestingly during the 19th century many individuals, particularly women of the upper social classes, avoided sunlight at all costs, and used special creams and collapsible hoods to cover and protect their complexion from sunburn and blisters (Albert and Ostheimer 2002, 930). However, with increasing medical evidence to advocate the use of light therapy, and the emergence and mass acceptance of sun tanning in the 1920s in the United States for cosmetic reasons, this perception completely changed. Essentially going from one extreme to another, UV light exposure became a public health goal and an important form of preventative medicine (Albert and Ostheimer 2003, 911)! For example, a public health announcement of the time read:

Sunlight is the finest tonic and health-builder in the world. It works its cures, mysteriously, through the skin. In sunshine there is a wonderful healing power – the ultra-violet rays (Albert and Ostheimer 2003, 911).

Parents were encouraged to maximize their children's UV exposure including the use of sun-penetrating clothing and encouraging their kids to walk on the more sun-exposed side of the road (Albert and Ostheimer 2003, 912). Glass was developed that more efficiently transmitted UV radiation and UV lights became advertised and installed in homes and schools (Albert and Ostheimer 2003, 912). A 1928 General Electric advertisement even proclaimed:

Bask in the health-protecting UV rays while you read, play bridge, or bathe. Give children UV radiation in their playrooms (Albert and Ostheimer 2003, 916).

Popular Perception Changes Once Again

The association between UV rays and skin cancer had been observed as early as 1894 by physicians like Paul Unna, who described common degenerative changes in the skin of sailors, and Hyde in 1906 who wrote an article entitled “On the influence of light in the production of cancer of the skin” (Albert and Ostheimer 2002, 933). These reports however, did not circulate outside of certain scientific communities and reach public awareness. Increasingly in the 1930s and 1940s, concerns regarding excessive exposure to UV rays began to emerge and eventually, experimental reports describing the induction of skin tumors in rodents exposed to UV lamps or sunlight became publicly known (Smith 1984, 41). As a result, light exposure was no longer a public health goal, and many in fact, became somewhat fearful of the sun.

Current Indications for Light Therapy

Currently, protected personal sun exposure is advocated in moderation. Medically, light therapy is pursued in limited, justified circumstances, including the use of visible light most importantly in neonatal jaundice, and seasonal affective disorder.

Rickets

Sunlight was, and to some extent still remains, particularly useful in the treatment and prevention of rickets. As early as the mid-17th century it became apparent that young children living within inner cities were afflicted with a disease causing severe muscle weakness and bone deformities (Holick 1981, 52). As the industrial revolution spread through Northern Europe, the incidence of this affliction increased substantially and by the turn of the 20th century, some reports suggested that 90% of children living in crowded, polluted cities were affected with the disease (Wurtman *et al.* 1985, 1). Although there was strong correlative evidence that sun exposure could cure and prevent the “English disease”, only a few physicians were willing to accept such a simple treatment modality (Wurtman *et al.* 1985, 3). It was not until Mellanby in 1918 using controlled animal studies, demonstrated that cod liver oil could prevent and treat rickets that perception began to change (Wurtman *et al.* 1985, 3). Only later did scientists identify a new vitamin, vitamin D, as the responsible agent. In 1919, Huldschinsky reported that he could treat rickets in children by exposing them to UV light from a mercury quartz lamp, and Hess and Unger (1921), cured eight children by exposing them for two months to sunlight on the roof of a New York hospital (Wurtman *et al.* 1985, 3). It therefore became apparent that rickets could be treated and prevented with cod liver oil via vitamin D, or sunlight. Currently, with the advent of vitamin D fortified milk and foods in many countries, rickets has been essentially eliminated.

Seasonal Affective Disorder

Seasonal Affective Disorder (SAD) affects 1-3% of adults in temperate climates, and is characterized by regularly occurring depressions in winter with remission in the following spring or summer. It is associated with increased appetite and sleep duration (Magnusson and Boivin 2003, 189). The etiology of SAD has not been completely elucidated, but serotonin dysfunction and the role of circadian rhythms have been implicated (Magnusson and Boivin 2003, 189). Fortunately, SAD can be effectively treated with light therapy and remains the usual course of treatment for these patients. Classically, the therapy involves sitting in front of a visible light box, exposed to 2000-10,000 lux for 30-120 minutes daily during the winter (Magnusson and Boivin 2003, 189).

Neonatal Jaundice

Two observations would initiate the use of light therapy in neonatal hyperbilirubinemia. First, accidental exposure of a blood sample to sunlight led to the finding that bilirubin in serum undergoes oxidation to biliverdin and degradation to colorless compounds (McDonagh 2001, S9). Secondly a nurse, Sister J. Ward, observed that the skin of jaundiced infants becomes bleached on exposure to sunlight, while unexposed skin does not (McDonagh 2001, S9). Today, it appears that phototherapy causes bilirubin to change its shape, resulting in less lipophilic isomers that are capable of being excreted more readily in urine and bile and to a lesser extent cause its degradation to other compounds (McDonagh 2001, S10). The use of visible light (blue-green wavelengths) to treat neonatal jaundice is now so well entrenched in pediatrics, so easy to use, and so safe, that its replacement in the near future is unlikely (McDonagh 2001, S10).

Personal Enjoyment

Perhaps most importantly, the benefit of sun exposure is for many the associated personal enjoyment that comes from being outdoors and the sense of satisfaction or rejuvenation that ensues. This aspect of sun therapy is difficult to measure objectively, but has no doubt been witnessed and observed since the beginning of time.

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BOTULISM TO BOTOX[®]: FROM POISON TO THERAPY

By

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ABSTRACT

What comes to mind upon mention of the word BOTOX[®] is the thought of a revolutionary cosmetic procedure sought by those who attempt to defy the aging process, or perhaps images of the most potent and lethal natural substance known. Nonetheless, the potential medicinal benefits associated with botulinum toxin appear to have been discussed since the initial reports of botulism poisoning in the early 19th century.

The first known outbreak of botulism occurred in Wildebad, Germany in 1793 due to “spoiled” sausage. However, it wasn’t until 1817 that the German physician and poet Justinus Kerner published the first accurate description of the clinical symptoms of botulism, in which he referred to it as a sausage poison. Kerner further probed this sausage poisoning through animal experiments and even clinical experiments on himself. He was also the first to describe the potential therapeutic applications of botulinum toxin in 1822.

Following the work of Kerner, the word botulism (Latin word *botulus*, meaning sausage) was used to describe the sausage poisoning by Müller in 1870, and the bacterium responsible for this toxin was isolated in 1895. Several experiments on monkeys with the purified toxin in the early 1970s confirmed that botulinum toxin type A could be used to treat strabismus. Subsequently, Dr. Allan Scott performed clinical trials on humans using botulinum toxin type A in the late 1970s, and the drug BOTOX[®], made from botulinum toxin type A, was approved by the Federal Drug Agency for clinical use in eye-muscle disorders in 1989.

Since its inception, BOTOX[®] has seen application to a wide range of cosmetic and non-cosmetic conditions such as cervical dystonia, cerebral palsy, migraines and hyperhidrosis to name a few. It is expected that this range of applications can only continue to grow as more is learned about this wonder drug.

Introduction

On a milligram per kilogram basis, botulinum toxins are probably the most potent biological toxins that can affect humans. In fact it has been said that a teaspoon of botulinum toxin is enough to kill the entire population of Great Britain, approximately sixty million people (Botulism Toxin, 2004). However, botulinum toxin type A, the medicinally active component of BOTOX[®] (Allergan, Inc.) is a revolutionary new pharmaceutical with a broad range of medicinal applications. This begs the question, “How can the world’s most potent biological toxin offer such a large range of therapeutic benefits?” The aim of this paper is to describe the transition of botulinum toxin from a poorly understood poison to an actively researched novel therapy.

Botulism Research in the Early 19th Century

The first documented outbreak of botulism occurred in Wildebad, Germany in 1793, wherein thirteen people became horribly ill after sharing a large sausage (History of Botulism, 2004). Of these thirteen people, six of them succumbed to the illness. This was consistent with the noticeable increase in food poisoning in Württemberg, Germany during the Napoleonic wars between 1795 and 1813 (Erbguth and Naumann, 1999). It is thought that the reason for this increase was the decline in hygiene for rural food production due to the poverty caused by the Napoleonic warfare. In July of 1802 the government in Stuttgart released a warning about the “harmful consumption of smoked blood sausages,” and in 1811 the medical section of the Department of Internal Affairs of the Kingdom of Württemberg hypothesized that this sausage poisoning was caused by prussic acid, also known as hydrogen cyanide (Erbguth and Naumann, 1999). This hypothesis preceded any scientific experiments with the poison, but seemed logical given the known toxicity of prussic acid.

Johann Heinrich Ferdinand Autenreith, a medical professor at the University of Tübingen, was one of the first people to begin researching the sausage poison. He requested that the government collect the reports of family practitioners and health officers on cases of food poisoning, and after studying these reports, published a list of symptoms associated with the sausage poisoning (Erbguth and Naumann, 1999). This list included gastrointestinal problems, double vision, and mydriasis. He also added that housewives were to be blamed for the poisoning because they hadn’t dunked the sausages long enough in boiling water, in an attempt to prevent them from bursting. Thus, it was recognized that sausage poisoning arose from poorly cooked sausage, but in the absence of scientific experiments, the agent responsible for this poisoning remained in question.

One of the medical officers that responded to Autenreith’s request was Justinus Kerner. Autenreith considered the reports of Kerner accurate and important observations, so they were published in 1817 in the “Tübingen papers for natural sciences and pharmacology” (Kerner, 1817 cited in Erbguth and Naumann, 1999). This is a significant event in the

history of botulism research as it was Kerner who devoted a great deal of his life to investigating the nature of this sausage poison, and is often referred to as the godfather of botulinum toxin research.

Kerner continued to observe more cases of this fatal sausage poisoning and published his first monograph on sausage poisoning in 1820 entitled “New observations on the lethal poisoning occurring so frequently in Württemberg through the consumption of smoked sausages” (Kerner, 1820 cited in Erbguth and Naumann, 1999). In this publication he summarized 76 cases and provided a thorough description of what is now known as botulism (Kerner, 1820 cited in Erbguth and Naumann, 1999). In 1821 Kerner’s involvement in the toxin research grew as he began animal experiments, and even experiments on himself. In this work he attempted to isolate the unknown toxin from sausages, and he referred to this toxin as “sausage poison” or “fatty acid.” The results of this work were published in a second monograph in 1822 entitled “The fat poison or the fatty acid and its effects on the animal organism, a contribution to the examination of the substance which acts toxically in bad sausages” (Kerner, 1822 cited in Erbguth and Naumann, 1999). In this monograph he described 155 cases of patients who most likely had botulism. He also discussed his animal experiments, which consisted of administering botulinum toxin extracted from bad sausages to birds, cats, rabbits, frogs, flies, locusts, and snails (Kerner, 1822 cited in Erbguth and Naumann, 1999). It was from these 155 cases and the results of his animal experiments that allowed Kerner to infer that the toxin acts by interrupting the signal transmission within the peripheral and autonomic nervous system.

“The nerve conduction is brought by the toxin into a condition in which its influence on the chemical process of life is interrupted. The capacity of nerve conduction is interrupted by the toxin in the same way as in an electrical conductor by rust.” (Kerner, 1822 cited in Erbguth and Naumann, 1999)

In his writing, Justinus Kerner was able to accurately describe all muscular and autonomic symptoms that characterize botulism poisoning in modern medicine. In his monograph he writes:

“The tear fluid disappears, the gullet becomes a dead and motionless tube; in all mucous cavities of the human machine the secretion of the normal mucus stands still, from the biggest, the stomach, towards the tear canal and the excretory ducts of the lingual glands. No saliva is secreted. No drop of wetness felt in the mouth, no tear is secreted anymore. No earwax appears in the auditory canal; also signs of drying out of the Eustachian tube become apparent. No mucus is secreted in the nose; no more sperma is secreted, the testicles decrease. Urination can only be performed by standing and with difficulty. Extreme drying out of the palms, the soles and the eyelids occurs.” (Kerner, 1822 cited in Erbguth and Naumann, 1999)

Perhaps the most intriguing of all Kerner's work with the sausage poison were the experiments he carried out on himself. These experiments involved placing a few drops of the toxin-containing extract on his tongue and observing the resultant effect. He reported that the toxin tasted sour and placing a few drops of the "acid" on the tongue caused great drying out of the palate and pharynx (Kerner, 1822 cited in Erbguth and Naumann, 1999). These experiments were quickly discontinued when Kerner's former teacher, Professor Autenreith, warned him that further trials were not advised (Erbguth and Naumann, 1999). In later experiments, Kerner attempted to synthesize an artificial "sausage poison" through various crude chemical reactions, but as one might imagine this did not result in production of the desired toxin.

In spite of failure to isolate or synthesize pure toxin, Kerner was able to speculate on the nature of the toxin and the pathophysiology of sausage poisoning. After comparing several recipes of many of the sausages that were known to result in poisoning, he found that the common ingredients were fat and salt. Since salt was probably not the causative agent in this poisoning, Kerner suggested that the toxic change in the sausage had to take place in the fat (Erbguth and Naumann, 1999). We now know that this is not the case, but given that the idea of a pathogen causing disease was not consistent with scientific knowledge during Kerner's time, this was a logical hypothesis. Kerner also found that the effects of this poison were similar to other known poisons such as atropine (anticholinergic) and snake venom, so he concluded that the fat poison was most likely biological (Erbguth and Naumann, 1999).

From his work with the sausage poison, Kerner made several important conclusions. The first speaks to the etiology of sausage poisoning, in that the toxin develops in spoiled sausages under anaerobic conditions (Erbguth and Naumann, 1999). Thus he suggested that sausages should be boiled long enough, stored under aerobic conditions, and bad parts should not be consumed. He also concluded that sausage poisoning is a result of the toxin acting on the motor nervous system and the autonomic nervous system, and the toxin is lethal in small doses (Erbguth and Naumann, 1999). In addition to these conclusions, Kerner also discussed the idea of a therapeutic use of this toxin. In the final chapter of his 1822 monograph, he concluded that in very small doses, the toxin could decrease or block the hyperactivity of the sympathetic nervous system, which at the time covered all nervous functions (Kerner, 1822 cited in Erbguth and Naumann, 1999). He cited St. Vitus dance (Sydenham's chorea), and hypersecretion of body fluids such as sweat or mucus as candidates for treatment with the toxin. As will be discussed later in this paper, some of Kerner's predictions are now a reality.

Botulism Research in the Late 19th and Early 20th Century

After Kerner, botulism research continued such that in 1870 a German physician named Müller referred to the sausage poisoning as "botulism" from the Latin word botulus, which means sausage (Erbguth and Naumann, 1999). However it wasn't until 1895 in Ellezelles, Belgium that Emile Pierre van Ermengem identified *Clostridium botulinum* as

the organism responsible for botulism poisoning (van Ermengem, 1979). The organism was isolated after an outbreak of contaminated preserved ham. Over the next twenty years, scientists realized that there were different strains of *C. botulinum* and these different strains produced serologically distinct types of botulinum toxins (Burke, 1919 cited in Carruthers, 2002). In fact these different toxins were classified according to an alphabetic system, i.e., types A through G. The type A toxin is the most potent and most commonly affects humans. In the 1920s, botulinum toxin type A was isolated in crude form. Attempts at purifying this isolate were first made by Dr. Herman Sommer at the University of California, San Francisco (Snipe and Sommer, 1928 cited in Carruthers, 2002), but it wasn't until 1946 when Dr. Edward Schantz isolated pure crystalline botulinum toxin type A at Camp Detrick in Maryland. Interestingly, this research began towards the end of World War II and was driven by the potential use of this toxin as a chemical weapon (Schantz and Johnson, 1997). The 1950s brought initial insights into the mechanism of action of botulinum toxin type A when Dr. Vernon Brook provided evidence that it blocked the release of acetylcholine from the presynaptic membrane of motor end plates (Schantz and Johnson, 1997).

From Poison to Therapy

As botulism research advanced and the toxin became better understood, it was realized that this toxin could be employed to selectively paralyze muscles and minimize muscle spasms. A pivotal individual in the transition from botulinum toxin the poison, to botulinum toxin as a therapy was Dr. Alan Scott. Dr. Scott was an ophthalmologist in search of a nonsurgical treatment for strabismus (eye muscle disorder), and this brought him into contact with Dr. Schantz who had a pure crystalline form of botulinum toxin type A. This collaboration eventually led to the nonsurgical treatment of strabismus. Dr. Scott began with experiments in monkeys in the 1960s and 1970s, and later performed clinical trials on humans with strabismus in 1977-78 (Carruthers, 2002). In 1980 Scott published the results of these clinical trials in a landmark paper that was the first to show the safety and efficacy of botulinum toxin type A in treating human disease (Scott, 1980). Specifically he showed that intramuscular injections of the type A toxin could selectively paralyze extraocular muscles and correct gaze misalignment in strabismus (Scott, 1980). However, it wasn't until 1989 that BOTOX[®] (Allergan, Inc.) was approved by the Federal Drug Agency for clinical use in eye muscle disorders (Botulism Toxin, 2004). It is worth noting that BOTOX[®], Allergan's formulation of botulinum toxin type A is not the only formulation available. The other type A formulation is called DYSPORT and is produced by Ipsen in Berkshire, England. However DYSPORT is not available in Canada or the U.S, so any further references to the clinical use of botulinum toxin type A in this paper will correspond to Allergan's formulation.

The use of BOTOX[®] in the treatment of cosmetic disorders was first realized in the mid-1980s, when a patient being treated for blepharospasm with botulinum toxin type A reported the smooth, relaxed appearance she had after intramuscular injections given in the glabellar area (Carruthers, 2002). The treating physicians, Dr. Alastair and Jean

Carruthers pursued this finding, and began treating wrinkles in the glabellar and crow's feet area with BOTOX[®]. They published the first systematic study on the use of botulinum toxin type A in the treatment of glabellar lines in 1992 (Carruthers and Carruthers, 1992). A full decade later, the U.S. Food and Drug Administration (FDA) approved BOTOX[®] injection treatments for cosmetic use in April of 2002. Since this approval, the number of BOTOX[®] injections and, therefore, BOTOX[®] sales have risen exponentially. According to the American Society for Aesthetic Plastic Surgery, in the U.S. in 1997 only 65,000 cosmetic procedures involving botulinum toxin type A were performed, whereas in 2002 after FDA approval there were 1.6 million such procedures (BOTOX[®] Cosmetic Surgery, 2004). Not surprisingly, BOTOX[®] sales in the U.S. totalled \$310 million in 2002 (BOTOX[®] Cosmetic Surgery, 2004).

Current Applications of BOTOX[®] Therapy

Although BOTOX[®] use in the treatment of cosmetic disorders may generate the most revenue and receive the greatest media attention, the application of this drug extends far beyond the treatment of facial wrinkles. In fact, the list of conditions for which BOTOX[®] has been shown to be an effective form of treatment is quite large. A few examples of such conditions include focal dystonias such as blepharospasm and cervical dystonia, extraocular muscle disorders such as strabismus, and other disorders of involuntary muscle contraction such as Parkinson's and cerebral palsy (Carruthers, 2002). Also on this list are migraine headaches, hyperhidrosis (excessive perspiration), and the aforementioned facial wrinkles. For many of these conditions the evidence in support of treatment with botulinum toxin type A is derived from case reports and thus their use is considered off-label, i.e., not FDA approved (Carruthers, 2002). However, there are a few conditions for which FDA approval has been issued, or for which clinical trials are in progress. Unfortunately this list is small, but includes eye muscle disorders such as strabismus and blepharospasm, facial wrinkles, migraine headaches, and hyperhidrosis.

One could easily write a novel on the plethora of applications of botulinum toxin therapy. Instead, the most common and most interesting applications will be discussed in the remaining section of this paper. These are facial wrinkles, and migraine headaches respectively.

BOTOX[®] as a Cosmetic Therapy

As discussed above, the cosmetic application of BOTOX[®] was first realized when patients being treated for blepharospasm reported a smoother, more relaxed appearance to their forehead. Since most facial wrinkles are caused by repeated muscle contraction, and botulinum toxin type A can produce weakness or paralysis of these muscles, it is entirely logical that such treatment would remove facial wrinkles. The disappearance of wrinkles is only temporary as the effect wears off after approximately four months (Carruthers, 2002). However as the number of treatment sessions increases, the duration of the effect increases, and there is a low incidence of side effects (Carruthers, 2002). Clinical effects

may be observed after one to two days, peak in one to four weeks, and as mentioned previously, decrease after three to four months (Carruthers, 2002). Major cosmetic indications for BOTOX[®] therapy in the face include glabellar frown lines (result of persistent frowning), crow's feet around the eyes (result of persistent squinting), and horizontal lines of the forehead (Carruthers, 2002). Some intermediate and minor applications include lines along the side of the nose, chin dimpling, lip lines, and corners of the mouth (Carruthers, 2002).

Some of the common side effects from treatment of facial wrinkles include excessive weakness of the treated muscle and/or local diffusion of the toxin from the site of injection, causing undesired weakness in nearby muscles (Carruthers, 2002). Such adverse effects are all mild and not permanent, i.e., they disappear after three to four months as the drug effect decreases. Contraindications to the use of BOTOX[®] include pregnancy or the presence of any neuromuscular disorder, such as myasthenia gravis that may amplify the effect of the drug (Carruthers, 2002). The simplicity of BOTOX[®] treatment and its low incidence of side effects make this nonsurgical method for treating hyperfunctional facial lines very appealing.

BOTOX[®] in the Treatment of Migraine Headaches

The use of BOTOX[®] in the treatment of migraine headaches was realized in much the same way as its application to facial wrinkles. During initial clinical trials of BOTOX[®] therapy for hyperfunctional facial lines, patients with concomitant migraine headache symptoms reported a relief of these symptoms upon receiving pericranial BOTOX[®] injections (Carruthers, 2002). This incidental finding led to a multicenter, nonrandomized, open-label study to determine whether the relationship would hold true. This open-label study showed that 51% of the "true migraine" subjects treated prophylactically with botulinum toxin type A reported a complete response with a mean benefit duration of 4.1 months (Binder et al., 2000). Following this trial, two double-blind, placebo controlled studies of BOTOX[®] treatment for migraines were initiated. Both of these double-blind trials found that BOTOX[®] therapy was more effective than placebo in treating migraine headaches. However they appear to have conflicting results regarding optimal dose. The study carried out by Silberstein et al. found that 25 units of BOTOX[®] had a greater effect than 75 units (Silberstein et al., 2000), whereas the study carried out by Brin et al. observed a treatment effect only for 75 units of BOTOX[®] (Brin et al., 2000). This seems to be the current roadblock with regard to FDA approval of BOTOX[®] use in treating migraines.

Conclusion

Since the initial reports of botulism poisoning over 200 years ago, research in this area has seen a shift from characterizing the toxic substance to understanding its clinical efficacy. The godfather of botulism research, Justinus Kerner, first realized the clinical potential of this toxin in 1822 when botulism research was still in its infancy. He

hypothesized that when given in small doses, the agent responsible for “sausage poisoning” would decrease or eliminate the hyperactivity of the sympathetic nervous system seen in conditions such as St. Vitus Dance, and hypersecretion of body fluids. These predictions have become a reality as botulinum toxin type A is used in many disorders of inappropriate muscle contraction, and its use in the treatment of hyperhidrosis is currently in phase III clinical trials (BOTOX[®] Cosmetic, 2004). The future of botulinum toxin therapy promises a number of novel therapeutic applications, and improved drug formulations to further decrease the probability and number of adverse treatment effects.

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HOLMES AND HOMEOPATHY

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ABSTRACT

In 1842, the physician and poet Oliver Wendell Holmes lectured on “Homeopathy and Its Kindred Delusions” to the Boston Society for the Diffusion of Useful Knowledge. He presented meticulous and well-reasoned rebuttals to the principal tenets of homeopathy, using logic and humour that still ring true today.

Given Holmes’ impeccable arguments against it, why did homeopathy remain so popular? Why is it still so popular today? The examination of nineteenth century medicine and the contemporary resurgence in popularity of complementary and alternative medicine yield considerable insight into Holmes’ inability to unseat homeopathy with scientific objectivity. There appears to be a flaw in Holmes’ objective approach; a flaw possessing a lesson for today’s aspiring medical practitioners.

Oliver Wendell Holmes Sr. was a respected poet, physician, and the first Dean of Harvard Medical School. He was a progressive thinker, pioneering the use of the stethoscope in the United States and promoting sanitary practice to prevent “child-bed fever” in the face of considerable resistance from the medical establishment (Felts 2002). As Dean, he tried unsuccessfully to admit women and African Americans to the school. Many of his ideas eventually came to fruition, but it is also particularly illuminating to examine one that did not.

In 1842, Holmes lectured on “Homeopathy and Its Kindred Delusions” to the Boston Society for the Diffusion of Useful Knowledge. He presented meticulous and well-reasoned rebuttals to the principal tenets of homeopathy, using logic and humour that still ring true today. Yet despite Holmes’ convincing arguments against homeopathic theory, homeopathic practice remained popular and continues to this day.

One recent clinical trial suggests that homeopathy may have significant therapeutic effects that stem not from its remedies, but from its method of probing at length for every symptom and its effect on the life of the patient (Bonne et al. 2003). Though the evidence from this trial is far from definitive, it is interesting to note that this homeopathic method is an example of the personalized and “holistic” aspect of complementary and alternative

medicines (CAMs), an aspect that is often cited as the reason for the popularity of CAM therapies.

Holmes was rather exhaustive in his examination of the principles of homeopathy, but he scarcely acknowledges homeopathy's unique history-taking methods. The last part of this paper hypothesizes the reasons for his dismissal of those methods via an examination of Holmes' 19th century cultural milieu.

An understanding of the basis and principles of homeopathy is necessary to appreciate Holmes' lecture. Homeopathy was founded by a German physician named Samuel Hahnemann (1755-1843). Hahnemann had abandoned his practice because he was disillusioned with medical treatments of the time, such as bloodletting, which he felt were doing more harm than good (Blackie 1986). He had worked as a scientific translator before he practiced medicine, and he subsequently returned to this career. In the course of translating a pharmaceutical text, he became interested in the mechanism of action of cinchona bark against malaria. Unconvinced by the original author's assertion that cinchona acted as a tonic on the stomach, he experimented on himself and found that the cinchona caused in him all the symptoms of malaria but without the fever (Blackie 1986).

From this he developed the Law of Similars, which he first published in 1796: *similia similibus curantur*—like cures like (Blackie 1986). According to this principle, a drug that causes particular symptoms in a healthy person will cure a disease that has similar symptoms; for instance, onions should be a cure for hay fever.

Hahnemann then noticed that an undiluted remedy would often aggravate symptoms before a cure was achieved, but that this was alleviated if he diluted the drug and shook it vigorously at each step in the dilution (Blackie 1986). From this observation, he developed the Law of Dynamization or Infinitesimal Dose. He believed that as the degree of dilution increased, so too did the potency. Dilution was achieved by a series of steps in which one drop of the remedy is mixed with 99 drops of alcohol, then one drop of this mixture is mixed with 99 drops of alcohol, and so on, such that by the third dilution the remedy is one millionth of its original concentration. This third dilution is considered less potent than, for instance, the twelfth dilution, at which point the remedy is one quadrillionth of its original concentration.

Hahnemann's third principle (which was never widely accepted by homeopaths) was that at least 7/8 of chronic diseases result from *psora*, or itch which has been internalized after being treated with non-homeopathic remedies (Holmes 1883).

Many people in the medical and scientific community object to these principles. Of course, these objections arose at the same time as homeopathy and have continued to this day. Holmes delivered his objections nearly fifty years after Hahnemann first published

his findings. In his lectures, he uses logic to refute the principles of homeopathy and to point out the ridiculousness of many of the “proofs” of its efficacy. Not all of his arguments can be detailed here because the lectures were fairly lengthy. Arguments have been selected that are particularly amusing or convincing. Also, some of the reasoning he argued against is still present, not only in today’s homeopathic literature, but in certain aspects of orthodox medical practice.

Holmes declines outright to address the third principle—that chronic disease is the result of itch being driven internally by the application of topical ointments—owing to the fact that it was really never accepted by anybody except Hahnemann (Holmes 1883). Holmes found that controversy about this principle has not even caused any rifts within homeopathic practice because it has no practical application.

Holmes addresses the second principle first—the idea of the power of the minute dose. He presents what he calls “simple arithmetical computations, level to the capacity of any intelligent schoolboy” (Holmes 1883, 52) to place the principle of the infinitesimal dose into perspective. If the entire drop of the original remedy were to be retained rather than 99/100ths being discarded at each dilution, “By the time the seventeenth degree of dilution should be reached, the alcohol required would equal in quantity the waters of ten thousand Adriatic seas. Trifling errors must be expected, but they are as likely to be on one side as the other, and any little matter like Lake Superior or the Caspian would be but a drop in the bucket” (ibid., 53).

Holmes spends the rest of the lecture addressing the “like cures like” principle. He says that if it is to be “the sole law of nature in therapeutics,” as Hahnemann claimed it to be, it must meet three conditions:

1. That the symptoms produced by drugs in healthy persons should be faithfully studied and recorded.
2. That drugs should be shown to be always capable of curing those diseases most like their own symptoms.
3. That remedies should be shown *not* to cure diseases when they do not produce symptoms resembling those presented in these diseases. (ibid.)

And so he first examines Hahnemann’s pharmaceutical text, the *Materia Medica*. Hahnemann assembled this text by administering remedies to friends and family and interrogating them extensively about their symptoms, and also by searching for symptoms alluded to in historical literature. Thusly, Hahnemann produced a text including 64 substances, with the number of symptoms assigned to each one ranging between 97 and 1491 (ibid.).

Holmes quotes randomly some of the reported symptoms: “After stooping some time, sense of painful weight about the head upon resuming the erect posture” and “An itching,

tickling sensation at the outer edge of the palm of the left hand, which obliges the person to scratch” (ibid., 58). Holmes then comments:

I have not cited these specimens with any view of exciting a sense of the ridiculous...but to show that the common accidents of sensation, the little bodily inconveniences to which all of us are subject, are seriously and systematically ascribed to whatever medicine may have been administered, even in the minute doses I have mentioned, whole days or weeks previously. (Ibid., 59)

He points out the inability of several non-homeopathic physicians to reproduce the symptoms recorded by Hahnemann. And he mentions a challenge offered to the best-known homeopathic physician in Paris in 1835: To blindly choose one remedy out of ten that supposedly had the most striking effects, to try it upon himself, and to identify it from the symptoms he experienced. “The challenge was at first accepted, but the acceptance retracted before the time of trial arrived” (ibid., 62).

Holmes then states: “From all this I think it fair to conclude that the catalogue of symptoms attributed in Homeopathic works to the influence of various drugs upon healthy persons are not entitled to any confidence” (ibid., 62).

To evaluate the second condition, that drugs should always be capable of curing the diseases whose symptoms they most resemble, Holmes looks first to Hahnemann’s interpretation of historical texts that supposedly proved that all cures ever effected were based on the like cures like principle.

Holmes found that Hahnemann quoted, misquoted, and mistranslated many sources both credible and incredible. However, this is not what he finds most worrisome. He states:

Even if every word he had pretended to take from his old authorities were to be found in them, even if the authority of everyone of these authors were beyond question, the looseness with which they are used to prove whatever Hahnemann chooses is beyond the bounds of credibility. (Ibid., 65-66)

Holmes then cites one example in which Hahnemann quoted that rose-water, which can cause some persons to faint, has been seen in literature to have been used to revive a person from a faint. He asks:

Is it possible that a man who is guilty of such pedantic folly as this,—a man who can see a confirmation of his doctrine in such a recovery as this—a recovery which is happening every day, from a breath of air, a drop or two of water, untying a bonnet string, loosening a stay lace, and which can hardly help happening, whatever is done—is it possible that a man, of whose pages, not here and there one, but hundreds upon hundreds are

loaded with such trivialities, is the Newton, the Columbus, the Harvey of the nineteenth century! (Ibid., 66)

Holmes next debunks one of the commonly employed illustrations of homeopathic law that of frozen body parts being treated with snow. He points out that in fact the snow is warmer than the frozen part, so it is not so much a matter of freezing being treated with cold but freezing being treated with gradual warmth.

He then proceeds to examine the state of evidence of the efficacy of homeopathic medicine. He dismisses the testimony of what he calls “the unprofessional public,” because they don’t have an understanding of the natural course of disease with which to compare their recovery. He next examines the use of mortality statistics—a use which he points out to be accepted by homeopaths when the statistics favour their methods, but scorned by them otherwise.

No longer ago than yesterday, in one of the most widely circulated papers in this city, there was published an assertion that the mortality in several Homeopathic Hospitals was not quite five in a hundred, whereas, in what [are] called by the writer allopathic hospitals, it is said to be eleven in a hundred. An honest man should be ashamed of such an argumentum ad ignorandam...Other things being equal, it must always be expected that those institutions and individuals enjoying to the highest degree the confidence of the community will lose the largest proportion of their patients; for the simple reason that they will naturally be looked to by those suffering from the gravest class of diseases...When, therefore, Dr. Muhlenbein, as stated in the “Homeopathic Examiner”...asserts that the mortality among his patients is only one percent since he has practised Homeopathy, whereas it was six percent when he employed the common mode of practice, I am convinced by this, his own statement, that the citizens of Brunswick, whenever they are seriously sick, take good care not to send for Dr. Muhlenbein! (Ibid., 73-74)

It is interesting to note that much of today’s homeopathic literature still uses these 19th century mortality statistics to make the case for the efficacy of their remedies. Perhaps more disturbing is the adoption of policies in some states in the U.S. of publishing the mortality rates of all hospitals so that patients can choose the “best” hospitals at which to receive treatment based on their lowered risk of mortality at said hospitals. It seems a dose of Holmes’ logic in this area might be good medicine indeed:

It is always a miserable appeal to the thoughtlessness of the vulgar, to allege the naked fact of the less comparative mortality in the practice of one hospital or of one physician than another, as an evidence of the superiority of their treatment. (Ibid., 73)

Holmes next quotes the cases reported in homeopathic journals, one of which follows:

Dr. Munneche of Lichtenburg in Saxony is called to a patient with a sprained ankle who had been a fortnight under the common treatment. The patient gets well by the use of [homeopathic remedy] in a little more than a month longer, and this extraordinary fact is published in the French 'Archives of Homeopathic Medicine.' (Ibid., 77)

Holmes then details numerous trials conducted by renowned physicians of the day that had shown no effect of homeopathic remedies (it is worth noting at this point that the evidence-based status of homeopathy today is that it shows no more effect than placebo in most trials). He outlines the response of the homeopathic community to these trials, which is dismissive regardless of the trial design. He then says:

In the view of these statements, it is impossible not to realize the entire futility of attempting to silence this asserted science by the flattest and most peremptory results of experiment. Were all the hospital physicians of Europe and America to devote themselves to this sole pursuit, and were their results to be unanimous as to the total worthlessness of the whole system in practice, this slippery delusion would slide through their fingers without the slightest discomposure, when, as they supposed, they had crushed every joint in its tortuous and trailing body. (Ibid., 82)

As to the third condition—that remedies must not cure diseases whose symptoms they do not resemble, Holmes states, “The burden of this somewhat comprehensive demonstration lying entirely upon the advocates of this doctrine, it may be left to their mature reflections” (ibid., 82).

So, the question arises: if none of its principles make sense and many of its “proofs” are fairly ridiculous, why was homeopathy popular then and why is it still popular today? Holmes seems to have attributed it to unscrupulous or unknowledgable practitioners duping an easily duped public and sometimes themselves. While this may well be the case, or part of it, it is useful to examine the differences between homeopathy and the 19th century medical practice that was Holmes’ milieu.

During the 19th century, medicine was evolving into an objective and analytical science that had no need to examine the nuances of each patient (Porter 1997). Diseases were entities unto themselves, best diagnosed by the newly invented stethoscope and techniques such as percussion, and confirmed by autopsy. The patient’s account came to be seen as unreliable and extraneous, and the idea of the medical gaze emerged: a detached, objective clinician reducing a patient to a diseased organ or tissue (Porter 1997).

Hahnemann, on the other hand, gave the following instructions for history-taking:

The physical constitution of the patient is to be taken into consideration, as well as his occupation, his mode of living and habits, his domestic relations, his age, his sexual functions, and so on. The unprejudiced observer notices only those deviations from the former healthy state of the now diseased individual which are felt by the patient himself, remarked by those around him, and observed by the physician. All these perceptible signs represent the disease in its whole extent. That is, together they form the true and only conceivable portrait of the disease. (Blackie 1986, 5-6)

Hahnemann's chief instructions on how to take a case are to listen to the patient and not interrupt with questions until he is finished. He emphasized that the doctor needs to be attentive to the symptoms which are peculiar to and characteristic of the patient, rather than being obsessed with symptoms characteristic of the disease (Blackie 1986).

The U.K. allopathic medical professor Conrad Harris, in his foreword to a current homeopathic text, disavows homeopathic remedies, but argues that conventional doctors have much to learn from the method in which homeopaths approach the therapeutic task (Swayne 1998). As mentioned previously, this method is the subject of current investigations into the clinical effects of homeopathy, and is likely one of the reasons for homeopathy's enduring popularity.

Therefore, there seems to be something missing from Holmes' argument. He mentions the topic of patient individuality and Hahnemann's approach to it only once. In discussing homeopathic principles, he remarks, "The symptoms of any complaint must be described with the most minute exactness, and so far as possible in the patient's own words" (Holmes 1883, 47). This is Holmes' sole comment on the topic, though he exhaustively works through all of the theoretical principles. It is as if he took no notice of it at all, found it completely irrelevant, and given the medical culture of the time, one can hardly be surprised.

It is not the intent of this paper to retrospectively chastise Holmes for (possibly) being influenced by a subtle cultural bias, but rather to take a lesson from that possibility. It is very difficult, if not impossible, to be truly objective. We can only examine "objectively" that which we have subjectively decided is worthy of examination. Our subjective frameworks are constructed in part by the culture we are part of—a culture from which we cannot divorce ourselves. The scientific and medical communities wield a lot of power and influence, and so it behooves us to at least attempt to stay aware that we are being influenced by pervasive cultural biases that contribute to our subjectivity.

Holmes can serve to both raise the question and act as a role model in this regard; he was clearly able to critically evaluate dominant cultural biases in his fight for the rights of women and African Americans, and in his advocacy for sanitary practice during childbirth. Hence, it is both ironic and instructive to note that more than 150 years after

Holmes' lectures, Harvard's current Dean, Joseph Martin, argued for renewed study into complementary and alternative medicine by drawing an analogy between the resistance against those medical traditions and that, faced by Holmes, against hand-washing at the child-bed (Martin 2001).

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PLACEBO: MEDICINE FOR DUMMIES

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ABSTRACT

The term ‘placebo effect’ was coined in the 1950’s when it was observed that the health of patients given sugar pills would often improve. It has since been proposed that the placebo acts as a sort of psychotherapy. It is the experience of healing, caring and attention that a patient receives from a doctor which translates into a positive physiologic response.

Many ancient remedies seem to have taken advantage of the placebo effect. Just 50 years ago, a revolutionary medical therapy called ‘Lidya’s Pink Medicine’ began sale on the market, promising to treat any problem ailing women. Excessive menstrual bleeding? Joint pain? Yeast infection? Never fear... Lidya was there.

In retrospect, it seems absurd to claim that a single potion could cure all types of ailments that are so physiologically diverse. And yet, through history there are numerous examples of therapies that were believed to be effective for a wide range of purposes. In fact, before 1963, US pharmaceuticals only had to prove their drug was safe, not that they were effective! Just imagine how many useless remedies were sold purely on their promises to heal all disease- propaganda that just may have stirred up enough of the placebo effect to make the person believe it was worth the 12¢ a bottle.

Through my presentation, I hope to explore some dubious historical remedies which, oddly enough, were regarded as the holy grail during their heyday. You’ve just entered the world of the *placebo effect*.

In recent years there has been much discussion surrounding the existence of the placebo-effect. Initial studies in the 1950’s suggested the placebo effect accounted for 30% of the effect of a drug (Beecher, 1955). Patients on placebo exhibited increased brain activity and increased release of endorphins. But despite these findings, there has been more recent evidence that the placebo is only a mild pain-killer that has little ability to alter other physiologic processes and disease. So is taking a placebo worthwhile? People throughout history seem to think so. There are numerous examples of ancient remedies which seemed to be effective despite our current knowledge that these remedies have no

physiological effect. One possible explanation for their success is the placebo effect—that is, a person’s health improved simply because they expected it to. In this paper, I will review the evidence for and against the placebo effect and then offer some examples of historical placebos. It is my aim to demonstrate that placebos have been an integral part of medicine since the beginning of time, even though the placebo-effect itself may be very minute.

Evidence in Support of the Placebo Effect

Brody (1982) has defined the placebo effect as “The change in the patient’s condition that is attributable to the symbolic import of the healing intervention rather than to the intervention’s specific pharmacologic or physiologic effects” (Jospe, 1978). The term placebo effect exploded into the academic world in 1955 when Beecher published his famous paper *The Powerful Placebo*. Through a meta-analysis of 26 clinical trials, Beecher showed that the placebo-effect was responsible for approximately 32% of a drug’s healing power. This study continues to have an immense impact on how society views the placebo. Even today, many student pharmacists are taught that the placebo is responsible for one-third of a drug’s effect.

Following Beecher’s study, many more placebo studies were conducted. In one study, two groups of patients were given a sugar pill. One group was told it was a stimulant, and sure enough, their pulse rate and BP increased. The other group was told it was a tranquilizer and these people experienced the physiological effects of tiredness in addition to a lowered pulse and BP (Jospe, 1978).

In other studies, placebos were shown to cause side-effects, particularly vomiting. Most commonly, these side-effects were pre-existing symptoms that became worse when taking a placebo (Shapiro, 1997). Perhaps even more astonishing are some case reports which describe some patients becoming addicted to placebos (Rich, 2003).

Evidence Disputing the Placebo Effect

Despite the significant volume of evidence in support of the placebo-effect following Beecher’s study, there is a more recent school of thought that argues this effect is very small. This group argues that patients enter studies when they’re feeling the worst. This is either because patients are trying to seek medical attention (and then enrolled in a study), or because investigators seek out sick patients to try and demonstrate a maximal effect of their drug. Unfortunately, this introduces a selection bias. It makes placebos seem more effective than they really are because the natural histories of most diseases show fluctuation such that when people are at their sickest, they will often become better *regardless of therapy* (Hrobjartsson & Gotzsche, 2001). This is the theory of regression to the mean. If people are entered into the study at their worst, their symptoms will invariably regress to the mean.

The problem is that few studies have both a 'no treatment' and 'placebo' group to compare between. This is the only way to differentiate between a placebo-induced affect & simply an upstroke in the natural history of the disease.

Hrobjartsson & Gotzsche (2001) realized this and so they analyzed 114 randomized controlled clinical trials that included both a 'placebo' group and a 'no treatment' group. In most of the healing modalities studied, they did not find that the placebo group improved in comparison to the no treatment group, and hence, concluded that the placebo effect is very small if it exists at all.

The Current View on Placebos

Currently, most experts view placebos as being able to cause some pain relief and perhaps an improved feeling of wellness, but not a powerful force capable of altering physiological processes. Even Hrobjartsson & Gotzsche (2001) admit that the placebo group experienced pain relief in comparison to the no treatment arm. They estimated that the pain relief was 1/3 as effective as NSAIDs (we can tell Tylenol & Motrin they won't go out of business just yet!). However there may be more to the placebo than just pain relief. After all, Hrobjartsson & Gotzsche's study may not have been large enough to demonstrate a small but statistically significant placebo effect. Based on the number of successful ancient remedies that have no proven physiological effect, this would seem to be very likely.

Historical Remedies and the Placebo-effect

For the remainder of this paper, I will discuss some historical remedies which seemed to be effective despite our current knowledge that these remedies had no physiological effect. Why were they effective? Well, one explanation is the placebo effect. In his book *The Powerful Placebo*, Shapiro (1997) claims that "until recently, the history of medical treatment was essentially the history of the placebo effect." Of course, this is not strictly correct since many ancient remedies such as digitalis, withering, and opium have proven physiologic influences (Koren, 1998). And yet, many old therapies were probably just placebos. One just has to remember that before 1963, US pharmaceuticals only had to prove their drug was safe, not that they were effective! (Jospe, 1978) One can only imagine how many ridiculous therapies were sold under the umbrella of the placebo-effect.

The cure-all "glyoxylide"

In 1919, Dr. Koch discovered a potion that could cure any known disease including cancer, tuberculosis and leprosy. This so called 'catalyst' could cause complete recovery in 80 per cent of cases by churning the body into such a fury that the body would manufacture its own remedies. By the 1940's Koch was collecting \$25 per injection and earning an estimated annual income of \$100,000. It wasn't until 1943 when government

chemists studied the fluid that it was revealed for what it really was: a simple placebo. These chemists testified that the potion was in fact indistinguishable from distilled water. And despite this evidence, many people continued to believe in Koch's medicine though he was banned from advertising it as a cure in the US (Gardner, 1957).

“Vrilium” radiation therapy

Another medication that could only have been successful via the placebo effect is Dr. Kay's vrilium. It is a mysterious substance that projects radioactive waves. During the twenties, a business man by the name of Robert Nelson sold small brass cylinders containing vrilium that could be worn about the neck. Nelson claimed that it could radiate for 20 ft and kill bacteria and germs in and around the body. The cylinders were sold for \$300 each and created a frenzy among the rich. The former mayor of Chicago wore one and he is quoted saying, “I don't pretend to know how it works, but it relieves pain. It has helped me and my wife.” In 1950, the US government took action against the company and testing revealed that the cylinders contained nothing but cheap rat poison. Ever the businessman, Nelson's response was, “I believe we have an unrecognized form of radioactivity” (Gardner, 1957).

Brown-Sequard Elixir: The Fountain of Youth

In the 1850's, Brown-Sequard invented an elixir from the testicular blood and seminal fluid of dogs and guinea pigs. After a very precise method of preparation including maceration and mincing, the elixir was injected into the blood. Brown-Sequard claimed that it improved mental concentration, induced greater physical strength and endurance, and increased sexual function. This medication became instantly popular, largely through the press, and for a time was used throughout the world. Clearly this potion must have been placebo. After all, the study which purportedly demonstrated its effectiveness included only one subject! What's more is the subject, the inventor, and the data-analyzer were all Brown-Sequard! Sure enough, the popularity of the elixir eventually waned (Heather Eliason, 1999), proving that the placebo effect can only carry a drug so far!

Blood Letting

This therapy is perhaps the most profound example of a placebo simply because it was so universally practiced and lasted for so long. Blood letting dates back as far as the Stone Ages and only died out as late as the 19th century (Brain, 1986). Medical paradigm during this period considered one's health to be a balance of the four humors (phlegm, yellow bile, black bile, blood). Sickness was often interpreted as having an excess of blood, so it was drawn out to restore balance. Some physicians actually viewed it as being capable of curing absolutely any illness. Perhaps even more absurd is that some physicians considered pregnancy to be one of the indications in the early 19th century. At this time pregnancy and the coinciding cessation of menstruation was considered

abnormal, so blood letting was performed (Kerridge, I.H. and Lowe, M., 1995). With our current medical knowledge, it is difficult explain how this therapy could possibly have been effective (although some have tried). Ten points for the placebo effect!

Placebos Today

Today, placebos are used primarily as a control in clinical trials. It is no longer legal for doctors to prescribe placebos, although there are probably still placebo-like medications being used. Vitamins such as B12 and C are potential examples. Some people faithfully take 500mg of vitamin C every day even though the body can only absorb about 30mg/day!

Although doctors would rarely have use for placebos these days given the market saturation of drugs (and the availability of alternative medicine), an ethical debate still exists concerning placebo prescription. Some argue that truth-telling and doctor patient trust are important enough to negate any instance in which a placebo may be of use. On the other side of the fence there are people who believe that a placebo can be a benevolent deception in circumstances where nothing else can be done or in some psychogenic conditions where medication is not actually required (Jospe, 1978). At least for now, truth-telling has been the choice of the medical profession. And yet, every time a doctor prescribes a medication and then adjusts his stethoscope on his shoulders while smiling at his patient, he is in fact harnessing just a little bit of that good ol' placebo effect.

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HISTORY OF THE PROSTHETIC EYE

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ABSTRACT

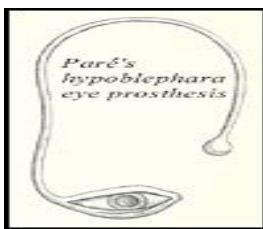
Historical the use of prosthetics for the eye can be traced back to the ancient world. In Egypt bronze and other precious stones were used to decorate the eyes of the deceased. The Romans would decorate statues with artificial eyes made of silver. It was not until the 1500's that the use of an artificial eye to fit an eye socket was described. Ambrose Pare was credited with this description. He described two types of prostheses, eklephara and hypoblephara. In the 19th century the use of a new technique brought on the creation of the enamel prostheses/glass eye. German and French craftsmen were specialists in the creation of these prostheses and thus they were creators of the glass art. Eye doctors would keep these 'stock eyes' in cabinets in a variety of sizes and colors thus the patient would be fitted with the best eye right out of a drawer. The ocular implant was used to replace the lost volume of the natural eye and the first account of placing an implant in the socket was in 1841. Due to the onset of World War II, the United States military with the help of private practitioners developed a technique of fabricating prostheses using oil pigments and plastics. At various times in history many materials have been used to create the ideal implant, some of these include: asbestos, rubber, peat, catgut, sponge, gold and aluminum. Oculo-prosthetics is a dynamic field founded on a dynamic history.

The eye has always been our window to the creation of an image. Its value in our sensory system is of great importance. Injury/insult to the eye is often seen to be critical by the medical community and society. Mechanism of injury/insult can in some cases result in change of the cosmetic appearance of the orbit. The eyes cosmetic appearance is often a sign of its ability to function as an integral part of our sense of sight. The use of prosthetics for the eye is rarely described in the historical archives of ophthalmology. In contrast though, the fascination and use of prosthetics in relation to the eye can be traced back to 1500 B.C. (1). Over the last century the advancements in enucleation and the surgical technique involved in oculo-prosthetics/implantation of a prosthetic eye has been pinnacle in the efficacy of the use of prosthetics. The use and making of the modern day prostheses emerged from Europe in the 1500's and many of the implants were refined in the 1900's by North American physicians and engineers. The progression of history in relation to the prosthetic eye can be split into three definitive periods: prior to the 19th

century, the 19th century to the onset of World War II, and post World War II. Each time period proved to be one of great advancement and the field of Oculo-prosthetics has thus proved to be dynamic and ever evolving.

The earliest record of the use of prosthetics for the eye can be traced back to Ancient Egypt. During this time period/place in history, the eye was a symbol of life and thus was endowed with the utmost of importance. From books by the church father Clemens Alexandrinus we know that the Egyptian priests had a set of 42 canonical books. The first 36 of them contained the entire wisdom of the Egyptians, while the last 6 dealt with medical topics such as parts of the body, various diseases, medical instruments, medications, as well as other medical endeavours. Of note though, is the fact that among the 6 medical texts, one dealt specifically with ocular disease.(1) In Ancient Egypt the use of prosthetics in association with the eye is found in the rituals of the community in their mourning ceremony. Bronze and other precious stones were placed on the deceased persons eyes as a representation of the importance of the eyes.(5) In addition, the Romans had also been noted to decorate statues with artificial eyes made of silver. The early history of oculo-prosthetics has a marked relationship to precious materials and it is this connection that prompts us to believe that the sense of sight held great value in the medical field and society in general.

In the 16th century the techniques used by Ambrose Pare (1510-1590) were well documented and depicted the use of an artificial eye. Pare, a famous French surgeon, was the first to report the use of an artificial eye to fit an eye socket.(2) He distinguished the prosthetic in to two types: Ekblaphara and Hypoblaphara. Ekblaphara is a type of prosthetic that is worn in front of the eyelid while in contrast Hypoblaphara is worn under the eyelids. These pieces were usually made of gold or silver and had an extension that wrapped around the posterior part of the head superior to the occiput.(5) In Bartisch text, reported cases of expiration of the eye can be found as early as the 16th century although, both of these inventions were made to be worn over an atrophic eye, as enucleation was not common practice until the 1800's.



Hypoblaphara Prosthetic Eye Piece - Ambrose Pare (5)

The history of enucleation is of integral importance and is intertwined within the history of the prosthetic eye. At Moorfields Hospital in England, between 1839 to 1848, of the 1,419 operations performed on the eye only 4 were expirations and thus the surgical technique was a rarely practiced art.(3) Jacques Rene Tenon (1724-1816) made a crucial discovery to further the technique of enucleation. Tenon discovered a fibrous capsule (Tenon's Capsule) that encapsulates the eye behind the conjunctiva. The nature of this

structure and its relation to the ocular muscles aided surgeons in developing the technique for modern day enucleation. In 1841, Ameede Bonnet (1802-1858) in France and Joseph Michael O'Ferrall (1790-1877) in Ireland simultaneously described enucleation with incorporation of Tenon's findings. Bonnet was the first to protect the soft tissues of the orbit by conserving the capsule of Tenon. A year later in Strasbourg, Victor Stroeber (1803-1872) performed an enucleation and his method was further refined and popularized by George Critchett (1817-1882) and by William White Cooper (1816-1886). Cooper who practiced at Mary's Hospital in London went on to write a book *On Wounds and Injuries of the Eye*, which was a comprehensive text devoted completely to injuries of the eye.(3)

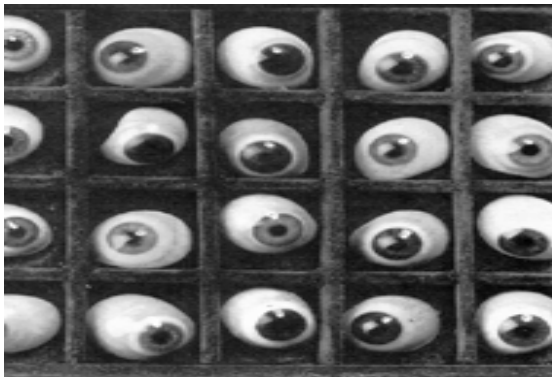
At the end of the 19th century enucleation was replaced by evisceration. Evisceration meant the complete removal of the contents of the eye, this could include the cornea, rather than total removal of the eyeball.(4) Philip Henry Mules is identified as one of the surgeons to first devise the technique of evisceration. In the operation he describes removal of the internal orbital structures with preservation of Tenon's capsule and then insertion of a hollow glass sphere in the scleral sac. A year after Mules first performed his technique, William Adams Frost (1853-1935) fine tuned Mules's method by suturing the horizontal and vertical recti over the implant thus providing the implant with greater stability. This was further advanced by William Lang (1863-1937) as he used Tenon's capsule in the closing sutures.(3) With the refinement of the surgical technique of enucleation and evisceration came the quest for the ideal orbital implant.

Enamel prostheses began the modern day search for the ideal implant. From the 1820s to the 1890s the use of enamel was commonplace. The prostheses were attractive but expensive and not very durable. Due to lack of durability when the introduction of glass implants occurred there was a sudden dismissal in the use of enamel. In 1835, German craftsmen are credited with the introduction of a prosthetic cryolite glass eye. The cryolitic glass was made of arsenic oxide and cyolite from sodium aluminum fluoride which, in combination, produces a greyish/white/yellow colour suitable for a cosmetic eye replacement.(5) In order to make these eyes a tube of glass was heated on one end until the form of a ball was obtained. The art of medicine was practiced at first hand in the creation of these implants and the intricate detail that went into each prosthetic was definitive and elaborate. The natural colours of the patients' eyes were imitated by using specific paintbrushes to paint various combinations of colours on to the prosthetic eye. Glass art especially flourished in France and Germany and in these countries fabricating secrets were passed down from one generation to the next. The town of Lausche Germany was famous for its rich history in both decorative eyes used on Christmas ornaments and doll eyes and for its prosthetic arts.

By the end of the 19th century German craftsmen began to tour the United States and other areas of the world. These craftsmen would set up for several days at a time in one city after another where they would fabricate eyes and fit them to patients. The earliest account of German sales of prosthetic eyes in North America is from the mid 1850's.

Several German founded companies started making custom prostheses in New York City. Craftsmen sold eyes to regional eye care practitioners or mailed semi-custom pieces to individuals. For more custom work a patient needed to travel to Philadelphia or New York City to have a custom prostheses hand blown from scratch. Eyes were also fitted by mail order from Germany. At this point in history the implant was used for cosmetic reasons and to replace the lost volume of the natural eye. European, especially German, influence in oculo-prosthetics played a fundamental role in the advancement of a feasible implant and thus provided a medically suitable replacement for the lost volume of the eye in a fashion suitable to the public.

By the 1900's the idea of stock eyes had become popular. At the time an 'eye doctor', known today as an Ocularist, would keep hundreds of glass stock eyes in cabinets. The patient could pick an eye color and shape right out of a drawer and the Ocularist would fit the patient with an appropriate size prosthetic eye.



Stock Glass Eyes (5)

Following the onset of World War II German goods and German glass blowers became limited in North America and they stopped touring the United States. This caused an interest in fabricating techniques and thus the United States Military and private practitioners developed a technique to make a prosthesis using oil pigments and plastics.(5) In addition, Ophthalmologists had a renewed interest in the reconstruction of the anophthalmic socket in response to eye injuries during World War II.(3) The desire to invent an ocular prosthesis that allowed for better mobility was strong. Albert D. Ruedemann Sr. (1897-1971) and Richard C. Troutman (b.1922) succeeded in this effort and the use of plastics has become the material of choice for the artificial eye.

Over the last 200 years many different materials have been used in the creation of the prosthetic eye. A large list of experimental materials can be composed of which a few include: glass, gold, aluminum, celluloid, sponge, cotton, asbestos, wool, silver, rubber, silk, catgut, peat, wire, agar, bone, fat, petroleum jelly, and paraffin. Today most ocular prostheses are made of acrylic (plastic) because this material can withstand wide temperature fluctuations, and is lightweight and unbreakable.(5)

The history of the prosthetic eye is still evolving today and it is clear that from its deep-rooted history there still exists the quest to find the ideal implant. Recently, Canadian researchers in Toronto unveiled a robotic prosthetic eye that does everything a natural eye does except offer the gift of sight.(6) The artificial eye was invented to provide a cosmetic solution to patients who have lost an eye to disease or an accident. The robotic eye is driven by a tiny motor that moves the orbit in response to signals from the brain that are picked up via electrodes on each side of the head.

In conclusion it is hopeful that the future of oculo-prosthetics is filled with new discoveries. With a history rich in innovation, the foundation of oculo-prosthetics is solid and provides great insight to the evolution of the prosthetic eye. Through each of the three time periods distinct to the history of the prosthetic eye came a new advancement. Prior to the 19th century came the introduction of prosthetics in treatment of an atrophic or unviable eye. Following this time period great gains were made in refining surgical techniques involved in evisceration and enucleation surgeries. Also, the introduction of the glass prostheses was of significant importance. In conjunction to the onset of World War II, the hunt for a better prosthetic produced the plastic orbital prostheses that proved to provide improved motility in comparison to its glass counterpart. These advancements have opened the doors to further refinement and the pursuit of an ideal implant.

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A HISTORICAL REVIEW OF THE METHODS FOR CORRECTING REFRACTIVE IMPAIRMENTS: PATIENT CARE OR TECHNOLOGICAL ADVANCEMENTS

By

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ABSTRACT

Visual impairments, especially refractive errors, constitute one of the most common needs for external aids in the human population. Advancements in both the pathophysiology and treatment of refractive errors have been substantial however none has offered the promise for a permanent solution or created so fear as laser surgical techniques. This paper will; 1) review the history of techniques for treatment of refractive errors; 2) review the complications and safety of laser technology and; 3) explore some of the ethical issues facing the future laser refractive surgery.

Glass lenses designed to increase magnification in the Roman times constituted the first attempt for visual correction and eventually such lenses evolved into wearable spectacles in the 13th century. The concept of a corneal lens placed directly on the eye fueled the advancements of contact lenses and represented a solution for the cumbersome nature of glasses. However, the concept of a surgical procedure that would permanently reshape the cornea was always being explored as a potential permanent “cure” for refractive errors. Computer and technological advancements in microsurgery in the 1970s initiated a strong interest in refractive surgery techniques. Manual surgical incisions to change the shape of the cornea provided some success, however it was not until the 1980’s with the development of laser guided technology that the possibility of a permanent solution started to become a reality. After a few short years, concerns about patient safety and a negative perception began to develop, as case reports of tragic complications began to occur more frequently. We must be aware that refractive eye surgery is an elective operation with a potential for complication. Advancements in laser surgery have been ongoing in the previous 10 years and have decreased the incidence rate for such complication. However, critical evaluation, full disclosure to the patient and ethical medical practices must be paramount in order to provide to achieve patient safety at the same pace as technological advancements.

Introduction

In the normal eye, light is refracted first by the cornea, then the lens and together causes light to be correctly reflected on the retina and proper vision achieved. The various shapes and lengths of the human eye have resulted in errors, whereby the lens and cornea fail to refract the light properly on the retina. The four common types of refractive error are: myopia, hyperopia, astigmatism and presbyopia, which affect almost 65% of the human population. In myopia, the axial length of the eye is too long, the refractive power of the cornea is too strong, and the image is focused in front of the retina. In hyperopia, the axial length of the eye is too short, the refractive power of the cornea is insufficient, and the image is focused behind the retina. Astigmatism results from the variations in the curvature of the cornea in different meridians, preventing a clear image from focusing on the retina. Presbyopia occurs with aging, due to the loss of accommodation as the lens becomes less elastic.

History of Refractive Error Procedures

Glass Lenses

The initial concept of using glass lenses to counterbalance refractive errors can be dated back to the Roman period of approximately 4 BC. The Roman, Seneca is alleged to have read "all the books in Rome" by peering at them through a glass globe of water in order to produce magnification of the words. Sophronius Eusebius Hieronymus (St. Jerome), the patron saint of spectacles is seen in a series of 15th century paintings with what appear to be spectacles. The evolution of glass lenses continued in the Venetian monk population around 1000 AD, in which they created what's called "the reading stone", referred to today as the magnifying glass. The Venetians used a segment of a glass sphere laid against reading material to magnify the letters and later constructed lenses that could be held in a frame in front of the eyes instead of directly on the reading material. The precise date from which the evolution from single glasses lenses into suitable eye wearing lenses, spectacles is unknown, however it's believed to occur around 1285 AD. Some literature suggests Salvano d'Armaneto, as the original creator in 1284AD. Credit may also go to the Chinese, as Marco Polo recorded seeing them with framed lenses, which were kept on their heads by weighted cords hanging over the ears. And there is argument from the Italians, who give credit to Alessandro di Spina who died in 1317 and whose tombstone bears the inscription 'the inventor of spectacles. Despite this uncertainty the creation of eyeglasses did not take long to gain acceptance. Bernard of Giordinion was a teacher at the medical school in Montpellier from 1285 to 1307, remarked on the major medical importance of eyeglasses (White 1998). The guild of Venetian crystal workers mentioned eyeglasses in their rules for 1300: 'Nobody in the said guild of crystal workers shall dare to buy, or cause to be bought, or sell, or cause to be sold, any work in colorless glass which counterfeits crystal; for example, buttons, handles, disks for small barrels and for the eyes...' (Lindberg 1986). "Friar Roger Bacon in 1267 remarked on a how the lens could help the elderly to read..." (White 998). Glasses for distant vision appeared around

the middle of the 15th century. "The earliest unambiguous reference to negative lenses [for myopia] is a letter sent from Ardouino da Baesse in Ferra to Piero di Cosimo de' Medici in Florence, dated 25 August 1451, noting that of four pairs of spectacles recently received, three were for 'distant vision'." (Lindberg 1986) Glasses were fashionable in the Milanese court at about that time as suggested by a letter, sent by Duke Francesco Sforza of Milan to Nicodemo Tranchedini da Pontremoli, in 1462, in which requested three dozen pairs of glasses: 'one dozen of those suitable for distant vision, that is for the young; another [dozen] that are suitable for near vision, that is for the elderly; and the third [dozen] for normal vision'." (Lindberg 1986) The earliest picture of someone wearing eyeglasses is in a portrait of Hugh of St. Cher, painted 1352 by Crivelli (Lindberg 1986) The next significant developments in spectacle making in the 16th century with the introduction of concave lenses, with quartz lenses set into bone, metal or even leather mountings, shaped like two small magnifying glasses with handles riveted together typically in an inverted V shape that could be balanced on the bridge of the nose. Benjamin Franklin in the 1780's developed the concept of bifocal lenses and the principle that is still used today. Today glasses are designed in all shapes and sizes and have been refined to use a lightweight lens.

Contact Lenses

Although glasses provide a potential solution for visual impairment they have many cosmetic and vocational limitations and therefore an alternative treatment was pursued. Leonardo da Vinci originated the concept of contact lenses in 1508, in a series of sketches of water filled device, covering the eyes and improving vision. In 1632 Rene Descartes furthered the evolution of contact lenses with a suggestion of corneal lenses. Physician Thomas Young in 1801 created the first pair of crude contact lenses by taking the small lenses from his microscope, covering the edges of them in soft wax and placing them into his own eyes. In 1827 English astronomer Sir John Herschel suggests grinding a contact lens to conform exactly to the eye's surface. It was the 1880s when Adolf E. Fick, Edouard Kalt, and F.E. Muller independently produced glass scleral shells that could be placed on the cornea that contact lenses became a possibility. Further evolution occurred in 1931, when Joseph Dallos determined that tear flow beneath the contact lens was essential for extended usage and the additions of fenestration at the cornea scleral junctions provided such flow. Polymethylmethacrylate (PMMA), developed in 1934, was the first type of plastic used for corneoscleral lenses and this material became the contact lenses of choice throughout the 1950's and 1960's. The production of first "soft" or "hydrophilic" contact lens occurred with the creation of hydroxyethylmethacrylate (HEMA), by Otto Wichterle. The 1980s and 1990's resulted in a refinement of a more user friendly design with the creation of a formulation of fluorosilicone acrylate material for rigid gas permeable (RGP) lenses that allowed for daily disposable soft contact lenses, lenses of different colors, and an ultra-violet light absorber lens.

The Search for a More Permanent Solution

If external lenses could be placed on the or near the eye is it possible to physically reshape the eye to alter the refraction and permanently correct vision? This question is the center for refractive surgery. L.J. Lans, a Dutch professor of Ophthalmology, laid out the basic principles of radial keratectomy as early as 1898. In Japan in the 1930s, T. Sato performed pioneering work with corneal incisions in the endothelia surface of the cornea as well as the epithelial surface, but the technique never advanced very far. Dr. Fyodorov of Russia is often cited as the originator of refractive eye surgery. In a case of eye trauma in the 1970's in which he was treating a boy whose glasses had broken causing corneal lacerations he made several interesting findings. Following recovery, the patient's refraction was significantly less myopic than prior to the injury and thus the hypothesis that incisions in the cornea maybe able to alter its shape and correct for refractive error and this created the field of radial keratectomy (RK). RK consists of a series of cuts in a spoke-shaped pattern around the pupil penetrating the depth of the cornea causing the perimeter to bulge out, flattening the center and changing the reflection of the light.

Laser Technology

Although manual microsurgery incisions into the cornea are difficult it provided much relief and was the surgery of choice for many years, undergoing many technological advancements in the 1980-1990s. The imprecision of performing corneal incisions with either diamond or steel knives led to interest in other methods. The use of the excimer laser begun by Charles Brau and James Ewing 1973, it consists of using two argon fluoride and krypton fluoride. It was first proposed in 1981 as a potential procedure and was suggested for use in the ophthalmology fields by Taboada, Mikesell and Reed in 1981 who performed procedures on the anterior corneal surface (Taboada, Mikesell and Reed 1981). The excimer laser uses invisible ultra-violet light to ablate the cornea during refractive surgery. This cool light laser produces virtually no damage to the surrounding tissue. Each pulse removes only a minute amount of corneal tissue, about 1/500th of the thickness of a human hair. In 1983 Stephen Trokel presented results using the potential of the excimer laser for performing photorefractive keratectomy (PRK) and correcting refractive errors on humans and the thus field of LASIK surgery was created (Trokel Srinivasan and Braren 1993). Shortly afterward the first experiments in 1985 and 1986 two companies, VISX and Summit Technology, Inc., introduced the excimer laser to the ophthalmology community of the United States and an expansion in procedures occurred.

Photorefractive Keratectomy (PRK)

PRK, was the first laser refractive surgical procedure performed in Canada. A lamellar procedure, it relies on the unique ability of the excimer laser to remove submicrometer amounts of tissue from the central region of the cornea through photoablation. The cornea

is thereby flattened and the refractive power of the eye decreased. The higher the degree of correction and the larger the treatment diameter, the more tissue that must be ablated in order to be corrected to 20/20 vision.

Laser-assisted in situ Keratomileusis (LASIK)

LASIK is a lamellar procedure that combines photoablation using the excimer laser and an intrastromal surgical technique that preserves the integrity of the out layer of the cornea. LASIK involves the placement of an incision into the cornea to create a hinged flap that can then be lifted up to expose the underlying corneal stroma that can be partially ablated with the excimer laser. The original flap is then repositioned. PRK and LASIK are the common laser surgeries of today and both are associated with advantages and disadvantages. The origins of LASIK procedure begin with Jose Barraquer who founded the operation of Keratomileusis in the 1970s by which a thin corneal wafer was removed, reshaped with a cryolathe, and then reinserted into the cornea. Automated Lamellar Keratectomy as created by Luis A. Ruiz in the 1982 took this concept further by using an automated device called a microkeratome, or corneal shaper, to excise an internal disc of corneal tissue. LASIK was originally described in 1989 by Pillikaris of Greece who used the excimer laser to treat the underlying stromal bed beneath a corneal flap which he had created with a microkeratome; a year later, Buratto of Italy used the same technique to successfully treat the undersurface of the corneal flap.

Complications and Safety of LASIK

The popularity of LASIK surgery soared in the 1990s with a greater number of people performing it each year. However, as the technology was still evolving many case studies with reports of high incidences of complications began to be reported by the media. Despite results that suggested that LASIK is effective and predictable in terms of obtaining very good to excellent uncorrected visual acuity and that it is safe in terms of minimal loss of visual acuity a general loss of confidence was reported in the procedure and the number of procedures began to decrease. Providing a direct estimation of the incidence of complications of LASIK surgery is difficult because what constitutes a complication compared to a minor nuisance/side effect is difficult to determine. The incidence of all microkeratome-related complications reported in the literature range from 0.7% to 11.8%, but studies with the largest sample sizes demonstrate complication rates of 2.2% or less with less serious vision loss complications less than 1% (Ambrosio and Wilson 2001; Ibrahim 1998; Lohmann and Guell 1998). Decentered ablations and central islands were considered in reports that appeared in 1999 or earlier however recent studies have not reported such complications. The success of refractive surgery depends on an accurate measurement of the shape of cornea, which has improved greatly in the past several years. Advancements in width of broad beams, thinner corneal flaps, separation of broad beam laser, improved patient selection, experienced surgeons, and enhanced methods of corneal shape have all contributed to the decrease in complications (Kawesch and Kezirian 2000). A number of studies have even documented a significant learning

curve for LASIK procedures, suggesting that the initial complications in LASIK may have been more the result of surgical inexperience than technological shortcomings. Vidaurri-Leal (1998) reported the experience in their first 5,000 LASIK cases, comparing the results of the first 200 cases with those of the next 4,800 cases. The incidence of intraoperative complications was 4.5% in the first 200 cases versus 0.87% in the next 4,800 cases.

Future Direction of Refractive Eye Surgery

Wavefront Technology

The goal to achieve perfect vision has now focused on an individualized laser procedure called wavefront-guided laser surgery. Wavefront emerged in 1996 and based on recognition that there were three main problems with regular LASIK procedures; 1) small optical zones, 2) decentered ablations, and 3) the presence of visual aberrations Wavefront LASIK involves creating a sophisticated corneal map of the individual eye and utilizing a visual Wavefront analyzer or aberrometer to study the way the eye bends light rays to improve the visual quality potential. This combined analysis is then applied directly to the cornea via the laser treatment. Wavefront LASIK not only improves the potential for 20/20 vision, it has the potential to create 20/10 vision. It represents a far more detailed assessment of the visual system, optimizing any imperfections to create the most ideal laser vision correction treatment pattern specific for that individual.

Future Concerns of the Practices of Refractive Eye Surgery

Since refractive eye surgery is an elective surgery patients have the option of the surgery and must chose to undergo it. This has created a highly competitive marketplace among physicians with advertisements, gimmick promotions, and celebrity endorsement becoming common marketing ploys. The attitude that LASIK is a “plug and play”, fast and easy procedure for patients to adopt, is misleading. One problem has been in pushing the envelope with LASIK procedures, doing surgeries where patients were only marginal [candidates] and hoping the technology would work. The initial period of laser technology underwent such a rapid technological growth and held such a promise for a permanent cure that patient safety was often considered only after a response to a complication. Today refractive surgeons have again been given an incredible opportunity to capture the imagination and acceptance of the spectacle-wearing patient by being at the forefront of an amazing technological advancement. However, the negative reports from complications of LASIK in the 1990s may linger in the minds patients unless historical awareness of what occurred is not considered. If new wavefront laser technology procedures are not scientifically scrutinized, peer reviewed and the results made openly available, confidence in the procedure may not be restored. Despite the amazing technological advancements the ultimate success of any procedure should depend on how safe it is to patients.

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THE HISTORY OF THE HOME PREGNANCY TEST

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ABSTRACT

One of the earliest records of a urine based pregnancy test comes found ancient Egypt. A woman who might be pregnant could urinate on wheat and barley seeds over the course of several days and watch for growth. ‘Piss prophets’ became popular in the middle ages, claiming to be able to diagnosis many conditions, including pregnancy, by the appearance of the urine. Before modern pregnancy tests, the best method a woman had of diagnosing pregnancy was careful observation of her signs and symptoms.

With the development of bioassays for the presence of hCG in urine in the late 1920's and 1930's, “The rabbit died” became a popular euphemism for a positive pregnancy test. Actually, as the test required inspection of the rabbit’s ovaries, the rabbit always died. In the 1970's with increasing medical knowledge and a heightened desire for early pregnancy detection, because of improved prenatal care and legal abortion, better pregnancy tests were developed. In 1977 the first home pregnancy test was released, trumpeted in early ads as a ‘private little revolution’. A year after its introduction the e.p.t. advertised its use by more than a million women. A decade later it claimed to have sold a test every thirty seconds for ten years. This paper will look at the history of one of the most popular home health care products and examine the place of the infamous little blue line in culture.

The home pregnancy test recently celebrated its 25th anniversary. Pregnancy tests answer an age old question: “Am I pregnant?” Until the most recent generations women had no accurate tests to answer this question. Today, it seems everyone has heard of the home pregnancy test. Millions have taken the test, often with intense emotional reactions, but a basic understanding of the method of peeing on a stick and waiting to read the lines extends far beyond those millions of women. It is truly amazing how common this relatively new medical test has become, in medicine, on drugstore shelves, and, in popular culture. This paper will examine the development of the pregnancy test, the movement that made this test available for home use, and briefly review its place in popular culture.

One of the earliest records of a urine based pregnancy test comes from ancient Egypt. A woman who might be pregnant would urinate on wheat and barley seeds over the course of several days and watch for growth. 'Piss prophets' became popular in the middle ages, claiming to be able to diagnose many conditions, including pregnancy, by the appearance of the urine. However, before modern pregnancy tests, the best method a woman had of diagnosing pregnancy was careful observation of her signs and symptoms (NIH-Timeline, 2003).

At the end of the 1890s, prenatal care was found to improve the health of both infants and mothers. However, most women would not see a doctor or midwife until well into pregnancy, and a woman herself would be unsure of the pregnancy until it had advanced enough to cause significant symptoms. Early detection was impossible, but public health advocates began to encourage women to see their doctors as soon as possible after pregnancy was suspected (NIH-Timeline, 2003).

With the development of bioassays for the presence of human Chorionic Gonadotropin (hCG) in urine in the late 1920's and 1930's, "The rabbit died" became a popular euphemism for a positive pregnancy test. Actually, as the test required inspection of the rabbit's ovaries, the rabbit always died. The development of this form of pregnancy testing can trace its development back to 1903 and Ludwig Fraenkel's description of the corpus luteum, the glandular mass that forms on the ovaries during the normal menstrual cycle, that we now know is supported by hCG during pregnancy. hCG is an ideal pregnancy test, as it functions in the body as a signal from the fetus to the woman, released from the trophoblast of the placenta, and detected only during pregnancy (NIH-Timeline, 2003),(Weiss, 2004), (Winona State University, 2004).

In 1927 Aschheim and Zondek described a test known as the A-Z test which identified the presence of hCG in the urine. In this classic test for pregnancy, the patient's urine is injected twice daily for six injections subcutaneously into immature female mice weighing between five and eight grams. After 100 hours the mice were killed. If the woman was pregnant the ovaries of the mice would be enlarged and have hemorrhagic spots and yellow elevations due the formation of corpora luteal. They reported 98 percent correct diagnoses in early urine pregnancy, and showed that the result became negative shortly after the placental tissue died. (In addition to its use in detection of pregnancy it was also used to diagnose hydadtid mole, chorio-epithelioma, ectopic pregnancy, and teratoma of testicle.) (Marshall, Goodsit, 1935)(Dictionary Barn, 2004).

Though considered a very reliable test for pregnancy, this test has several, very obvious, drawbacks. With time, animals and expertise involved these tests were quite labor intensive and expensive. This test required a collection of mice of specified age and weight. Injection of urine required 48 hours, and test results required 100 hours more. Mice ovaries are very small. In most cases microscopic examination is required to make the diagnosis. The skill of the lab staff could certainly influence the accuracy of the results. Morning urine contained a higher concentration of hCG, so women were required to consume no beverages after 6PM and to collect their first morning urine (Marshall, Goodsit, 1935).

The various modifications of the Aschheim-Zondek test depend on the same basic principles. Many researchers who were able to reproduce the work of Aschheim and Zondek, were able to demonstrate its reliability, and were able to modify the procedure to allow the use of other lab animals, or allow for quicker results. Brown claimed almost 100 per cent correct results using blood serum intravenously in rabbits. Jones and Murgrage used female rats instead of mice and further stated that the specimens could be preserved in toluol for one week so they could be shipped long distances. Reinhart and Acott, in their report, although using the rabbit as the test animal, stated that the ferret and cat could be used. In 1930, Hogben reported that injection of a pregnant patient's urine into the dorsal lymph sac of a female South American claw-toed frog would cause egg extrusion within 8 to 12 hours after injection. In 1931, Friedman reported on a pregnancy test in which two morning samples of urine were injected into the marginal ear vein of a virginal female rabbit that had been isolated from male rabbits. The result was available 48 hours after the first injection. Of all the biologic tests, Friedman's was the most accurate, and became the common 'rabbit test' in the 1930's. Popular childbirth books of the 1930s and 1940s encouraged woman to see their doctors and get tested (Marshall, Goodsit, 1935)(NIH-Timeline, 2003)(Ziel, 2001).

Pregnancy testing changed again in 1960. L. Wide and C.A. Gemzell developed an immunoassay, using cells in place of the animals required for bioassays. This test was a hemagglutination inhibition test based upon antibody-antigen reactions. Most important to this development was the observation that insulin-dependent diabetics developed antibodies to insulin and the hypothesis that animals could be induced to produce antibodies to hCG by repeated injections. Wide and Gemzell's technique mixed the urine sample with hCG antibodies from rabbits, then added sheep red blood cells coated in hCG to the mixture. Urine from a non- pregnant person will not contain hCG. hCG antibodies will remain in solution until the red blood cells with hCG are added. The antibodies will then bind to the cells, causing clumping, more accurately labeled agglutination. If the urine sample is from a pregnant woman it will contain hCG, and the hCG antibodies will bind to that hCG. When the red blood cells are added they will simply fall out of the solution, forming a reddish brown ring at the bottom of the vial. A red ring indicated pregnancy. (NIH-Explanations, 2003)(Weiss, 2004).

During the 1970's there was heightened desire for early pregnancy detection, because of improved prenatal care and legal abortion. Hemagglutination inhibition tests were used, in doctors' offices, to diagnosis pregnancy in the 1960s and 1970s. This test was faster and cheaper and more sensitive than the bioassays. However, this test was still relatively insensitive in early pregnancy, when hCG levels were very low. Also, a number of other substances in the urine, including some medications, cross reacted to give many false positives and false negatives, making the test inaccurate in addition to insensitive. User skill also affected these tests. Tubes had to be kept still to allow cells to settle and the ring pattern to form. As with earlier bioassays, these tests required careful collection of the first morning urine. Women were advised, "Drink no liquids after dinner the night before, then, as soon as you awake in the morning collect a urine sample in a clean, dry, soap-

free jar and take it to the laboratory”. Like all laboratory tests, results should be interpreted in the context of the individual’s history and physical examination (NIH-Timeline, 2003) (NIH-Explanations, 2003).

While bioassays, such as Friedmans ‘rabbit test’, were so highly complex to make the issue of home testing a moot point, immunologic tests were refined into highly accurate, simple agglutination inhibition 2 minutes slide tests that “could be performed by any person who could read the instructions”. One such test, Pregnosticon Dridot, was sold in small complete test kits of 25s and 100s that required no refrigeration and could easily be sent through the mail. Though more difficult to ship and to use, tube agglutination kits were also simple enough for most women to perform. Such tests were intended for physicians but were used as the first self pregnancy tests as part of an underground action of the woman’s health movement. (Stim, 1976)(Weiss, 2004).

One such group which was involved in the woman’s movement, and involved with providing pregnancy testing, was the Chicago Woman’s Liberation Union (CWLU). In the spring of 1970, these women attempted to set up a women’s health clinic and a pregnancy testing workgroup. At that time, the only places a woman could get testing done were doctor’s offices and health clinics. They felt many women were reluctant to seek testing from these institutions. The CWLU wanted to provide testing to women, especially women who were considering abortion, unmarried women, very young women, and women who could not afford doctors fees. CWLU and other groups demonstrated that these tests were easily learned by people without much background in science, and were easily performed with minimal equipment (Wessel).

In 1976 Dr. Edward Stim, medical director of 78th Street Center, a consumer-oriented woman’s health facility in New York City wrote: “Our own experience at the 78th Street Center in New York has convinced us that a Do-It-Yourself Pregnancy Testing Program can be a major health benefit, providing that an accurate simple test is used and that each woman receives an instruction sheet advising her of the possibility of error and the confirmatory symptoms of pregnancy. Indeed, the costs of each test are so low (about \$1.00) that questionable tests can easily be repeated....We hope that in the not-too-distant future pregnancy test kits will become readily available to women who have missed their periods just as urine paper strips are presently available to diabetics”(Stim, 1976).

In 1978 the first home pregnancy test was released, trumpeted in early ads as a ‘private little revolution’. A year after its introduction, the e.p.t. advertised its use by more than a million women. A decade later, it claimed to have sold a test every thirty seconds for ten years. Early test kits were essentially mini labs, containing “pre-measured ingredients consisting of a vial of purified water, a test tube containing, among other things, sheep red blood cells...as well as a medicine dropper and a clear plastic support for the test tube, with an angled mirror at the bottom”(advertisement for e.p.t. 1978 Mademoiselle). These tests had similar limitations to in-lab hemagglutination inhibition tests, as they were essentially the same test. But women were now able to test at home. A woman could be

the first to know if she was pregnant. It had been reported that 56% of woman had not contacted their physicians within the first two months of pregnancy. It was hoped home testing could help women come for earlier prenatal care, or safer abortion. Women were still advised to see their physicians to confirm diagnosis (NIH-Timeline, 2003) (NIH-Advertisements).

Following the development of immunoassay hemagglutination inhibition tests in 1960, research into human reproduction and human hormones continued and intensified. Throughout the 1960s and 1970s this research led to new understanding of hormones, steroids and antibodies, and to new approaches and techniques. In her 2001 article 'Reproductive Endocrinology and Human Health in the 20th Century- A Personal Retrospective', Neena Schwartz listed Radioimmunoassay (a technique which uses a radioisotope as a label to detect and measure the amount of a hormone in a sample) as the second most important application of basic endocrine biology, behind only the birth control pill. "First used for the measurement of hormone levels, the technique is now used for measuring many other substances, providing a reliable, valid, and most important, more sensitive substitute for bioassays"(Schwartz, 2001;NIH-Timeline, 2003).

It was in 1966 A.R. Midgley developed the first radioimmunoassay for hCG. Unfortunately, this assay could not differentiate hCG from the chemically similar luteinizing hormone. In 1972 National Institute of Health (NIH) researchers Vaitukatis, Braunstein and Ross published their paper describing a radioimmunoassay that could isolate hCG. The paper is often quoted in any discussion of pregnancy testing. It appeared in the American Journal of Obstetrics and Gynecology, titled "A radioimmunoassay which specifically measures human chorionic gonadotropin in the presence of human luteinizing hormone" (NIH-Timeline, 2003)(Vaitukatis, Braunstein and Ross. 1972).

Compared to hemagglutination inhibition tests, radioimmunoassay is much more sensitive and specific for hCG. RIA can detect minute amounts of hCG and thus detect pregnancy far sooner. This sensitivity reduces the number of false negative tests. Unlike the hemagglutination inhibition test, RIA is a more direct measure of hCG and therefore less susceptible to interference by other substances in the urine. This specificity reduces the number of false positive tests. RIA also allows scientists to quantify the amount of hCG present, an important improvement upon the 'yes/ no' results of hemagglutination inhibition.

From the beginning of modern hCG related pregnancy testing, it was recognized that there are a few situations beyond normal pregnancies in which hCG is found. Aschheim and Zondek in 1927 recognized that in addition to its use in detection of pregnancy, hCG could also be used in bioassays to diagnose hydatid mole, chorio-epithelioma, ectopic pregnancy, and teratoma of testicle. As RIA can quantify the amount of hCG present, a physician can correlate the value to the clinical situation. In this way, abnormal pregnancies, such as ectopic or molar pregnancies, or Down's syndrome pregnancies, can

be identified. hCG can be used to follow patients with hCG-producing tumors post-treatment to ensure hCG production has returned to zero. In fact, in the mid 1970s, before the test became readily available, Vaitukatis, Braunstein and Ross spread the word about the test to oncologists. The NIH scientist were doing assays for people all over the country, and giving out antisera to research labs and showing them how to run the assay (Marshall, Goodsit, 1935)(NIH-Timeline, 2003) (Winona State University, 2004).

Before publishing, Vaitukatis, Braunstein and Ross met with NIH lawyers to discuss patenting their process. The scientists had already proven its usefulness for following a subset of cancer patients. In a 2003 interview, Braunstein explained that they saw the other uses for the test as well. “We knew this would be a fantastic pregnancy test. We went to the government lawyers and said, “This is a technique that is going to be extraordinarily useful. Why not have NIH profit from it?” But since it was developed with public funds, the lawyers said no”. Several companies recognized that the technology, with some modification, could be used to develop a home test (NIH-Research, 2003) (Rubin, 2003).

Using RIA as a foundation, enzyme immunoassays were developed as specific and sensitive home pregnancy tests. Instead of using antibodies labeled with radioactive isotopes uses an enzyme sandwich assay. This means that two antibodies, collected from the serum of test animals in the lab, capture hCG between them and in doing so change color creating a positive test. One antibody, the capture antibody, is permanently attached to a membrane. The second antibody, the tracer antibody, is labeled with a dye and is in the liquid phase (or at least can dissolve into liquid phase). Urine, or blood, is added to the assay system, incubated a short time and if any hCG is present it will bind to both the capture and tracer antibodies linking them together. In this way, the hCG is sandwiched between the two antibodies. There are over 8 different binding sites that can be identified on different parts of the hCG molecules. Each commercial test uses a slightly different combination of capture and tracer antibodies which recognize any two of the eight different binding sites. In any combination, the capture antibody is attached to the membrane in a given pattern (+), the hCG attaches to that antibody, grabs the tracer antibody that has the label and shows a positive line. This entire procedure will concentrate the tracer antibody into a very limited area over the membrane and typically reveals the conformation of pregnancy (Winona State University, 2004).

As mentioned previously, it was in 1978 that the first home pregnancy test was released, trumpeted in early ads as a ‘private little revolution’. Sales exploded, and a decade later it was claimed that one single brand, e.p.t., had sold a test every thirty seconds for ten years. Drug stores stock whole shelves of tests, with at least (23) brands marketed in USA. Retail marketing in the USA exceeds \$200 million dollars a year. The home pregnancy test is one of the most ubiquitous home health care products (NIH-Popular Culture, 2003) (Rubin, 2003).

Pregnancy tests have changed over time. The first reliable tests were bioassays of the 1930's and 1940's. Hemagglutination inhibition tests were simplified and used as the first home tests. Radioimmunoassay and enzyme immunoassays were developed, and continually refined to be more specific and more sensitive. Home tests are now easier to use and easier to read. In 2003 the FDA approved a new home test which may be the start of the next generation of home pregnancy tests. Clear Blue Easy, the same brand which introduced the first one step test in 1989, has recently been approved to market the first digital pregnancy test. Instead of the standard blue line associated with the brand, the new test will display 'pregnant' or 'not pregnant' on a digital screen (NIH-Timeline, 2003).

Despite the innovations in design, each pregnancy test, from antiquity to present, attempts to give women the answer to the age old question: "Am I pregnant?" With increased understanding of hormones and of human reproduction, the development of reliable pregnancy tests became possible. Instead of detecting pregnancy through a "combination of guesswork, intuition, and time" (NIH-Introduction, 2003) women today have only to pee on the stick and wait for the infamous blue line.

With increasing prenatal care, and increasing availability of abortion, early detection of pregnancy became even more important. A pregnancy test has direct implications for the health care of any woman and for the treatment of abnormal pregnancies or pregnancies of women in poor health. Early knowledge of pregnancy is crucial for women with hypertension, diabetes, heart disease, renal disease or other serious health condition, both for her health and well-being, and for normal development of the fetus. Early diagnosis helps women to avoid any potentially damaging exposures to x-rays, medications, smoking, alcohol, or other dangers. The earlier a woman becomes aware of the pregnancy the earlier she can make lifestyle modifications to aid in her health and the health of the fetus, such as a change in diet or increase in exercise. In the 1980s the importance of folic acid in health development was recognized. Though it is recommended to start a folic acid supplement before becoming pregnant, a woman detecting an unplanned pregnancy early may still decide to start folic acid. Early detecting is also important in an unplanned pregnancy that is unwanted. Early abortions minimize complications and are safer and easier procedures. They may also cause less emotional stress on the woman than later abortions (NIH-Timeline, 2003) (Stim, 1976)(Johnson, 1976).

The pregnancy test is not simply advanced notice of a condition, or lack thereof, soon to make itself obvious. Pregnancy is related to societal norms, expectations and pressures. Issues surrounding pregnancy are complex. Unlike other medical tests, a negative test may be a cause for celebration, or despair. The reaction is dependant on personal, interpersonal, economic, religious and societal factors (NIH- Advertisements, 2003).

It is because of the complexity of issues surrounding pregnancy that home testing was, and is, desirable to so many women. In addition to providing a quick, convenient test without waiting for a doctor's appointment, the appeal of home testing is that it is private. "At last early knowledge of pregnancy belongs easily and accurately to us all" proclaimed a 1978 ad for e.p.t. Women became the first to know of their own pregnancies. Women's groups in the 1970's felt this was especially important to woman who were considering abortion, unmarried women, and very young women. Recent studies still report that half of those taking tests do not want to be pregnant, but women trying to become pregnant may also take frequent pregnancy tests (Market Research, 1997) (Wessel).

With so much diversity between women taking the pregnancy test, and such a range of personal factors affecting the desired outcome, marketing pregnancy tests to the public is difficult. Despite the desire of women in every era to know if they are pregnant, and despite the benefits of early diagnosis, "hCG sounds foreign and urine stream is hard to sugar coat" (advertisements). The marketing campaigns for all brands waver between an emphasis on science and a more emotional appeal. For example, a 1978 ad for e.p.t. featured eight paragraphs of text and diagrams and photos of the kit, while a 1978 ad for ACU-TEST showed a woman's face with a large heading "I wonder if I'm pregnant". Most marketing is focused on the accuracy of the test or the short time frame for results (NIH-Advertisements, 2003).

Television and movies have often focused on the emotional aspect of pregnancy testing. Though most characters do not discuss the science or history behind the pregnancy test, the pregnancy test has been a frequent quest star on many television shows and movies. The pregnancies, and pregnancy scare storylines seems sometimes to parallel the experiences of real women and sometimes seem to say something about society. The presence of the pregnancy test on so many programs, geared at different audiences, hints at its cultural relevance. Viewers of this generation even complain that the season finale pregnancy test has become predictable and contrived. For a medical test to have become so well known and pervasive, in only 25 years, again emphasizes the importance of this test to society (Rubin, 2003)(NIH-Advertisements, 2003).

One of the earliest storylines about pregnancy testing aired in the same year as the introduction of the home pregnancy test. In January 1978 *M*A*S*H* character Margaret (Hot Lips') Hannahan had a pregnancy scare. Hawkeye explained the basis of the rabbit test to Radar, and the audience, promising not to kill his pet bunny while performing the test. She was not pregnant, and the rabbit survived the injections and oophorectomy. Interestingly, Margaret had been portrayed as a sexually active single woman but the pregnancy scare came only after her marriage (NIH-Television, 2003) (*M*A*S*H* home page).

Perhaps the most discussion generated by a pregnancy test came in May and September of 1991 when single woman, and career woman Murphy Brown found out she was pregnant. The delivery of her son sparked international debate after American Vice President Dan Quayle made remarks about the poor role model Murphy Brown was setting as a single mother. In a speech about family values and the need for fathers he said : “It doesn't help matters when prime time TV has Murphy Brown - a character who supposedly epitomizes today's intelligent, highly paid, professional woman - mocking the importance of a father, by bearing a child alone, and calling it just another "lifestyle choice"(NIH-Television, 2003)(CNN, 2002).

Most pregnancy tests on television as in real life are more personal, private matters. *Sex and the City* character Carrie Bradshaw had a late period in 1998, and debated as to whether she wanted the result to be positive or negative. *7th Heaven* teen character Lucy thinks she may be pregnant so she and her sister go to buy a test in 2003. Marge Simpson's first pregnancy was diagnosed by Dr. Hibbard (who consoles the young couple saying “So, you ruined your lives.”) but subsequent pregnancies, and one pregnancy scare, were tested by home tests. Of course, since it is a comedy test packs included instruction such as “If ye water turns blue, a baby for you! If purple you see, no baby thar be! If ye test should fail, to a doctor set sail!” in the Barnacle Bill's Home Pregnancy Test (NIH-Television, 2003).

Media representations of pregnancy keep pace with societies changing views and values. *M*A*S*H* talked about pregnancy testing, albeit in a married woman, during the sexual revolution of the 1970s, at a time when the first home tests had been approved. *Murphy Brown* showed an independent woman making lifestyle choices during a time of debate about family values. Recent shows like *Will and Grace* show single woman Grace testing for pregnancy after artificial insemination by her gay best friend Will. *Friends* showed Phoebe testing for pregnancy after implantation of embryos in her womb for her brother and his girlfriend. More recently on *Friends* Rachael became pregnant after a one night rekindling of a relationship with her former boyfriend/husband Ross. These tests have been widely discussed by fans of the shows, and generated considerable text on viewer chat rooms, but generated no comments from high ranking politicians. (NIH-Television, 2003).

The portrayal, and acceptance, of these representations of sexuality, pregnancies and families on television highlight the changing views and values of society. Pregnancy tests on television are a way of showcasing, and examining, those changes. The sheer volume of references shows how commonplace pregnancy testing has become, and that in itself is culturally significant.

In tracing the development of pregnancy testing the correlation with changes in societies changing views and understanding of pregnancy is obvious. Pregnancy testing developed alongside changing views on prenatal care, women's roles, abortion and the sexual revolution. Pregnancy testing was also influenced by the larger consumer health movement, which helped make pregnancy tests available over the counter. Tracing the development of the pregnancy test also traces advances in laboratory medicine, and

advances in the understanding of hormone chemistry. Thus, a historical look at the development of the pregnancy test can serve as an example of the complex interplay of medicine, science, technology, psychology, society and consumerism.

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COMPRESSING CONSUMPTION: THE SURGERY OF PULMONARY TUBERCULOSIS

By

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ABSTRACT

“Hello and welcome to medical school. It is good to see so many young and bright faces in the class of 1928 here at McGill University. I will be your visiting lecturer today and our topic will be surgical therapy as applied to tuberculosis of the lung”.

A case study is an appropriate model for instruction here so lets us read the patient presentation often seen in a tuberculosis ward. A young 25 year old is admitted with a wracking cough that seizes her frail form every few moments. It is a cough that has been persistent for weeks and will most likely consume her frail form if left to its usual devices. It is obvious that this girl has tuberculosis. Referred to by many names over the years, phthisis, consumption, the white plague, and the King’s evil, some of these terms date back as far as the writing of Hippocrates in 460 BCE.

“Does anyone know who Herman Brehmer is and why he is well known for his work in medical tuberculosis treatment? No, well then I shall first go over some past treatments for tuberculosis before introducing the new surgical procedures that are becoming more the norm than the exception now in the 1920’s. Let us begin...”.

Tuberculosis was referred to by many names over the years; phthisis, consumption, the white plague, the King’s evil. Some of these terms date back as far as the writings of Hippocrates in 460BCE who identified the affliction as the most widespread disease of the times and as almost always fatal. Some writings in the bible even suggest that Jesus suffered from the infection. Little changed in the centuries from the times of ancient Greece, and up to the 1900’s tuberculosis was still considered mankind’s oldest and most widespread scourge.

In considering the development of modern tuberculosis therapy, a great advance in preventing its spread and treating those afflicted was made with the creation of Sanatoriums. Essentially a treatment centre specifically for tuberculosis patients, Sanatoriums were invented by Herman Brehmer, a Silesian botany student, in 1854. His own personal cure for tuberculosis came from isolating himself in the Himalayan Mountains where cold air, simple nutritious living, and self healing conquered the

consumption in his lungs. Brehmer returned home to study medicine, combining hospital sanitation and specialist directed care with his down to earth remedies. So were Sanatoriums created, and while patients often improved their condition, they unfortunately were still rarely cured.

Despite this growing knowledge and technology, one out of every six deaths was due to tuberculosis in Canada by 1880; it was still North America's number one killer. However, with new developments in surgical therapy it was believed that change was imminent as a relatively new but extremely promising procedure, surgical compression therapy, gained acceptance amongst the ranks of medical doctors everywhere.

While not indicated for all patients, the surgery was said to cure or improve approximately two thirds of far advanced pulmonary tuberculosis. This was quite a statement considering that only a few years previously, any kind of surgery for the disease was considered ill advised and meddlesome. This stigma was difficult to shake and there existed among many physicians and patients a hazy notion that the shock and mortality from the "rib operations" were severe, the postoperative pain scarcely endurable, and permanent clinical success a rarity. It was not entirely unexpected to face skepticism; after all there has often been a resistance of the medical profession to any change from therapeutic orthodoxy. There was however no doubt in the minds of a few surgeons that those "hopeless cases" of far advanced consumption of predominantly unilateral pulmonary tuberculosis had an excellent chance to escape a certain death and become permanently well.

There were many medical pioneers who developed compression therapy into a life saving technique. Dr. James Carson laid the foundations around the time of Brehmer when he pointed out how great a bar to healing processes were the elasticity, condition of extension, and constant movement of the lungs. He is quoted as saying: "In an abscess of the lung the sides are prevented from falling into a salutary contact, not by the matter which lodges between them, but by the powerful elasticity and retraction of the surrounding substance. One could as soon expect healing in a divided Achilles without mechanical aid. By collapsing the lung the diseased part would be placed in a quiescent state, receiving little or no disturbance from the movements of respiration, which would be performed solely by the other lung. The divided surfaces would be brought together into close contact by the same resilient power which before had kept them asunder. A wound or abscess in this lung would be placed in circumstances at least as favorable to the healing process as the same affection on any other part of the body." With this statement began the search for the most effective means of collapsing a lung in order to compress, and thus conquer, the consumption within it.

Dr. Forlanini of Pavia was the first to develop and practice the artificial pneumothorax in 1882. In this procedure air is injected into the chest cavity, which creates positive pressure to collapse the lung. While advocates claimed this non-deforming and non-shocking procedure avoided the acute circulatory and respiratory upsets of surgery, there was a growing feeling that its avoidance of immediate potential mortality and complications was usurped by its lack of results. Artificial pneumothorax frequently

failed to bring about a cure and was prone to serous exudates, empyema, progression of disease to the other lung, pleural shock, and gas emboli. It was also known that the immediate results of pneumothorax were so satisfactory to some patients that they failed to return for the necessary continuation of the treatment. Revisits were required up to every two weeks for one to five years, making compliance especially low. This indicated to some that the one time therapy of surgery could well be indicated first instead of a secondary treatment to failed artificial pneumothorax.

In 1885 the limitations of artificial pneumothorax led Dr. Edouard Bernard De Cérenville of Switzerland to devise and perform the first operation to relax the tuberculous lung by thoracoplastic operation. Surgeons later called it “pioneer work, experimental in character, and the beginning of an active surgical interest that gradually evolved into the modern thoracoplastic operation.” De Cérenville’s approach however, would prove to be inadequate for treating the disease. The unsatisfactory results of the early cases were attributed to the costal resections not being extensive enough to fully compress the lung and stave off the spread of tuberculosis.

Around the same time Dr. Ludolph Brauer of Germany proposed full removal of ribs II to IX to obtain complete compression rather than mere relaxation. Dr. Paul Leopold Friedrich later made the first attempt at this procedure in Königsberg, Germany, operating rapidly under light general narcosis supplemented by local anesthesia. Through a horseshoe shaped “Schede” incision running down the front of the chest around to the back and up between the scapula and the spine he removed from 10-25cm of the ribs. When looking at the astounding failure of most of these overly extreme operations one can almost understand critics of thoracoplasty of that time. In addition to terrific shock, patients often suffered paradoxical chest movements causing mediastinal flutter and displacement. These complications resulted in narrowing of the opposite lung cavity and respirations becoming rapid and laboured. Circulation was often impaired as well and many patients died of acute respiratory insufficiency or stasis pneumonia.

Surgeons pressed on with the belief that a sound theory would eventually lead to discovery of appropriate therapy. Drs. Boiffin and Gourdet of France both worked in the mid 1890s to further the development of thoracoplasty, but it was Dr. Max Wilms who first clinically demonstrated the efficacy of paravertebral resections in Heidelberg, Germany a few years later. A distinctive feature of Wilms’ operations was filling certain extrapleural cavities with bone fragments, fat or paraffin to maintain collapse of the lung, a procedure which would continue for years and come to be known as plombage. Wilms kept his resectioning of ribs to one area rather than whole lengths like the Brauer-Friedrich method. The removal of these short sections created a sort of column in the thoracic cage, so he called it “Pfeilerresektion” or columnar resection. Across the country in Berlin, Dr. Ernst Ferdinand Sauerbruch, originally an assistant to Paul Friedrich, performed similar operations at the same time as Wilms but worked independently. Each surgeon modified the other’s first technique, and therefore both deserve credit in the Wilms-Sauerbruch procedure.

Patient preparation involved regional anesthesia or general narcosis while lying on the good side and slightly declined. The initial incision, Sauerbruch's "Bogenschnitt" which translates as "curved cut", began at the fourth vertebral spine and traveled down the back to the tenth rib where it curved forward to the midaxillary line. It extended through the skin and muscles of the back to expose the ribs. Each rib was sectioned anteriorly first and then posteriorly. 3-15cm were removed from each of the first eleven ribs from the tips of the transverse processes laterally. With the growing acceptance and use of extrapleural thoracoplasty, new rib shears with a more powerful and steady action were rapidly developed to replace the early ones, which fatigued the surgeon's hand after 2 or 3 ribs had been cut. Closure consisted of trimming resected tags of tissue and continuous suture of the heavy muscles of the shoulder girdle into two layers. Time was an important element in this procedure to reduce shock, and it was said that Sauerbruch's highly trained team's operating time was around 20 minutes.

With proper selection of patients, preoperative preparation, careful anesthesia, and rapid operation, the postoperative condition was expected to be excellent even in cases of extensive unilateral tuberculosis. For the first four or five post operative days patients often suffered from fever, difficult scanty expectoration, cyanosis and dyspnea. Considerable pain in the chest, shoulder and arm would gradually abate within two or three weeks. After thoracoplasty there was some displacement of the heart and disturbance of circulation, but the mediastinal flutter, seen so often in the previous Brauer-Friedrich procedure, was rarely a concern due to the smaller segments of ribs being removed. Nevertheless, support bandages to assist patients' breathing during recovery were necessary. The procedure did change the physical signs of the whole chest on inspection, but deformity of the thorax and functional disability of the arms was argued to be slight. When clothed the patient usually appeared to have a normal figure and only physical examination or radiographs would tell otherwise. The greatest post operative risk was still further progression of the disease. It came about from either aspiration or spilling of infected secretions into unaffected portions of lung.

Thoracoplasty would continue to improve as an intervention in pulmonary tuberculosis and by 1937 was used in 50-80% of cases in a number of centres in North America. Every patient regardless of their stage of disease was considered for surgery. The Wilms-Sauerbruch procedure would eventually be replaced by a multi staged operation spread over many weeks which resulted in an 83% success rate with completely closed cavities and continuously negative sputum.

The use of collapse therapy ended with the advent of lobectomy and pneumectomy procedures where tuberculous lesions or the entire lung were removed from the chest cavity. This intervention gave way to chemotherapy which was used until Selman Waksman discovered a bacterium called *Streptomyces*, which produced a substance that killed many of the bacteria unaffected by penicillin including the tuberculosis bacillus organism. Streptomycin soon became the leading treatment of tuberculosis until 1951 when isoniazid or INH was found to be the best treatment against mycobacterium tuberculosis, which was developing a resistance to streptomycin in many areas. It is still the therapy of choice today.

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THE RENAISSANCE ARTISTS: CREATORS OF MASTERPIECES AND PERFECTORS OF MEDICAL ANATOMY

By

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ABSTRACT

As the 14th century came to a close, Europe began to experience a series of social, political, philosophical, and scientific developments which coalesced into what is now termed the Renaissance. For the previous millennium, anatomical knowledge was based on the work of classical anatomists, the foremost of which was the Roman physician Galen. A combination of religious taboo and a general acceptance of current practice kept anatomical study from the collective conscience of natural philosophers. The status quo, however, began to be challenged as man delved deeper into the workings of the human body in search of an explanation of its inner workings. This shift from man as a divine whole, to man as complex machine was part of the larger changes occurring during the Renaissance which saw a movement away from the heavenly and toward a philosophy which considered “man the measure of all things.” Revolutionary thought during the Renaissance produced many great minds. One such man, Leonardo da Vinci, laid the foundations for anatomical science by uniting the disciplines of anatomy and art by not only observing dissections but also drawing them in exquisite detail. The former practice of describing anatomy solely through use of written texts was made obsolete by the drawings of da Vinci which allowed students of anatomy to fully appreciate the complexity of man. Anatomy influenced not only the understanding of the human body but also art, as demonstrated by the Renaissance artist Michelangelo. His sculptures, the most famous of which, David, demonstrate a deeper understanding of human anatomy than could be gained through external examination. In fact, Michelangelo attended many dissections which he incorporated into his sculpture and paintings, thus increasing its realism and beauty. All these earlier developments culminated in the publishing of Andreas Vesalius’ *De Fabrica Humani Corpora*. This groundbreaking work incorporated all previous knowledge of anatomy in addition to Vesalius’ focus on minute detail into one single collection. By systematically dissecting the human body and faithfully recreating the structures in his book, Vesalius created a template for all further works in anatomy. Starting with da Vinci and continuing on through to Vesalius, the science and art of anatomy evolved to a point which can easily be recognizable by any student of the discipline.

The Renaissance was a time of political and social upheaval as well a period of unprecedented cultural and scientific achievement. Awakening from a thousand years of slumber, Europe rediscovered classical arts and sciences, among them medicine and anatomy. Leading the way were Renaissance painters and sculptors in search of a deeper understanding of the human body so that the fundamental beauty of the human form could be better captured on canvas or marble. Beginning with Leonardo Da Vinci's quest to accurately depict the anatomy of the body through careful observation and to gain insight into the inner workings of man, the body of knowledge of anatomy slowly increased and began to refute the earlier beliefs of the ancients. Following on the heels of Da Vinci, the artist Michelangelo continued the practice of dissections but instead of seeking the fundamental truths of nature and the human body, he performed dissections to better his art. Although not a scientist nor even seeking to approach anatomy scientifically, Michelangelo's genius and talent brought anatomy to a new level as artists throughout Europe strove to portray the ideal human form. Finally, Renaissance anatomy culminated in the work of Andreas Vesalius who performed his own dissections and published all his sketches in *De Humani Corporis Fabrica*. This book set the bar for all subsequent works of anatomy and stimulated a whole generation of scientists to study anatomy. The contributions of Da Vinci, Michelangelo, and Vesalius laid the foundations for the study of anatomy and paved the way for a greater understanding of whom we are and what we are made of.

Leonardo Da Vinci

Perhaps one of the Renaissance's greatest products, the painter, inventor, scientist, and sculptor, Leonardo Da Vinci was perhaps the quintessential Renaissance man. In the context of anatomy, Da Vinci was one of the first to synthesize contemporary art's focus on the external beauty of the human form with the newly emerging picture of the body's inner structures into a coherent, and accurate, representation of the human body. Before Da Vinci, anatomical drawings were crude at best and many were drawn by artists with little to no scientific knowledge. Furthermore, the artistic practice of the time was to observe a dissection and then reproduce the structures of the body in the studio at a later date. As would be expected, this led to many inconsistencies born of not only of poor memory but also of artistic license.

Early attempts by Leonardo Da Vinci to accurately depict the internal structures of the human body were similarly inaccurate as he also painted from memory; but as he grew more interested in the field of anatomical representation, Da Vinci started to keep notes of the dissections that he then reproduced in his studio. In fact, a common practice during the Early Renaissance was to publish anatomical treatises completely in text form with no accompanying illustrations. This practice may seem to be counter-intuitive in a discipline that is highly visual, but it was a way in which early anatomists were able to publish their findings without arousing too many opponents not only in the Church, but in the scientific community as well.

If Leonardo Da Vinci had continued on his previous path, he would be but a footnote in most history textbooks, however his genius advanced the art and science of anatomy

through a series of new methods of depiction. Perhaps Da Vinci's most important innovation was the creation of a system of representation that depicted four different perspectives thus allowing the student of anatomy to see the structure from all angles. Since an anatomical structure exists in three dimensions and its form varies depending on perspective, Da Vinci's new system of representation allowed students and anatomists to more accurately identify structures without having to orient the specimen exactly as it appeared in the textbook. Furthermore, Da Vinci caused a revolution in the way anatomists thought about their art since they were now forced to picture structures in three dimensions within the body, not as a two dimensional object on paper.

Besides creating a new method of representing structures, Da Vinci also introduced the practice of cross-sectional representation to more completely understand the constituent parts of a structure. Concentrating mainly on the head, Da Vinci produced a series of highly detailed drawings of the human skull, brain and associated organs that are accurate enough for the modern student of anatomy to accurately identify most structures. Along with his observations and illustrations, Da Vinci also tried to locate the structures responsible for the sensation. Working solely on anatomical observation, Da Vinci concluded that "the Common Sense [the brain], is that which judges of things offered up to it by the other senses." This final innovation of anatomical science by Da Vinci, that of structure following function, is a concept which still holds great interest in anatomy, comparative anatomy, and paleontology. Although the idea that the function of an organ or structure could be deduced by careful observation was not Da Vinci's alone, he was one of the first to enter the dissection free from preconceptions or previous theory. By coming to conclusions based solely on his own observations and intuition, Da Vinci was able to accurately identify the function, however crude the interpretation was, of the body's most complex organ.

A great number of Leonardo Da Vinci's drawings still survive, many of which would not seem out of place in a modern textbook. One of his most famous sketches is that the Embryo in the Womb (1510). This was one of the first glimpses of miracle of human life and led to a greater understanding of the development of life before it left the body. Even during Da Vinci's time, the subjects of conception and birth were taboo and little was known of life in its earliest stages. This was all starting to change as the scientific view of the world began to overturn the views of the Catholic Church, and Da Vinci was at the forefront of this movement. Other sketches by Leonardo Da Vinci of the human heart contained notes that described the movements of blood during diastole and systole and also contained accurate descriptions of functioning of the heart valves. Above all, Da Vinci strove to accurately represent the human body, with his comments on function and mechanisms of operation only the secondary objectives.

In many respects, the evolution of Leonardo Da Vinci's process of anatomical investigation and communication mirrors the development of the field of study as a whole. From his humble beginnings of sketching from memory to the massive amounts of highly detailed illustrations with comments on function, Da Vinci revolutionized the practice of anatomy in its infancy. The conventions of representation that Da Vinci pioneered are still used to this day and many of his observations have subsequently

proved to be correct. Quite amazing for a man who approached the study of anatomy from an artist's perspective and juggled his time in the study of anatomy against his sculpture, art, and other scientific pursuits.

Michelangelo

Michelangelo also practised anatomical dissections, however unlike Leonardo Da Vinci, Michelangelo's investigation of anatomy was used purely for artistic purposes. Paintings such as 'The Creation of Adam' and sculptures such as 'David', reflect his superior knowledge of the human body. As said by one of his contemporaries, 'the artist very often used to flay dead bodies in order to discover the secrets of anatomy'.

Michelangelo's introduction to public dissection likely began in his youth, and was probably conducted by Elia del Medigo, a physician-philosopher who was a member of Lorenzo de' Medici's circle, which Michelangelo joined in his mid-teens. By the age of 18, he was thought to have become well versed in the art of dissection and subsequently began to perform his own dissections and demonstration. He is said to have made molds of muscles to experiment in their shapes and forms during various body positions, something that he applied elegantly to his sculptures and paintings. This is clearly evident in the 20 nude slaves (*ignudi*), seated on blocks above the thrones of the Sibyls and Prophets that decorate the small panels of the Sistine Ceiling.

Although the church objected on principle to the desecration of the dead, it did allow for dissection of the cadavers of condemned criminals and even facilitated it. Permission to dissect corpses, provided the remains were buried decently, had been granted by Pope Sixtus IV (r. 1471-1484), who had been a student at the Medical School of Bologna. Still, corpses were rare, the notion resisted by the public, and cadavers were either stolen or made available through the church. Beginning in 1492, Michelangelo did most of his dissections at the Monastery of Santo Spirito. However, the bodies were not always those of criminals as it he is said to have mistakenly dissected the corpse of a young Corsini, whose powerful family subsequently sought revenge during the chaos that followed the fall of the Republic of Florence in 1530. His realization of this digression from the accepted norm may have contributed to his having given up dissection after more than a decade of persistent work.

Michelangelo's interest in anatomy is thought to be reflected in his painting of the Last Judgment (1536-1541). Displayed to the left of Jesus is Saint Bartholomew, holding a piece of flayed skin in his left hand and the flaying knife in the right. Furthermore, the face on the flayed skin is that of Michelangelo's. What might be the significance of this? Bartholomew, having been adopted as the saint of butchers seems to have been chosen also by anatomists and artists, still looking for acceptance and blessing for the dissection of cadavers.

It has also been suggested that Michelangelo's had an interest in the project of a text on medical anatomy. According to Condivi, one of his biographers, Michelangelo had discussed with Master Realdo Colombo, a very superior anatomist and surgeon and a

particular friend of his, to provide the anatomical drawings for his anatomy book 'De Re Anatomica'. Whether Michelangelo made any anatomic drawings for Colombo will never be known. Colombo's De Re Anatomica was published in 1559, shortly after his death, without any illustrations other than that of its frontispiece. Michelangelo's own project to publish an anatomical treatise for artists was never realized. He is known to have destroyed many of his drawings on an ongoing basis and to have burned most of what remained shortly before his death. Very few of his anatomical studies have survived. One can only wonder what turn the course of the history of medicine would have taken had Michelangelo gone on to illustrate Colombo's De Re Anatomica.

Vesalius

Although Leonardo Da Vinci had a major impact on scientific illustrations, Vesalius's went one step further and mounted the first serious challenge to Galen's work. This came in part from Vesalius's revolutionary thinking that an accurate understanding of the human body could only be obtained by direct dissection and illustration.

Andreas Vesalius was born in Brussels, Belgium in 1514. After studying medicine under the Galenic tradition in France, he returned to Belgium where he was appointed a lecturer in surgery and anatomy and was one of the first to perform his own dissections for his classes. In 1543 Vesalius became physician to the household of the Emperor Charles V and in 1559 he was appointed physician to his son, Philip II. While in royal service, he acted as a military surgeon during the Hapsburg campaigns. During a stay at the imperial court in Madrid, Vesalius made a pilgrimage to the Holy Land. On the return voyage in 1564, he died in a shipwreck off the island of Zakynthos.

Vesalius's revolutionary approach to human dissection transformed the way anatomy is looked at today. In contrast to common practices of the past, Vesalius himself performed detailed dissections, stripping away layer after layer of tissue to record the structure of the human body. Furthermore, he teamed up with students from the studio of Titian, renowned Renaissance artists, to record his dissections, producing a remarkable volume known as the *Fabrica*, the first comprehensive textbook of anatomy. This in stark contrast to pre Vesalius times where students learned their anatomy lessons out of un-illustrated, text only books where only poor drawings of the components of the human body existed.

Vesalius's textbook, 'The *Fabrica*' describes human anatomy in such a manner that it seeks to provide the reader with the fullest possible description of the human body, and therefore the presentation is far more detailed than any of its predecessors or its successors for a considerable time to come. This text was written in Latin with many of the anatomical terms in Greek, Arabic and Hebrew. Joannes Oporinus of Basel printed the *Fabrica* as a folio on demi-size paper using a "creditable roman letter" and the "Grobe Texte" types and the "Basel" italic. The work was completed in June 1543.

Upon performing the dissections for his text, Vesalius began to question some of the conventional anatomical representations instilled by Galen for the last 1400 years. By the

1540's Vesalius was certain that Galen's research reflected the anatomy of an ape. He believed that active dissection and observation of the human body was imperative to correct these errors. Also, it was Vesalius' plan that all earlier and brief anatomical descriptions must be extended and verified by reference to the human cadaver. He hoped to persuade the established medical world to appreciate anatomy as the foundation of all other medical research.

However, Vesalius's battle to change societies perception on dissection was extremely difficult since Galenists doubted the existence of a need to acquire further anatomical knowledge. Societies attitude was such that if one had faith in Galen's work, there was no need to dissect. Thus the audacious mentality Vesalius possessed was in contrast to the society's attitude. The title page to *De Humani Corporis Fabrica* portrays one of Vesalius's public dissections and shows him flamboyantly lecturing to a tightly-packed audience. The scene is captured in a very fluid way, meaning that the motions and expressions of the people depicted are realistic enough that one can almost feel the bustling of the room. The concept and even the idea of a human dissection taking place was shocking to the viewers. Seeing the scene depicted in the title page was thereby made more memorable to them because it went against the deeply held beliefs of their society. Although shocking, it was likely not Vesalius's purpose to offend Galenists or his other contemporaries. Rather, his purpose was to show a shift in authority from the anatomist to the body itself, a concept that relates to his hands-on teaching methods.

The drawings within the book also show that, like Galen, Vesalius opened up the body not just for intellectual and scientific improvement, but for entertainment: his illustrations include a weary skeleton leaning on a spade, and another sitting on a ledge looking melancholy. Some of his drawings depict him surrounded by crowds of people as he cuts open a human corpse, likely a corpse of criminal obtained through the church. In specially built anatomy theatres, Vesalius played to packed crowds. Like Galen, he had favourite dramatic routines: his was to plunge his hand into the body, pull out the heart and display it to onlookers.

Vesalius's contribution to modern day anatomy and medicine is remarkable. Strongly believing that the understanding of accurate anatomy was an integral part of medicine, he crossed accepted norms of society with his attack on Galen's work. By putting dissections at the forefront of anatomy, and the development of an illustrated anatomy text, Vesalius changed the way anatomy is taught and understood today. These revolutionary ways of thinking enabled Vesalius to leave his mark in society.

The Renaissance was a time of cultural and scientific rebirth that began in 14th c. Italy, and then spread throughout Europe. During this time, significant advances were made in areas such as science, theology, literature and art. Of one considerable interest was the deeper understanding of the human body and the human form. Although many scientists and artists shared the belief that human dissection provided the means of achieving this goal, their underlying motives differed considerably. Leonardo Da Vinci interest in human dissection was purely to observe and depict the anatomical make up of the human body, and likely represented his innate curiosity. Although his work was not hugely

influential in terms of any medical or anatomical discovery, he did help lay the foundations of modern scientific illustration. On the other hand, Michelangelo's motivation to dissect the human body was the belief that it would help improve his ability to paint and sculpt the human body. Finally, Vesalius realized the limitations of current anatomical knowledge and firmly believed that anatomy could only be understood through direct dissection and illustration. Consequently, he published the first comprehensive illustrated textbook of anatomy and in doing so, mounted the first major challenge to the long accepted views of Galen. Revolutionary ways of thinking along with a progressively changing time period resulted in developments that influence the way we look at anatomy today.

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THE ART OF OBSERVATION

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ABSTRACT

'I feel languid both in body and spirit, because even though the fever is going down, you know that the intermittent days have been occupied by doctors with purges, bloodletting, and similar remedies often more grave than the illness itself.' In this letter to a friend, Peter Paul Rubens is describing in words what he more cleverly reveals in his works. His depiction of rheumatoid arthritis in his paintings and self-portraits corresponded to his own progression of the disease. Although it was 1859 when Sir Alfred Garrod, a London Physician, gave the disease a proper name, it was, in truth, discovered two hundred years previous by a careful observer.

The art of medicine is an art of observation, and thus it is not astonishing that since ancient times, artists have been conscience of disease in its varied forms. Particularly from the sixteenth through to the nineteenth century, many artists were beginning to do away with convention and 'ideal beauty', and depict life in its true form. Caravaggio's faithful representation of St. Thomas illustrates three apostles staring at Jesus, one of them poking with his finger into the wound in His side. This suggests a curiosity of medicine that produced lasting impressions of the effects of disease on the human being. Rubens, Caravaggio, Rembrandt, Grünewald, and others accurately described disease as it pertained to the *person*, in all its agony and splendor, at a time when medicine was an imperfect science.

Although it crippled the body, it could not spoil the art. Due to its apparent absence in the literature prior to the 19th century, rheumatoid arthritis (RA) had generally been believed to be of fairly recent origin. The cause of this progressive and crippling disease has been an enigma for centuries, and even today there is no completely effective treatment. RA has been proposed as a "new" disease owing to the fact that there was no convincing evidence for RA earlier than the 19th century, i.e., prior to Landré Beauvais' description of the disease at the start of the 1800's. This observation led some to believe that RA is a recent disease, perhaps reflecting recent changes in the human environment. Both art and archaeology can be used to obtain new data from which scientific, historical, and epidemiological information can be extracted (Aceves-Avila, 2000). A series of rheumatic conditions had struck the imagination of artists, in particular Peter Paul Rubens and Pierre-Auguste Renoir, who not only reproduced what they saw, but also used their creativity to express pain and changes in the quality of life.

The absence of a convincing description of the disease has been continuously argued as firm evidence against the existence of RA before the 19th century in European populations (Parish 1963). Some suggest that RA appeared in the Old World after the exploratory travels to the New World in the 15th century. It could thus be speculated that seamen of Christopher Columbus brought back the triggering agent which then found a favourable biotope and susceptible hosts in Europe, who subsequently developed an aberrant immune reaction (Appelboom 2002). However, it is more likely that there was simply a lack of specific reference to RA in texts predating the Columbus voyage due to both difficulties in interpretation, and a lack of systematic disease classification. Buchanan proposed a viral aetiology, and suggested the eventual disappearance of the disease as the inciting agent loses pathogenic power (Buchanan and Murdoch 1979). To date, it is debatable if RA in populations is losing severity.

Not only has the theoretical baggage of medicine changed with time, but the way we perceive pathological conditions has also changed. Our powers of observation have increased immensely, and therein lies the grounds to account for the supposed lack of descriptions of RA in medical literature (Aceves-Avila et al. 2000).

Artists such as Pierre-Auguste Renoir, Peter Paul Rubens, and others have painted us a window through which we can observe the progress, the effects, and the implications of rheumatoid arthritis on human life between the 16th and 20th centuries. In addition, it is quite fascinating to note the impact that RA had on the lives and works of these painters themselves. To regard these paintings is analogous to observing a naturally occurring experiment, where we, as observers, have no external influence.

The first reported case of erosive arthritis was in a skeleton from Kulubnarti, Republic of Sudan (c. 700-1450 A.D.)(Kilgore 1989). Although it is accurate to find evidence of a disease such as RA in human skeletal remains, I have directed my interest in the paleopathology of rheumatism to paintings, which may disclose soft-tissue traces of RA of ancient time that are poorly seen in skeletal remains.

Rheumatoid arthritis, which is one type of inflammatory polyarthritis, is characterized by a variable but usually prolonged course with exacerbations and remissions of joint pains and swelling which frequently lead to progressive deformities. The arthritis is the dominant clinical manifestation of a more generalized systematic disease of connective tissues (rheumatoid disease). Radiographic examination early in the disease reveals evidence of periarticular soft tissue swelling and joint effusion. Subsequently, osteolytic areas in subchondral bone and narrowing of the cartilage space become apparent. Subluxation and dislocation, which are most common in the hands and feet, are late features. Bony ankylosis, which is most common in the wrists and ankles, is seen only in advanced RA. Typical deformities of RA include ulnar deviation of the fingers at the metacarpophalangeal joints, subluxation of the interphalangeal joint of the thumb, fusiform swelling of the proximal interphalangeal joints, and flexion deformities of the knees, hips, elbows, and wrists.

Analysis of the hands in Rubens' paintings during the last thirty years of his life suggests that RA was present at the time, two hundred years before some modern authors are willing to date its appearance. Rubens was known (from letters written between 1623 and 1640) to have rheumatic disease. The disease was chronic in nature, and was complicated by flares of more than one month's duration, so that he was seriously disabled. He frequently depicted RA in his paintings, perhaps finding some cathartic relief through representation of the visible symptoms in his subjects. Many of his works clearly portray the ravages of RA, particularly those involving the hands and wrists. Appelboom and colleagues have studied Rubens' works in which they found clues suggesting just this. 'Few artists faithfully rendered all of their subjects' physical shortcomings. Most artists' bettered life, and the success of Rubens lay in the heroic embellishment of his commissions. The appearance of disease stigmata would therefore be of signal importance.' (Appelboom et al. 1981).

Rubens had what physicians then called gout, a term used to describe virtually any arthritic condition. It was only much later in 1859 that the differential diagnosis between RA and gout was made by Sir Alfred Baring Garrod. Garrod points out the characteristic features of arthritis and the extra-articular involvement of RA. Garrod's treatment plan included quinine sulphate, opium tincture and the application of leeches (Appelboom 2002). Gout itself has been a prominent rheumatic condition throughout history, especially during the time of the Roman Empire. 'Colchicum automnale', used by Greco-Roman physicians, and which had been abandoned as a treatment because of its side-effects, came back into use at the beginning of the eighteenth century as the major component of a drink, Eau d'Husson (named after Nicolas Husson, a French officer who in 1783 boasted the efficacy of a 'new' secret remedy against gout) (Nriagu 1983).

In 1606, Rubens developed pleuritis which sometimes accompanies RA. As Rubens wrote to a friend in 1628, 'These last few days I have been very sick with gout and fever, and to tell the truth, I could hardly draw a breath between groans and sighs.' The latter part of his life, despite his irrepressible energy and almost unceasing activity in arts, cultural affairs and politics, is filled with physical complaints and serious illness (White 1968).

Rubens recorded, through his subjects, the progress of his own condition. In "The Holy Family with St. Anne" (figure not shown) completed in 1628 when Rubens was fifty-seven years of age, the left hand of St. Anne, resting on Mary's shoulder, is depicted with a characteristic swollen rheumatoid wrist. This is especially noteworthy since today it is known that RA affects nearly twice as many women as it does men. This painting is a singular example of its kind because Rubens only rarely included older women as principle figures in his paintings, and thus to have included the prestigious figure of St. Anne with her deformed hand argues in favour that RA was also prominent in women at the time.

"The Adoration of the Magi" was commissioned in 1609 to hang in the room in the Town Hall of Antwerp in which peace negotiations between Spain and the United Provinces were to take place. Its symbolism is rather interesting: the burgomasters of Antwerp, all

wealthy merchants eager to conclude truce, are – in the guise of the three Kings – laying their riches at the feet of the Prince of Peace. However, the picture ended up in Madrid a few years later, and in 1628-1629, Rubens retouched and substantially enlarged the painting (figures 1 and 2). The 1609 version (when Rubens was 32) shows no signs of RA, yet the hands of the kneeling King in the 1629 version does show symmetrical swelling of the wrists and the metacarpal joints. As a good deal of the artist goes into the painting itself, such deformities might well represent a form of signature, perhaps portraits of the artists who did them. That they are portraits of the model is unlikely if the same kind of lesions are detected in successive paintings and, most particularly, if some progression in the lesions is seen. That seems to be the case in the paintings of Rubens (Appelboom et al.1981).

Painfully reminded by his frequent attacks of ‘gout’, Rubens was keenly aware that not much longer was left to him to enjoy the pleasures of the world, and before departing he wished to leave a monumental but utterly human portrait of himself (figure 3). This self-portrait is unlike any of his earlier ones; here, his sombre face during a moment of melancholy introspection, is nothing like his proud and ambitious gaze in the self-portrait with his wife, Isabella Brant, 1609. Rubens’ left hand, resting on his sword, shows obvious subluxation of the metacarpo-phalangeal joints, swelling of the knuckles and wrist, as well as ulnar deviation.

On June 2, 1640, a friend of Rubens’ wrote, ‘Sir Peeter Rubens, whoe deceased three dayes past off a deflaction which fell on his heart, after some days indisposition of ague and goutte.’ There lies suggestion that towards the end of his life, the fear of death prevailed, and the tone of his paintings were becoming increasingly despondent. In support of this, some of his last paintings included ‘The Rape of Hippodamea’, ‘The Banquet of Tereo’, and ‘Saturn devouring his Children’ all finished in 1636-7. During this time, he wrote to a friend in Paris that a high fever kept him confined to bed: ‘I feel languid both in body and spirit, because even though the fever is going down, you know that the intermittent days have been occupied by doctors with purges, bloodletting, and similar remedies often more grave than the illness itself.’ it can be said that RA was a serious and prevalent disease of the time, and was regarded as a terminal illness.

Rheumatoid-like lesions can also be observed in a painting by an anonymous artist of the Flemish-Dutch School of the mid 15th to early 16th century (Escorial Museum, Madrid, Spain) (Figure 4). In “The Temptation of St. Anthony” a beggar is shown with hand and wrist rheumatoid-like deformities not found in any of the other portrayed individuals (Aceves-Avila 2000). St. Anthony is accosted by the queen of the devils, who tries to lead him into temptation by exposing him to naked bathing women, luring him with promises of money and a castle. In an attempt to resist the temptation, St. Anthony resorts to prayer in the castle while devils in the form of animals take flight through the window.

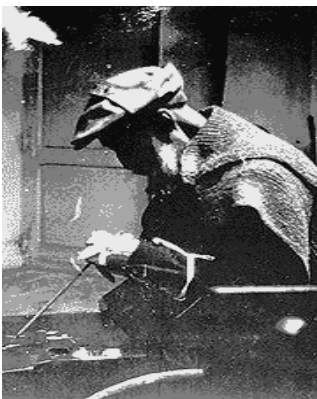
In the left foreground is the figure of a crippled, middle-aged, bearded beggar, holding a staff and supported by another person. Closer observation of this crippled man discloses a manifest central luxation deformity of the right wrist, ulnar deviation of the three lateral fingers, and flexion of the proximal interphalangeal joints. The left hand, which holds a

staff, is covered by a cape. Although the left wrist does not seem to be luxated, the staff is held between the fingers instead of being gripped firmly in the palm of the hand, suggesting the presence of flexion contractures of the left hand that inhibit the use of the hammer grip (Dequeker and Rico 1992). The beggar's left knee is flexed and slightly twisted outward. The right knee is also in flexion, indicating a position of bilateral flexion contracture of the knees and perhaps of the hips. These rheumatoid-like deformities are not found in any of the other portrayed individuals. A diagnosis of leprosy can be ruled out because the signs of leprosy, such as one frequently finds in illustrations from that period (nodular face, lagophthalmos, or madarosis), are lacking.

It is evident that rheumatoid arthritis existed well before the 19th century. Paleopathological research can only progress further in the research of RA and other diseases in an attempt to date and potentially propose a root and origin of certain diseases.

Pierre-Auguste Renoir (1841 – 1919) one of the great French impressionist painters, suffered from severe rheumatoid arthritis for the last twenty five years of his life. Although no medical records remain, it is possible due to photographs, his personal letters, and biographical notes by people who knew him well to get a reasonable idea about the course of his disease.

In a photograph of 1896, when he was fifty-five, the swelling of the metacarpophalangeal joints can be clearly seen. Subsequently, the arthritis became more aggressive, and in 1903, at the age of sixty-two, we see the dramatic change where he tries to hold his cigarette in his deformed hands (see figures below). The aggressive nature of the disease resulted in the destruction and ankylosis of his right shoulder and ruptures of several extensor tendons of fingers and wrists, leading to poor hand function. There is evidence that the rheumatoid arthritis affected not only his joints. At the beginning of the disease a pleuritis is reported and later a facial palsy, which was treated with electrotherapy. In 1912, at the age of seventy-one, a stroke was reported, which partially paralyzed his arms and legs. It is more likely that the paralysis was due to rheumatoid arthritis affecting the cervical spine. From then on he could not walk anymore and he was confined to a wheelchair.



Renoir had two family doctors who prescribed purges and antipyrine. He followed their advice but limited the use of antipyrine because he was frightened that it would influence his artistic creativity. He relied more on physical exercise to remain in good condition and to keep the optimal use of his hands and arms. Renoir applied modern principles of physiotherapy and psychotherapy long before these terms entered the vocabulary of rheumatologists (Boonen et al. 1997).

Renoir had to adapt his painting technique continuously; the brushes had to be fixed in his hands by his wife or model and he couldn't hold his palette, so he let it balance on his knees and the edge of the easel. His wheelchair was already of modern design, and he filled the back with cushions to prevent the development of bedsores. He changed his brush less often than before and became slower in painting. This might explain why he used a progressively shorter brushstroke and started to paint dry on dry instead of wet on wet. Still, he always continued to paint starting with a touch of white, then adding and mixing the other colours afterwards.

When looking at Renoir's paintings it is easy to forget that he suffered a great deal. Painting was almost a physical need and sometimes a cure, as if Renoir wanted to create on the canvas those things which he had to miss in real life because of his disability. This is very much unlike how Rubens dealt with the progression of his disease as his last days drew closer.

Management of painful diseases long remained largely a reflection of the beliefs and attitudes of the time, rather than having any basis in physiological or pharmacological understanding. Indeed, such factors are considered to be responsible for the many delays and wrong deductions of past epochs (Phillips 1993). These have effectively postponed a proper understanding of pain aetiology, and hence of effective medical management, until relatively modern times.

Rheumatic disease in general is synonymous with swelling, fever, disability, and chronic pain, all of which cause damaging changes to the affected person's quality of life. Treatment of RA prior to and during the period of Rubens was much the same as for any other gout or gout-like disease: bloodletting and purges. Garrod's treatment plan in 1859 (just before the time of Renoir), included quinine sulphate, opium tincture, and the application of leeches. NSAIDs, although discovered very early on by the ancient Egyptians and Assyrians, only entered clinical medicine in 1899 as Bayer Aspirin (Appelboom 2002). However, later on in the early 20th century, treatments with no or little rationale were asked about, recommended, or tried, often with reference to some anecdotal evidence. For instance, an early observation by Hench stated that acute RA improved during pregnancy and recommended the transfusion of blood from pregnant



Figure 1 and 2. The 1609 and 1629 versions of "The Adoration of the Magi" by Rubens. (Gronigen; Prado, Madrid).



Figure 3. Self-portrait, 1638-40 (Vienna).



Figure 4. "The Temptation of St. Anthony". Anonymous, mid-15th-16th ce.



Figure 5. Detail of "The Temptation of St. Anthony". (Escorial museum, Madrid). Rheumatoid arthritis deformities are seen in the figure of a crippled, middle-aged, bearded beggar, holding a staff and being supported by another person. Notice the ulnar deviation and flexion of the proximal interphalangeal joints. The beggar's knee is flexed and rotated.

women (Hench 1951). It was overlooked that acute rheumatoid arthritis might occur during pregnancy and that the amount of any hormone in the 300-500 ml blood or plasma

transfused is too small to have any biological effect (Karsh and Hetenyi 1997). Further failed attempts included electroshock therapy, multiple typhoid vaccine injections to induce fever, and antihistamines on the assumption that at least in some cases acute rheumatoid arthritis has an allergic component (Karsh and Hetenyi 1997).

It is generally agreed that RA is the consequence of a sustained immune response probably triggered by an external antigen in a susceptible host (Aceves-Avila et al. 2000). The nature of this antigen is still a matter of debate. In reality, there may be no unique entity that is capable of being integrated into the chain of the pathophysiology of chronic disease. RA depends on the conjunction of a genetic predisposition and a supportive environment – not only HLA genes, but also a genetically determined threshold at which the body is told to produce inflammation. It seems to need the right person in the right place; it requires a susceptible host and a specific environment. The modification of any of these conditions should modify the presence of the disease in populations. The pragmatic benefit of knowing the etiological factors of RA would be a rational design of treatments and a possible preventive strategy for RA (Aceves-Avila et al. 2000). Predisposition to disease should not be considered just a property of the individual, but as the result of the interaction with social groups and the environment (Aronowitz 1998).

Painting and photographs as tools for the paleopathological research of RA are extremely valuable. Rheumatic diseases affect primarily soft tissues, and only secondarily, after many months and years of disease, can bone lesions be detected. In paintings such as “The Temptation of St. Anthony” and those by Rubens, the deformities as a result of RA are unmistakable, so much so that these subtle hints have led us to believe that RA did in fact exist before the 19th century, and it was quite prevalent at the time. The photographs of Renoir in the various stages of RA are remarkable to view because not only do they illustrate Renoir’s determination, they may give encouragement to those suffering from RA today.

The art of observation is an essential exercise, whether it be in a clinical situation or even in a museum. Perhaps the photographs and paintings of today will help future generations understand the origins of diseases.

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FROM SURGERY TO SONNETS: THE STORY OF JOHN KEATS

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ABSTRACT

The question was raised whether physician-poets of the nineteenth century were influenced by the art of antiquity. In particular, Greek and Latin were featured prominently in the school curricula during this time. In an attempt to answer the question raised, the poet John Keats was selected.

As one of the most famous poets of this period, Keats had dedicated seven years to the study of medicine. Despite a clear talent for surgery, recognized by Astley Cooper, poetry lured him away from his initial career plans. After four years of writing as an aside, he finally abandoned surgery and devoted himself entirely to poetry.

Keats was greatly influenced by art and disease. He was fascinated by Ancient Greece, but was profoundly affected by tuberculosis, a disease which had ravaged his family.

At the age of twenty-five, Keats succumbed to the family fate that he had feared all his life. Having gone to Rome for a cure, he was further devastated by a scathing review of his poetry. Keats died believing that all his efforts had gone to waste. As he had requested, his tombstone bears no name, and reads simply “Here lies one whose name was writ in water.”

The Ancient Greek adage, “whom the gods love, die young,” epitomizes the story of John Keats, whose promising life came to a tragic end at age twenty-five. Dedicated to serving mankind, Keats explored both poetry and medicine. After spending seven years in each field (with a four year overlap), he succumbed to tuberculosis, a disease with which he had grown all too familiar. Keats is known for his romantic poetry; it has been said that, had his life not ended so quickly, his works would have rivaled those of Shakespeare.²

Keats was born in Finsbury, England, on October 31, 1795, to Thomas and Frances Jennings Keats. He was the eldest of five children in this close-knit family, which suffered poverty and repeated tragedy. A younger brother died in infancy, and when Keats was nine he lost his father in a riding accident. Soon after his death, Frances remarried and then divorced, upsetting the family dynamics. At the age of fifteen, Keats

became a true orphan, losing his mother to tuberculosis. This early experience of nursing his dying mother had a profound effect on the young boy.⁷

Keats had been attending Clark's school in Enfield since the age of eight, displaying an interest in reading and literature. Shortly after his mother's death in 1810, he voluntarily became an apprentice to the apothecary-surgeon Thomas Hammond in Edmonton, England. Although Hammond was a competent doctor, his heavy drinking caused friction between the two men. As an apprentice, Keats had been living with Hammond, but moved out to distance himself from the doctor's evening habits. Having to pay for his board and lodging was hard but it provided him with the privacy and time to explore his poetic aspirations.²

Despite their differences, Hammond wrote an excellent reference letter for Keats, after he had completed his five-year apprenticeship. This letter gained Keats a position at Guy's Hospital in 1815, where he pursued studies to become a surgeon. His talent and effort caught the eye of his favorite lecturer, Astley Cooper, landing Keats the highly respected title of senior dresser (junior house resident) astonishingly quickly.

Despite his achievements and progress in the medical profession, Keats began to realize that serving mankind could also be achieved in other ways. He began to see truth in the works of William Wordsworth, a favorite poet and source of inspiration. Wordsworth presented the poet as a healer, suggesting that verse was also capable of allaying the ills of mankind.²

Around the time that Keats began considering poetry more seriously, he became a dresser for William Lucas Junior, who was known as the butcher of the hospital. As described by Astley Cooper, "he was neat-handed, but rash in the extreme, cutting amongst most important parts as though they were only skin, and making us all shudder from apprehension of his opening arteries or committing some other error."² After experiencing the brutality of this surgeon's ways, Keats developed a dread of committing similar mistakes.⁷

On May 5th, 1816, Keats' first poem was published in "The Examiner," edited by Leigh Hunt. A few months later, he passed his licensing exam, which would have enabled him to open a country practice. However, he doubted his own ability to perform operations.² He felt more secure in the world of poetry, and abandoned medicine on March 3rd, 1817, the same day that his first book, *Poems*, was released.

Keats' poetry was greatly affected by his experience with tuberculosis, whose destruction he had witnessed in many close relatives, including his mother and brother. Having seen the helplessness of his relatives and patients in the face of this disease, the young man was fully aware of his own vulnerabilities. It is interesting to note that his profound admiration for Ancient Greek art served to inspire his lyrics, and also reminded him of his own mortality.

The history of Ancient Greece provided the poet with a new perspective on life and the world. Translations of Homer's "The Iliad" and "The Odyssey" instilled a sense of profound awe in the young man, as he describes in "On first looking into Chapman's Homer:"

*Then felt I like some watcher of the skies
When a new planet swims into his ken.
Or like stout Cortez when with eagle eyes
He star'd at the Pacific – and all his men
Look'd at each other with a wild surmise –
Silent, upon a peak in Darien.⁴*

Keats was also captivated by the sculptures of Ancient Greece, the Elgin Marbles. The story of the marbles, as well as their beauty and splendor, affected Keats and his lyrics. Their immortal beauty reminded Keats of his own human frailty and mortality.

In 1816, Lord Elgin was appointed British Ambassador to the Ottoman Empire, in Constantinople, Turkey. Greece and Egypt were parts of this Empire. Elgin was mesmerized by the beauty of the Greek architecture and sculpture, and requested permission of the Turks to remove the marble artwork adorning the Parthenon. The Turks readily agreed, as they wished to maintain good relations with the British ambassador, and as they also had little appreciation of the Greek art. Elgin sacrificed his fortune, his marriage, his family and his health, and finally had to sell the artwork to the British government, who still retains possession of the marbles despite heart-felt disapproval from modern Greeks.¹

Keats was fortunate enough to see these marbles when they first arrived in London, and was awestruck by their perfection. He was envious of the immortality of this artwork, realizing that their beauty and life would far outlast his own. He writes in the poem "On seeing the Elgin Marbles:"

*My spirit is too weak – mortality
Weighs heavily on me like unwilling sleep,
And each imagined pinnacle and steep
Of godlike hardship tells me I must die
Like a sick eagle looking at the sky.³*

One of Keats' most famous poems, "Ode on a Grecian Urn," portrays a similar admittance of his mortality, compared to the everlasting beauty of the Ancient Greek artifact:

*When old age shall this generation waste,
Thou shalt remain, in midst of other woe
Than ours, a friend to man, to whom thou say'st,
"Beauty is truth, truth beauty," – that is all
Ye know on earth, and all ye need to know.⁴*

When, at the age of 23, he himself began to show signs of consumption, he was struck with the grim reality that he was to die a lingering death. His experience in medicine allowed a self-diagnosis one night, after an episode of hemoptysis. Keats stated: “I know the color of that blood; it is arterial blood. I cannot be deceived in that color; that drop of blood is my death warrant; I must die.”⁶

Keats had seen how tuberculosis afflicted his patients and his relatives, resulting in the poem “La Belle Dame sans Merci (The Beautiful Woman without Mercy).” He personifies tuberculosis throughout this verse, as a woman whose deadly beauty is inescapable. In Keats’ time, the symptoms of tuberculosis were considered attractive, for the rosy (feverish) forehead and cheeks, set against a delicate pale face, were desired features. Keats combined the beautiful manifestations of the disease with its tragic outcome:

*I see a lily on thy brow
With anguish moist and fever dew
And on thy cheeks a fading rose
Fast withereth too.*⁴

He continues on to describe the relentless progression of the disease:

*I saw pale kings, and princes too,
Pale warriors, death pale were they all;
They cried – “La belle dame sans merci
Hath thee in thrall!”
I saw their starv’d lips in the gloam
With horrid warning gaped wide,
And I awoke and found me here
On the cold hill’s side.*⁴

The physical weakness portrayed so graphically by Keats can be contrasted with an observation made by Wells, the author of a biography on Keats: “[...] the tubercular victim, realizing his life is doomed, works with terrific energy, speed and persistence to accomplish something worthwhile before he dies.”⁷ The contrast between his mental strength and physical weakness is remarkable, and Keats worked diligently to accomplish more writing before his premature death. This may explain how the young poet produced the equivalent of a lifetime of poetry, in a mere seven years.²

The treatment of tuberculosis actually hastened the end. Episodes of blood letting, isolation and a restricted diet served to weaken the suffering man even more. Shelley heard of Keats’ illness and invited him to Pisa, suggesting that the warmer climate could aid his recovery. Keats finally agreed to travel to Italy, choosing Rome as his destination. His friend Joseph Severn made the journey with him, and was at the young poet’s side until his death.

Amidst his misery, Keats was further punished by a poetry critic, who dismissed his works as being worthless and bearing no talent. The young poet, who had led his life in the hopes of serving humanity with his lyrics, was shattered by the comments. Convinced that his goals in life had not been achieved, and suffering from imposed starvation and constant blood loss, Keats saw in death his only hope of comfort.

In “Ode to a Nightingale,” Keats portrays his dismal perspective of what life had become:

*The weariness, the fever, and the fret
Here, where men sit and hear each other groan;
Where palsy shakes a few, sad, last gray hairs,
Where youth grows pale, and spectre-thin, and dies[...].⁴*

He also expresses death as his only escape, which he yearns to be easy and painless:

*I have been half in love with easeful Death,
Call'd him soft names in many a mused rhyme,
To take into the air my quiet breath;
Now more than ever seems it rich to die,
To cease upon the midnight with no pain [...].*

On February 23rd, 1821, John Keats died of tuberculosis. As he had requested of Severn, his tombstone in Rome bears no name and reflects his melancholy perception of his life gone to waste: “Here lies one whose name was writ in water.”⁵

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THE HISTORY OF SYPHILIS, MUSICIANS, AND MENTAL ILLNESS

By

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ABSTRACT

The stereotypical fine line between genius and madness is one common to many disciplines, from the mad scientist to the misunderstood poet, but perhaps one of the most fascinating examples is that of the virtuoso musician. What, however, lies beneath this image of the “artiste” persona? The genius of many prominent composers of classical music from the Baroque era to the late Romantic is postulated to be influenced by, if not directly ascribed to, an underlying physical and/or mental illness.

This paper will focus on illnesses afflicting several composers, ranging from the Baroque (Paganini) to the late Romantic era (Schumann). Paganini was called the Demon Violinist: he had a connective tissue disease (now thought to be Ehler’s-Danlos Syndrome), and later developed the neurological degeneration of tertiary syphilis. Schubert was also afflicted with syphilis, which led to a deep despair that appears remarkably absent from his later works, considered to be among his greatest.

Beethoven’s infamous deafness has been attributed to many things, including syphilis of the 8th cranial nerve, however was confirmed at autopsy to be due to Paget’s disease. His unpredictable and often antisocial personality combined with an occasionally violent temper were thought to be an indirect product of his deafness. Finally, Schumann perhaps is the most salient example of both an organic mental illness as well as one that developed from the later stages of syphilis. Schumann is now believed to have suffered from bipolar disorder, which was also complicated by later stages of neurosyphilis, for which he was eventually committed to an insane asylum where he spent the last ten years of his life.

The answer to the question of whether insanity begets creativity, or whether the frustrated ambition and/or dubious lifestyle of the artist begets insanity, is virtually impossible to quantify. As Aristotle pronounced: “no great genius was without a mixture of insanity” (quoted in Rothenberg, 1990).

The stereotypical fine line between genius and madness is one common to many disciplines, from the mad scientist to the misunderstood poet, but perhaps one of the most

fascinating examples is that of the virtuoso musician. Often tolerated for the beauty of their craft, musicians were allowed personality “quirks” and “eccentricities” that were socially unacceptable in others. What, however, lies beneath this image of the “artiste” persona? Many of these were attributed to underlying medical conditions and (sometimes related) mental illnesses, of which the majority have been the subject of much debate since the death of the musician in question. Is the musician’s secret betrayed by his/her work? The genius of many prominent composers of classical music from the Baroque era to the late Romantic is postulated to be influenced by, if not directly ascribed to, an underlying physical and/or mental illness.

It is perhaps appropriate to begin with a caveat: the inherent flaw in any posthumous analysis of the medical conditions ascribed to historical personages is that we are limited by the medical knowledge at the time. The vast majority of diagnoses were made on a purely clinical basis, and documentation to justify or accompany diagnosis and treatment was, unfortunately, rare. Moreover, many diseases were considered to be socially unacceptable subjects: in these cases, letters and other surviving documents describe signs and symptoms in details without once mentioning the actual diagnosis. And finally, diagnoses of various historical figures are apt to vary with time and the advance of medical knowledge. Corpses are disinterred, sometimes repeatedly, to glean new information in the light of recent developments in post-mortem diagnosis.

This paper will focus on illnesses afflicting several composers, ranging from the Baroque (Paganini) to the late Romantic era (Schumann). Throughout this time period, mental illness was the subject of fear and discrimination from lack of insight into the various disease processes. Few diagnoses existed, with even fewer treatments of any efficacy. Recently, we have made huge advances in the field, but much of the pathophysiology of mental illness is still unknown. Because of the lack of evidence for specific psychiatric illnesses in great artists of the past, I will focus on the neurological sequelae of syphilis. Sir William Osler, the father of history of medicine, stated: “Know syphilis in all its manifestations and relations, and all other things clinical will be added unto you”². The name “Syphilis” originated from a poem by the physician Girolamo Fracastoro in 1530 entitled *Syphilus sive morbus Gallicus*. In other words: “Syphilis, or the French disease”. Syphilus was the name of a shepherd who cursed the sun and destroyed altars when Apollo sent a drought that killed the king’s sheep. Fracastoro was the first to suggest a theory of germs when he postulated that tiny, invisible living things caused the disease.⁴ Of course, no one knew at that time what caused the Great Pox. Theories included the common potato, the American iguana, the curse of God for illicit sex, and cannibalism. Some believed that it could be transmitted by the breeze generated by the batting of an eyelash.⁵

One prevailing theory with respect to the origin of syphilis was that it was brought to Europe by Columbus in 1493. In fact, in a biography written by his son Fernando, Columbus exhibited many signs of a “badly overwrought nervous system”⁶ on his voyage home. The biography describes details of his bouts of “grave illness”⁷, and coined the term *morbus Gallicus* that was came into widespread use, especially by the aforementioned Fracastoro. Soon after Columbus sailed into the harbour of Palos, Spain,

on March 15th, 1493, King Charles VIII of France declared war on the city of Naples, Italy. His army incorporated mercenaries of many nationalities, including Spaniards, and a cohort of military prostitutes to accompany them.

After victory in Naples, Charles VIII, afflicted with this strange new illness, brought it back to France:

*“a violent, hideous, and abominable sickness by which he was harrowed; and several of his number, who returned to France, were most painfully afflicted by it; and since no one had heard of this awful pestilence before their return, it was called the Neapolitan sickness.”*⁸

And so it began. The French blamed the Italians, and the Italians blamed the French. In Russia it was called the Polish sickness, Poland blamed the Germans, and the Germans called it the “Spanish itch”. Muslims blamed Christians. Catherine the Great of Russia later put the blame on the Americas, although her calculations were somewhat off: “two hundred years are now elapsed since a disease unknown to our ancestors was imported from America and hurried on to the destruction of the human race.”⁹ Voltaire stated that this infliction was the “first fruit” brought back from the New World by the Spaniards, whose Conquistadors even introduced it to parts of the New World that had not yet been affected.¹⁰ By 1495, the disease was considered to be an epidemic in Europe, which was to last for centuries to come.

We now know that syphilis is caused by the spirochete *Treponema pallidum*, or *Spirocheta pallida*. It was first named by Fritz Schaudinn in 1905, and the first evidence of neurological syphilis was discovered in the brain of a late-stage syphilitic by Hiyedo Noguchi of the Rockefeller Institute in 1913. A blood test was developed by August von Wassermann in 1907, but was only useful in detecting early syphilis. This became a boon to errant husbands who convinced their wives that they were being tested for anemia, and were then treated with chocolates laced with mercury.

The disease itself is only manifested clinically once concentrations of spirochetes reach ten million organisms per gram of human tissue. The body’s immune system destroys most of these, however some remain in reservoirs and are periodically released into the blood and/or lymph, resulting in the signs and symptoms of the disease.¹¹ Syphilis is defined by several stages: primary, secondary, and late-stage, including tertiary syphilis. Primary syphilis describes the period between the organism’s entry into the body through a break in the body’s innate barrier (ie. skin or mucous membranes), until 2-6 weeks later when the systemic disease has become established. After an incubation period of around three weeks, a chancre or ulcer develops at the spot of infection, which is often painless and may go entirely unnoticed. The organism spreads through the perivascular lymphatics and then the systemic circulation before developing into a primary lesion. By the time the primary syphilis phase resolves, the highly infectious lesions have often disappeared, though they may persist throughout the secondary phase.

Secondary syphilis is responsible for many of the symptoms that have garnered it the title Great Imitator. A general systemic infection with fever, malaise, and diffuse rash covering even the palms of hands and soles of feet appears within 5-12 weeks of the initial appearance of the chancre. Relapses of secondary manifestations may occur within one year of latency, called the early latent period. In this period, the relatively few remaining spirochetes form destructive tumours called *gummas* that can occur almost anywhere in the body except that hair, nails, and teeth. Tertiary syphilis is characterized by signs and symptoms that form the mnemonic “paresis”. This stands for personality, affect, (hyper) reflexivity, eye (Argyll-Robertson pupils, sensorium (delusions, hallucinations), intellect (decreased memory, orientation, and judgment), and speech abnormalities. Aortic aneurysms are often detected at autopsy.

With only limited understanding of the pathogenesis of syphilis, however, its diagnosis among musicians of the past few centuries becomes more than suspect. It was often difficult for physicians to even distinguish between signs of tertiary syphilis and the side effects of the mercury sold on the streets and taken liberally at even a suspicion of the disease. Fortunately, this paper did not set out to prove a posthumous diagnosis using the tools and perspectives of modern medicine: rather, to see the disease as did the society (medical and otherwise) of the time.

Franz Schubert (1797-1828) received little recognition for his musical contributions during his lifetime. He lived in relative poverty, and was it not for the patronage of wealthy young friends such as Franz von Schober, may not have had the means to compose at all, and remained in his career as a schoolteacher that he gave up in 1818. Schubert is largely remembered for his *lieder*, or art songs, many of which were written for the influential baritone J.M. Vogl. According to the New Grove Concise Dictionary of Music, “Schubert almost certainly contracted syphilis in late 1822”(Sadie, ed., 1988). Both he and his friend Schober were treated by Dr. Josef Bernhardt for the same condition. He was put on a diet of bread soup alternating with veal scallops and large quantities of tea. He was also prescribed a regimen of baths and fasts that was typical of early syphilis (Hayden, 89-92).

Much of the documentation of the progress of Schubert’s illness exists in letters to and from friends. One friend wrote to another: “Schubert is better, and it won’t be long now before he will have his own hair again, which had to be cut off because of the rash. He is wearing a very comfortable wig”(Hayden, 94). He could no longer play the piano because his left arm gave him too much pain, and lesions in his mouth and throat prevented him from singing. He believed that people were trying to poison him, and at one point “ate almost nothing more and merely took medicines”(95). As his death approached, Schubert fell into a delirium of manic singing, and had to be restrained. The official cause of his death was “nervous fever”(96), although his headache, insomnia, giddiness, and belief that he was being poisoned may have due to mercury poisoning.

During this period of time, Schubert’s musical output continued. Some scholars considered his behaviour to represent a “cyclothemic” pattern, affecting his ability to compose.

"Cyclothymia is defined medically as a mild form of manic depression characterized by pronounced changes of 'mood, behaviour, thinking, sleep, and energy levels.' In adults, periods of depression, hypomania (mild mania), and complete normality alternate, the latter lasting no more than two months at a time. The condition at this level of severity is not debilitating, but the severity is liable to increase with the years, in many cases into full-blown clinically definable manic depression. However, even when psychotic illness is severe, many individuals are normal for most of the time, and are able to reason and function without impairment of the faculties in both personal and professional capacities. Common early symptoms of cyclothymic depression are dark moods manifested by apathy, lethargy, pessimism, self-deprecation, and irritability, and loss of interest in things usually enjoyed."(McKay, 138)

While this condition existed before his diagnosis with syphilis, periods of good health and musical output became shorter and less frequent. However, Schubert composed some of his greatest works during this time: the epic 'Wanderer' Fantasy for piano, the passionate, two movement *Eighth Symphony (the Unfinished)*, the exquisite *Schöne Müllerin* song cycle, *Die Verschworenen* and the opera *Fierabras* (full of haunting music if dramatically ineffective). By the time he died he had produced one thousand compositions, many full of yearning and sorrow at the height of the Romantic era (Hayden, 91).

Niccolo Paganini (1782-1840) was another famous syphilitic, although far less evidence remains of his condition. He was known as the Demon Violinist not only for his fiery personality and virtuosity of play, but also for his unusually flexible fingers that allowed him an abnormal reach across the fingerboard. Modern medicine has a name for this type of connective tissue disorder: Ehler's Danlos Syndrome. Paganini's life was a mixture of triumphs and personal excesses. He earned large sums of money but he indulged recklessly in gambling and other forms of dissipation. On one occasion he was forced to pawn his violin. In performance he enjoyed playing tricks, like tuning one of his strings a semitone high, or playing the majority of a piece on one string after breaking the other three. He astounded audiences with techniques that included harmonics, double stops, pizzicato with the left as well as the right hand, and near impossible fingerings and bowings. Although facts regarding Paganini's death are scarce, it appears that he did not die of either syphilis, the mercury treatments that turned him a silver-grey colour, or the cardiovascular manifestations associated with Ehler's Danlos Syndrome such as aortic aneurysm. Instead, it is likely that Paganini died of tuberculosis. Indeed, "by his technique and his extreme personal magnetism he was not only the most famous violin virtuoso but drew attention to the significance of virtuosity as an element in art"(Sadie, ed. 1988).

Finally, one of the most famous syphilitic and neurotic musicians was Robert Schumann (1810-1856). Born in a family with a history of mental illness, he suffered from what we now diagnose as manic-depression, or bipolar disorder. He even composed under the guise of his two personalities: the measured, contemplative Eusebius, and the fiery,

volatile Florestan. Schumann had periods of great output, such as the year 1840 where most of his celebrated songs were written, and the four great symphonies that were written near the end of his life. This pattern was so unusual that R.W. Weisberg did a statistical analysis of the correlation between Schumann's moods and musical output. He concluded, however, that mood was related more to motivation, and motivation to output, rather than any direct link between "madness" and creativity (Weisberg, 1994).

Schumann himself once wrote in a diary: "in 1831 I was syphilitic and was treated with arsenic"(Franken, 11). Despite this, he met Clara Wieck, the daughter of his piano teacher, whom he married in 1840, against her father's wishes. Schumann, however, was a noted philanderer, and by some reports an alcoholic. His periods of depression grew progressively worse until, in 1854, they became unbearable. Schumann began experiencing hallucinations and hearing voices. He attempted suicide and was committed to a mental institution. Throughout this process, his doctor Franz Richarz kept a meticulous journal recording Schumann's meals, rages, medications, and fantasies, which was used as a basis for Weisberg's study. Richarz listed the various indications of progressive paralysis that accompanied the tertiary phase of Schumann's syphilis. Paralysis of the hand had already prevented him from playing the piano, and now he began to suffer from difficulties with speech, convulsions, a deterioration of his personality, and one of the hallmarks of late-stage syphilis, a differing dilation of his pupils (Argyll-Robertson pupils). At autopsy, the report confirmed syphilis: "the yellowish, gelatinous mass that he described at the base of the brain therefore corresponded, as we had already suspected in 1831, most likely to be a syphilitic gumma" (Ostwald, 298). Bone tumours were found at the base of the skull, and the heart was described as "big, flaccid, thick-walled, in all chambers symmetrically too large" (298). Cardiac enlargement could have been due to syphilis affecting the valves or the aorta.

Schumann spent the rest of his life in the mental institution at Eendenich, where he died at the age of 46 from the combined effects of tertiary syphilis and the toxic mercury treatments he was receiving. During this time, Brahms moved in with Clara Schumann, and purportedly never consummated the relationship while helping raise her children. Ostwald mused on the subject, saying that

"Genius and madness have often been thought to be related in some way. In the life of Robert Schumann, it is particularly difficult to draw a line between the two. The problem of distinguishing between his creative and psychotic behaviour has confounded many biographers, musicologists, and psychiatrists. Thus far no single diagnosis has done justice to the facts"(xi).

Does madness contribute to the creative process? Handel wrote *The Messiah* in 24 days, in what had to be a somewhat manic state. Others cultivated the image of the madman. Paganini often wore black, showed up to his concerts characteristically late, arriving in a black carriage drawn by black horses. He certainly benefited from his celebrity as the "Demon Violinist". But as to whether any of this is a necessary element of the creative process remains the subject of debate.

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DIAGNOSING DIS-EASE: DR. WALKER PERCY AND THE PATHOLOGY OF MODERN MALAISE

By

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ABSTRACT

Physicians who take to writing are by no means unheard of: Chekov, William Carlos Williams, and Michael Crichton are several of the more distinguished names on what is an extensive roll call. What is much more rare is a “doctor-writer” born and raised in the southern United States who contracts tuberculosis while working as a pathology intern, and, after enduring the better part of 3 years in a TB sanatorium, leaves his medical vocation behind, and starts writing philosophical essays and novels inspired by his reading of existentialist thinkers like Soren Kierkegaard, Gabriel Marcel, Karl Jaspers and Martin Heidegger.

Having graduated with his M.D. from Columbia University in 1941 with interests in pathology and psychiatry, Walker Percy was only a few months into his pathology internship at the Bellevue Hospital when he was struck with TB—he never did treat patients as a licensed physician. In a later reflection on his experiences with TB, Percy stated: “I was the happiest man ever to contract tuberculosis, because it enabled me to get out of Bellevue and quit medicine.” Given his apparent lack of participation in medicine, one wonders how it can be that increasing numbers of scholars, including many physicians, find tremendous value in exploring Walker Percy’s connection to medicine—in thinking about what Harvard psychiatrist Robert Coles calls “Dr. Percy’s hold on medicine.”

The present work will address these questions in a historical framework that explores the manner in which Percy’s philosophical and literary themes as well as the history of his family line—with its stunning record of high achievement and suicide—have fostered understanding on matters of depression, suffering, meaning and purpose, ethical medicine, and the role of doctors in fostering healing.

Scientific discovery and the progression that such discovery affords are fundamental to the field of medicine. To put a finger on disease processes that have been previously misunderstood, overlooked or unexplored, and to yield new, effective methods of diagnosis and treatment is highly esteemed by broader society, and, understandably so. One need look no further than to the topics that inspire research in the history of medicine

to recognize the weight that scientific discovery has carried and continues to carry, and the way in which such discovery can fire the collective imagination. A survey of the student abstracts for the 2004 History of Medicine Days at the University of Calgary is highly suggestive in this regard. New ways of thinking about mechanism, diagnosis and treatment of disease take center stage in the work of medical students from across Canada, covering the days of ancient Egypt and the Greco-Roman empire all the way up to recent times.

The present work, which deals with the life and literary art of Dr. Walker Percy, is no exception—save for one small caveat. Whereas scientists throughout history have sought answers to those aspects of somatic disease that have thus far eluded explanation and elucidation, Dr. Percy's kind of diagnostic exercise is focused not so much on the "objective" investigation of physical illness as it is on the pathology of "dis-ease," namely, that which is endemic to life in modern and post-modern society. In this regard Percy is the master diagnostician, showing an uncanny capacity to diagnose what it is that ails the person who feels strangely lost in the world. His patients are people like Binx Bolling, Percy's protagonist in *The Moviegoer* (1961), which was Percy's first published novel, and the winner of the National Book Award in 1962. At one point in *The Moviegoer*, Binx offers the following, very telling, assessment:

During those years I stood outside the universe and sought to understand it....The greatest success of this enterprise, which I call my vertical search, came one night when I sat in a hotel room in Birmingham and read a book called The Chemistry of Life. When I finished it, it seemed to me that the main goals of my search were reached or in principle reachable, whereupon I went out and saw a movie called It Happened One Night which was itself very good. A memorable night. The only difficulty was though the universe had been disposed of, I myself was left over. There I lay in my hotel room with my search over yet still obliged to draw one breath and then the next. (Percy 1961, 60)

The specific pathology that emerges as Percy follows Binx Bolling throughout *The Moviegoer*—and indeed, the protagonist in each of his novels—is a class of malaise that results from "the loss of individuality and the loss of identity at the very time when words like 'the dignity of the individual' and 'self-realization' are being heard more frequently than ever." For Percy, this malaise is fundamentally defined by the departure from the notion that "man is more than an organism in an environment, more than an integrated personality, more even than a mature and creative individual as the phrase goes. He is a wayfarer and a pilgrim" (Percy 1991, 246). To deny the feelings of loss was, in Percy's estimation, a major reason for the widespread psychic unrest that he observed in contemporary society.

Dr. Percy's two great interests in medicine were pathology and psychiatry, and, though it is somewhat of an oversimplification to regard these two medical specialties as the bookends of the spectrum of medicine, it is nevertheless helpful to consider them as such in framing Percy's diagnostic endeavor. On the one hand, Percy was inclined to see himself and his work as a "pathologist." For example, when describing *The Moviegoer*

during his acceptance speech for the National Book Award, Percy quite consciously employed the metaphor of the pathologist, saying: “Its posture is the posture of the pathologist with his or her suspicion that something is wrong” (Percy 1991). According to Percy scholar Kevin Majeres, careful attention should be paid to Percy’s choice of words. Majeres writes:

That this diagnosis comes from a pathologist—qua medical practitioner—is not to be passed over lightly: it may be a bold claim regarding the diagnostic possibilities of medicine, even in its most physical, laboratory-based discipline. In other words, Percy may not be using the word pathologist as a metaphor. The modern malaise may be so real that, while not an anatomical or physiological disease, perhaps even a medical pathologist could arrive at ample data to diagnose it. (Majeres 2002, 580)

If Percy is indeed functioning in some sense as a “pathologist,” then the specimen at hand is not solely modern and post-modern culture in general, but it is also, more specifically, the interplay of medical models and other models, including spiritual ones, of illness within culture. And this leads, on the other hand, at the other end of the spectrum, to the medical discipline of psychiatry. It is in the context of psychiatry that words like those frequently uttered by Percy’s protagonist, Binx Bolling, are most appropriately considered. For instance, at one point early on in *The Moviegoer*, Binx muses:

What is the nature of the search? you ask. Really it is very simple, at least for a fellow like me; so simple that it is easily overlooked. The search is what anyone would undertake if he were not sunk in the everydayness of his own life. This morning, for example, I felt as if I had come to myself on a strange island. And what does such a castaway do? Why, he pokes around the neighborhood and he doesn’t miss a trick. To become aware of the possibility of the search is to be onto something. Not to be onto something is to be in despair. (Percy 1961, 18)

By framing Percy’s diagnostic endeavor in light of both pathology and psychiatry, Percy scholar Kevin Majeres asserts that the “whole medical field implicitly in-between” is brought into focus and necessarily subjected to a host of questions. For Percy these fundamental questions include things like: is medicine to address the “pilgrim” status of its patients, and, in doing so, must it address the spiritual reality of its patients’ sufferings and strivings? If it does not, can medicine be true to itself, retaining its therapeutic efficacy while denying fundamental truths of the human condition? Can medicine afford to treat its patients solely along biological or psychological models, or must it be open to more? (Majeres 2002, 580). Such questions align with the central thrust of this present work, as the emphasis is not so much to probe how Percy’s medical background has informed his literary art, but rather it is to probe how a careful consideration of Percy’s life and literary art might yet transform medicine.

To better understand what marks Dr. Percy as particularly qualified to provide answers to the kinds of questions outlined above, it is necessary to take a step back to consider the tortuous path of his life’s journey. This process of recounting Percy’s biography was

purposely delayed at the outset of this present work in order to create a framework of curiosity about what exactly it was that happened to Dr. Percy that he would come to concentrate his energy of discovery on the diagnosis of “sickness unto death” in modern and post-modern society.

Born into a wealthy, aristocratic family in Birmingham, Alabama, in 1916, Walker Percy and his mother and two brothers moved to Athens, Georgia in 1929, the year his father committed suicide. This suicide was no isolated incident in the Percy family, for, as one Percy family neighbor observed in the 1930’s, “tragedy pursues the Percy family like a nemesis” (Wyatt-Brown 1999, 114). Percy scholar Bertram Wyatt Brown, who has studied the relationship between artistic creativity, honor, psychological depression, melancholy, and suicide in the Percy family, notes:

For almost a hundred and fifty years, the family’s members were struck down prematurely in life either by psychological or purely somatic maladies. For six generations of male Percy’s, the average age at death was thirty-nine. The Percy’s troubles were compounded by an additional, equally dismaying and irremediable problem that ordinarily but unjustly bears the stigma of moral weakness and condemnation. From 1794 to 1929, in each generation save one, a male member of the lineage took his own life, and women in the family had to be treated for madness. Under such conditions of persistent tragedy, survivors cannot help but wonder what they contributed by action or neglect to such unhappy, even horrifying, situations. (Wyatt-Brown 1999, 134)

Especially drastic for young Walker Percy was the fact that both his grandfather—who also bore the name Walker Percy—and his own father died in hauntingly similar fashion. Bertram Wyatt Brown believes that neither financial difficulties nor marital stress precipitated the father’s desperate act, which, it should be noted, occurred prior to the stock market crash of “Black Tuesday,” October 29, 1929 (Samway 1997, 232). In the suicide of both his grandfather and his own father, the weapon of choice was a shotgun designed for sport, fired through the head. This method of suicide would later appear in two of Percy’s novels: *The Last Gentleman* (1966) and *The Second Coming* (1980).

From these brief words about the longstanding Percy family history of suicide and mental illness, the glaring issue that arises is the role of genetics in predisposing individual family members to depression and madness. Indeed, it is the study of family histories like the Percy’s that assists in the process of scientific discovery as researchers seek to uncover some of the reasons why depressive illness persists in particular family lines. Although there is not time to explore this subject in detail here, it is examined thoroughly by Bertram Wyatt Brown in several of his works, including a succinct article called “Inherited Depression, Medicine, and Illness in Walker Percy’s Art” (1999). A point that is however worth mentioning now is that in Percy’s writing there exist clues for fellow “pilgrims and wayfarers” who too are seeking to survive the unhappy pattern of suicide and melancholy that affects so many lives each year. Speaking in the third person, Percy once cited his connection with that “species of affliction that sets him apart and gives him an odd view. The wounded man has a better view of the battle than those still shooting”

(Percy 1975, 101) Born out of his own tragic experiences, Percy's literary art offers insights that simply cannot be gleaned from psychiatric textbooks—insights that yield new ways of thinking about, and combating, the ravages of depression.

In 1930, only a year after moving to Athens following the suicide, Walker and his brothers moved to Greenville, Mississippi, at the invitation of their father's cousin, William Alexander Percy. It was with William Alexander Percy—a remarkable “bachelor-poet-lawyer-planter” and author of the *Lanterns on the Levee* (1941)—that Walker was exposed to the world of arts and letters. After finishing high school in Greenville, further education took Walker to the University of North Carolina at Chapel Hill where he studied chemistry and then to New York City, where he received his M.D. from Columbia University in 1941. Walker's decision to pursue science and medicine was apparently derived from a yearning for order and solidity in light of a family history marred by suicide and his mother's accidental drowning in 1932—an incident that Walker interpreted as being connected with the fact that his mother was a victim of suicide. Percy biographer Jay Toolson reports that at this time in his life Percy was “searching” for certainties in a world that offered none (Toolson, 1992, 96). Percy's medical school of choice in 1937, Columbia's College of Physicians and Surgeons, was congruent with his quest for “certainties,” given that along with Harvard and Johns Hopkins, Columbia was a leading medical school in investigative science, heavily influenced by the German emphasis on empirical research. During his four years there, Percy became fascinated with the mechanism of disease—a concept that he regarded as “a very beautiful idea that disease can be explained as a response of the body to an invading organism” Percy would later refer to the beauty of the scientific method as “the first great intellectual discovery of my life” (Percy 1991, 188).

Despite these endorsements of the scientific method there were signs even as Percy went through his medical training that something was lacking in a purely objective, “spectator,” approach to knowledge. When tuberculosis struck Percy while he was conducting autopsies as a pathology intern at Bellevue Hospital in the fall of 1941, the crisis that resulted was both an existential crisis and a physical one. As Percy would later put it: “The same scarlet tubercule bacillus I used to see lying crisscrossed like Chinese characters in the sputum and lymphoid tissue of patients at Bellevue was no longer out there; Now I was one of them” (Percy 1966, 9). While his younger brothers fought in Europe and in the Pacific, Walker took up residence at the Lake Saranac TB Sanatorium in upstate New York. Under the clinical eye, Percy felt as though he had become his disease, and it was his disenchantment with a narrowly focused biomedical paradigm that prompted him to seek a “shift of ground...a broadening of perspective.” The physical inactivity that accompanied his ordeal as a patient forced on him an awareness of the limitations of the scientific method, while simultaneously providing him with huge amounts of time during to read the work of thinkers like Dostoevsky, Camus, Sartre, Marcel, Heidegger, and especially Kierkegaard. It was this pursuit of a different way of seeing the world and seeing himself that eventually led Percy to what he would come to call his second great intellectual discovery. Quoting Percy:

If the first great intellectual discovery of my life was the beauty of the scientific method, surely the second was the discovery of the singular predicament of man in the very world which has been transformed by this science. An extraordinary paradox became clear: that the more science progressed, and even as it benefited man, the less it said about what it is like to be a man living in the world. Every advance in science seemed to take us further from the concrete here-and-now in which we live. Did my eyes deceive me, or was there not a huge gap in the scientific view of the world (scientific in the root sense of the word “knowing”)? If so, it was an oversight which everyone pretended not to notice or maybe didn’t want to notice. (Percy 1991, 188)

In 1944, seemingly cured, Walker returned to the College of Physicians and Surgeons at Columbia, this time as a pathology instructor, but he soon suffered a relapse requiring another year’s hiatus at the Gaylord Farms Sanatorium in Connecticut. This time upon recovery, Percy married Mary Bernice Townsend (“Bunt”), left his medical vocation behind and became a writer, first of essays, then of fiction. Of his decision not to continue working in medicine, Percy once reflected in an interview: “I was the happiest man ever to contract tuberculosis, because it enabled me to get out of Bellevue and quit medicine” (Percy 1985, 185).

It was in the early 1950’s when Percy, now fully engaged in his own “search,” began writing philosophical essays, many of which were published in philosophy journals even though he had received no formal academic training in this field. The most important of these essays was entitled “The Man on the Train.” In this essay, Percy dealt with the predicament of a hypothetical, solitary train commuter who attempts to overcome his malaise and the boredom of his everyday life, searching for some kind of meaning in his life. This essay profoundly influenced Paul Tillich, the theologian, as well as Robert Coles, the psychiatrist. Given the history of medicine focus of this present work, Percy’s influence on Dr. Robert Coles from the time of “The Man on the Train” until Percy’s death in 1990 is particularly significant given Coles’s own wide scope and contributions to medicine—Coles was awarded the Presidential Medal of Freedom, the highest civilian award in the United States for exceptional meritorious service, in 1998 by President Bill Clinton who referred to Coles as the most influential American psychiatrist of the 20th century. Coles wrote a biography of Percy in 1978 called: *Walker Percy: An American Search* in which he speaks at length of Percy’s “hold on medicine” and the way in which this “hold” influenced Coles’s own career in medicine.

The philosophical essays eventually gave way to novels, a medium in which Percy found that he could more fully embody his ideas and more appropriately reflect the concrete here-and-now in which each of us must live. At the time of his death in 1990, Percy had published six novels: *The Moviegoer*, *The Last Gentleman*, *Love in the Ruins*, *Lancelot*, *The Second Coming*, and *The Thanatos Syndrome*. His published non-fiction works included: *The Message in the Bottle*, *Lost in the Cosmos*, and a posthumous collection of essays, *Signposts in a Strange Land*. In essence, the cumulative thrust of these works represent Percy’s attempt to put his finger on something of tremendous consequence for

the modern and post-modern person, a specific problem—a “dis-ease” for which the scientific method had failed to account.

So, in light of his life experiences, his career decisions, his literary art, his lifelong pre-occupation with suicide, his far-reaching influence, and his frequent criticism of science and modern medicine, what is one to make of the relationship between Walker Percy and medicine?

As the relatively recent publication of *The Last Physician: Walker Percy and the Moral Life of Medicine* (1999) from Duke University Press attests to, Walker Percy has had a profound influence on the way in which physicians, past and present and spanning the spectrum of medical specialties, practice medicine and think about the true healing needs of their patients. Similarly, there continues to be tremendous benefit for psychiatric research in the assessment not only of Percy’s family tree, but also in his very telling presentations of what it means to endure a family legacy of suicide and grievous mental anguish. But all of this is really secondary to the kind of searching for answers that Percy was ultimately after, driven by the tragedy and pain of his own very personal experiences. Many people—and especially that certain kind of person who finds him or herself “strangely lost in the world,” “sunk in the everydayness”—would argue that Percy did indeed succeed in his diagnostic endeavor, that he was able to put his finger on something, and that something, that pathology of malaise, had far reaching implications for how the medical field understands and treats patients in the modern and post-modern world. To conclude then, it seems only fitting to commend further study of Percy’s life and his literary art to anyone engaged in the practice of medicine. Diagnostic and potentially therapeutic, Dr. Percy’s search for answers was undertaken in hope, not only for himself, but also for the profession of medicine.

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MAUDE ABBOTT: A BIOGRAPHY

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ABSTRACT

Maude Abbott was born in Quebec in 1869. Maude was a bright girl, who grew into a young woman with great drive and determination. In 1886 she began studies at McGill University, faculty of Arts, in the third class ever to accept women. When Maude completed her studies, she pursued her dream of a career in medicine. Although her alma mater, McGill, would not accept women into medicine, Maude was invited to enroll in medicine at the University of Bishop's College. In 1894 Maude's dream was realized when she graduated from Medicine with honours.

The year 1898 marked an important step in the development of Maude's career: she was appointed assistant curator of the medical museum at McGill. She had the daunting task of organizing several years' worth of specimens, many of which were collected by Sir William Osler. In her capacity as curator, she had the opportunity to meet Sir William Osler, 'an event which enlarged and invigorated her life as did no other single circumstance in her career'.

With new enthusiasm, Maude threw herself into her work at the museum. She developed a special interest in congenital heart defects and worked tirelessly to enhance the medical world's knowledge and approach to these defects. Maude became known as the world's authority on congenital heart defects, owed in part to her masterpiece, the *Atlas of Congenital Cardiac Diseases*, which detailed over 1000 cases when it was finally published in 1936.

Throughout her career Maude had numerous roles and successes. It is undisputed that Maude was a great Canadian medical pioneer. She was an innovator, and played an integral role in the advancement of women in medicine. She was a devoted worker who left her mark on medicine with innumerable contributions, including her research, her teaching, and her many literary works.

MAUDE ABBOTT

Maude Elizabeth Seymour Abbott was born on March 18, 1869 in St. Andrews East, Quebec. Her parents were the Reverend Jeremiah Babin, and Elizabeth Abbott. Unfortunately their marriage was extremely unhappy and Jeremiah left the home shortly before Maude's birth. Maude's mother then died of tuberculosis seven months after Maude's birth. Maude had an older sister named Alice, and after their mother's death, their maternal grandmother adopted and raised them (MacDermot 1941, 4). A governess home schooled Maude for most of her life. When she was only fifteen, she began writing in her journals about her desire for education. She wrote, "One of my day-dreams, which I feel would be selfish, is that of going to school. ... Oh, to think of studying with other girls!" She also showed the humility that was so much a part of her character in the same journal entry when writing "How dreadfully ashamed I should be of anyone knowing for an instant that I am not half thankful enough for what I have, but desire something more." (MacDermot 1941, 10) Maude was fortunate enough to have the opportunity to spend the last year of her education in a private school in Montreal. There she realized how strongly she wished to attend college, and on completion of that year she received a scholarship to attend McGill University (MacDermot 1941, 26).

In 1886 she began her studies in the faculty of Arts. Although Britain and the United States had been supporting the higher education of women since the middle of the century, 1886 marked only the third year women were admitted into general studies at McGill. Even so, Maude carved a niche for herself at McGill and was actively involved in a number of activities during her four years there. She was class president, a founding member of the YWCA and the Delta Sigma debating society, the editor of the college's publication the *Fortnightly*, involved in establishing a soup kitchen for the needy, and she helped in the formation of the future McGill Alumnae Society. When Maude completed her studies in 1890, she received the Lord Stanley medal of academic excellence, and was valedictorian of her class (Roland 1970, 371).

Sadly, Maude's grandmother died in 1890, and as a new graduate Maude was now left in charge of caring for her sister, Alice, who was mentally ill. It has been hypothesized that Alice suffered from Manic Depression (Waugh 1992, 56), but others suggest it was perhaps Schizophrenia (Kelen 2000, 894). Despite her new responsibilities, Maude had decided she desperately wanted to pursue a career in medicine – an idea originally suggested to Maude by her best friend Mrs. C. H. Eastlake. Unfortunately, at that time McGill would not accept women into medicine because the faculty felt that granting women admission was "nothing short of a calamity" (Dobell 1988, 658). Maude began petitioning her alma mater while only in her third year of studies. The first response from the school came from J. Stewart who was the Registrar at the time. It read, "I am sorry to inform you that the Faculty of Medicine can hold out no hope of being able to comply with your request." (MacDermot 1941, 37) Despite her continued efforts she was denied admission. She was, however, invited to enroll in the Medical Faculty of the University of Bishop's College which was a rival school of McGill's. Fortunately for Maude, the students at Bishop's did their hospital work at the Montreal General Hospital along side the McGill students. In 1894 Maude graduated from Medicine with brilliant honours and

won the senior anatomy award and the Chancellor's Prize for best examination in a final subject (Smith 1982, 774).

Maude and Alice then moved to Europe for Maude to begin post-graduate work. They traveled through several cities, including London and Zurich, before settling in Vienna. They remained there for over two years during which time Maude studied obstetrics and gynecology as well as pathology. About this experience Maude said "...the greatest things to be had there [Vienna], by far, were the Pathology with Kolisko and Albrecht and the Internal Medicine courses with Ortner...that made possible my later work at McGill." (Smith 1982, 775)

She returned to Montreal in 1897 and began working in private practice, however her practice grew slowly. It was good fortune that brought her into contact with Dr. Martin (who was superintendent of the Montreal General Hospital while Maude was a student there) who offered her a job at Royal Victoria Hospital. She then began working under Drs. Charles Martin and J. Adami where she began working on a statistical study of functional heart murmurs. She prepared a paper on the subject, which was presented to the Medico-Chirurgical Society on her behalf as women were not at that time admitted to membership. Based on her well-received paper, Dr. Adami proposed that women be admitted to the society and nominated Maude for membership. The proposition to admit women had been made a year earlier on behalf of another medical woman, however it had been turned down. This time, the response was an overwhelming yes, and Maude became the first woman admitted (MacDermot 1941, 61). Another project Maude was working on for Drs. Martin and Adami was a case of pigmentation-cirrhosis. She had brought slides to Canada from Vienna and asked to show them to Dr. Adami knowing that he was working on a similar case. As a result of their meeting she was asked to work on the case and prepare a paper. Her paper was ultimately presented on her behalf to the Pathological Society of London in January 1900 and published in its *Transactions* – the first material presented to the society from a woman (MacDermot 1941, 64).

The following year marked an important step in the development of Maude's career – she was appointed assistant curator of the medical museum at McGill. At the time, however, she was not given very specific duties and her salary was poor. During this time Maude even considered a position at the Verdun Protestant Hospital for the Insane as an alternate to her currently non-stimulating job. In 1892, the Chair of Pathology position was created, and directorship of the museum was one duty of the position. Dr. Adami was the first to hold this position. It was decided that something more needed to be done about the state of the museum which had been collecting samples since 1823 but which no one had catalogued before. It was decided that Maude was right for the job owing to her enthusiasm and energy. She now had the large task of organizing many years' worth of specimens, many of which were collected by Sir William Osler during his years at Montreal General Hospital between 1876 and 1884 (MacDermot 1941, 70). As no system was in place for classification of pathological specimens, Maude traveled to Baltimore and to Washington, among other centres, to see the method of organization used by other medical museums. She brought with her Dr. Wyatt Johnston's decimal classification system as a starting point. Maude suggested the organization of a society

of curators although nothing came of her suggestion at that time. It was in Baltimore "...that she discovered William Osler, an event which enlarged and invigorated her life as did no other single circumstance in her career." (MacDermot 1941, 72) She went on rounds with him, and was even invited to a students' night at his home. She was irrefutably mesmerized by him, and indeed even fostered a love of him that would grow for the rest of her life. It was Osler who reaffirmed for her what a splendid opportunity she had at the museum, and encouraged her to see what she could do with it (Waugh 1992, 56).

Maude returned from Baltimore a little overwhelmed with the trip, her practice responsibilities, the museum duties, and personal problems. She wrote in her journal how she "...had a sort of nervous breakdown from worry and over-tiredness, and was off work for six months." (MacDermot 1941, 75)

She returned to work and dedicated herself completely to the development of the museum collection. In 1900, while still working on classifying and organizing the many specimens, she came across a unique heart specimen in the museum. It had been improperly labeled, so Maude wrote to Sir William Osler to ask for more information about it. He replied that the heart was one of the oldest in the museum. The specimen was a three-chambered heart, which had been previously described by Dr. Andrew Holmes in 1823 – and is consequently known as the Holmes heart. Maude's sixth paper, published in the *Montreal Medical Journal* in 1901, revisited this previously described specimen (MacDermot 1941, 76). Subsequent to this, students began visiting Maude's museum to learn from her specimens. Students loved this exposure partly because Maude imparted such enthusiasm to them and dedicated so much time and effort to helping them. This museum teaching was so well liked by the students, that in 1904 the school incorporated it into the mandatory curriculum (Dobell 1988, 659).

While writing about the historical Holmes heart, Maude became interested not only in the history of the specimen, but also in the history of Dr. Holmes himself. Maude published her account of Holmes in 1901, her first historical work, which led to an invitation to write about a new medical building opening at McGill the following year. Maude exceeded any expectations, and wrote a historical sketch of the Medical Faculty of McGill University including a history of the building. This sketch was published in the *Montreal Medical Journal* and established Maude as an authority on the medical history of Montreal (MacDermot 1941, 205).

In 1904, Sir William Osler came to Montreal to visit Maude. The purpose of his visit was to accurately identify as many of his pathological specimens as possible for Maude who was cataloguing them. With surprising memory of the specimens, which he hadn't seen for some twenty years, he described the history and clinical information for the specimens. Maude used the notes taken during Osler's visit to develop a book, which she completed in 1905, called the Osler Catalogue (Waugh 1992, 59).

During her curatorship, Maude developed a special interest in congenital heart defects. It was her special interest in heart specimens that prompted an invitation from Osler in 1905

to write a chapter on congenital heart defects in his book *System of Modern Medicine*. Of the 105 contributors to the work, she was the only woman. Tragically, in the spring of 1907, the medical building was ravished by fire destroying many of the irreplaceable specimens. Some pathologists lost whole libraries, and Dr. Adami lost a whole manuscript for a book he was writing. Maude, however, was most fortunate in that her manuscript for Osler's book was saved. The fire had stopped just before the Osler Collection. Maude had to work hard to salvage damaged specimens, many of which had lost labels and had fallen from their broken glass containers. Contributions from the London Museums and the Army Medical Museum replaced many of the lost specimens. When Maude's contribution to Osler's book was completed later in 1907 it was highly praised by Osler who said in a letter to Maude "...it is far and away the very best thing ever written on the subject... For years it will be the standard work on the subject, and it is articles of this sort – and there are not many of them – that make a system of medicine." (MacDermot 1941, 102) It included her system for grouping defects, as well as some very modern thoughts on the possibility of surgical correction of some defects, and on the role and importance of prevention by prenatal care, recognizing possible genetic and environmental risk factors (Ferencz 2000, 891).

The other significant activity Maude undertook during her museum days, was the organization of the International Association of Medical Museums (now the International Academy of Pathology). Maude was the secretary-treasurer of the association from its inception in 1906 until her death. She was also the editor of the regular *Bulletin of Pathology* prepared by the association to encourage exchange of specimens between curators, and to promote the uniform system of classification she had developed (Waugh 1992, 68).

Although Maude's relationship with McGill hadn't substantially improved in terms of respect and acknowledgement of her talents, she was receiving such international recognition that McGill could deny her no longer. Maude was presented with an honorary MD in 1910. Although not a large enough recognition of her contributions, it was a big step for the school, as they did not begin admitting women into Medicine until 1918 (Kelen 2000, 897).

In 1915 to 1918 Maude was thrown into yet another role. Because the existing editors of the *Canadian Medical Association Journal* were off in Europe fighting in World War I, Maude became the acting editor of the journal. She remained on the editorial board of the *Journal* for the remainder of her life. As in many other roles, Maude was not remunerated for her work (MacDermot 1941, 117).

Also in 1915 Maude's role as a teacher and historian expanded. She had given a lecture on Florence Nightingale to the Harvard Historical Club. It was so well received, that the lecture was printed and sold by Maude to raise money for the Canadian Red Cross Society. When Maude's hero, Sir William Osler, read the work he wrote to Maude "What a delightful bit of work! ...Stop pathological work at once and take to your natural vocation – bibliography!" (Waugh 1992, 99) The lecture also prompted an invitation to teach a section of history to Nursing Students at the Royal Victoria Hospital. For this

role, Maude developed a set of over 200 lantern slides. They became so popular that she published her lectures with the slides in *The Canadian Nurse*. Her lectures became so desired that several teaching schools in Canada and the United States purchased them (MacDermot 1941, 118-9). She continued teaching nursing students until 1933.

Owing to her leadership in the field, in 1918 Maude was appointed acting curator of the Canadian Army Medical Museum. The army's specimens, along with some military workers to do the actual cataloguing, were brought to McGill and Maude supervised the work. Her McGill catalogue was used as the model for this War Museum catalogue. Maude also performed the editing of the catalogue before its publication. She held this position until 1922 (MacDermot 1941, 155).

The year 1919 was indeed one of great sorrow for Maude Abbott. It was during this year that her life-long mentor, guide, father figure, and supporter Sir William Osler, died. It was very shortly after his death that Maude began working on a tribute to her hero. She dedicated an entire volume of the *Bulletin of Pathology* in memoriam to "Canada's most famous physician, teacher, and pathologist." (Kelen 2000, 897) Osler was, after all, instrumental in the organization of the Bulletin and in obtaining funding to keep it securely running. She requested and received contributions from 120 people from all over the world, and over a period of six years, created what ended up to be a 600-page book to honor Osler (Smith 1982, 776). Because the book became so extensive, the cost of it naturally increased significantly and surpassed the ability of the society to fund. Maude took it upon herself to fundraise and wrote personal letters to people asking for contributions.

By the year 1923 Maude was still fighting with McGill for advancement. In an attempt to pressure the school into promoting her, Maude took a leave of absence and accepted a position at the Philadelphia Women's Medical College. She was an assistant professor of Pathology and Bacteriology from 1923 to 1925. Finally, upon her return she was promoted to Assistant Professor of Medical Research at McGill (Kelen 2000, 897). This would be the highest rank she would achieve, and she remained assistant professor until her retirement in 1936.

Maude's most ambitious historical project was published in 1928. *The History of Medicine in the Province of Quebec* was written as part of a series called *The Storied Province of Quebec*. Maude later had her piece published as a separate volume (MacDermot 1941, 207). Her work as a historian continued throughout her life, and in all she published eleven historical works (Waugh 1992, 100).

In the years following Maude's chapter in Osler's *System of Modern Medicine*, Maude continued adding specimens to her congenital cardiac diseases collection. She was aided in doing so by a growing circle of professional friends. When Maude's masterpiece – the Atlas of Congenital Cardiac Diseases – was published in 1936, it contained 1000 cases. The book was instantly successful and for many years it was known as the "definite work on the subject" (Waugh 1992, 80)

In 1935 Maude received a letter from the university informing her that "...in keeping with standard institutional practice, she was to be retired the following year, when she reached the age of sixty-five." (Waugh 1992, 116) This news caused old battles between Maude and the University to flare. She pleaded for permission to continue working, although her request was denied. Also refused was her request to be retired with an advanced academic rank of Emeritus Professor. It softened the blow somewhat for Maude that friends of hers Stephen Leacock and Charles Martin (her best friend and the dean of Medicine) were also being forced to retire.

Even after her retirement Maude remained actively involved in her profession. She continued as editor of the *Bulletin* until 1938. In 1939 McGill finally gave Maude some much deserved recognition by awarding her an honorary LLD (doctorate of laws). Only 2 days after this award was conferred, Maude left for a lecture tour of the Pacific Coast of the United States. This lecture tour was sponsored by the Women's Physician's Club of San Francisco. The tour lasted just over four weeks, and in Maude's description of the tour "...[reflected] both the warmth of her own reaction to the treatment she received as well as the esteem and affection in which she was clearly held by her distinguished hosts." (Waugh 1992, 117) Her schedule was very demanding and had her giving lectures, participating in clinics, demonstrations, and consulting on unusual cases. Maude recounted in her journal that her delivery of the Stanley P. Black Memorial lecture on Sir William Osler "...might well be described as the crowning experience of this memorable tour." (MacDermot 1941, 192) It was on this trip that Maude learned of her election as honorary member of the New York Association of Medicine and the California Heart Association. She was most gratified, however, by her honorary membership in the Osler Society of McGill, which had not yet permitted female members.

It was the following year that Maude suffered a cerebral hemorrhage that ultimately took her life. She died on September 2, 1940. Her death was felt throughout the medical community worldwide, and there were tributes to her in *BMJ*, *CMAJ*, *JAMA*, the *Medical Women's Journal*, and *Lancet* among others. The *McGill Medical Journal* devoted the October 1940 issue to tributes to Maude from many colleagues and supporters including her dearest friend, Dr. Charles Martin. "These were warm and glowing reminiscences, anecdotes and expressions of friendship that reflected the impact Maude had left on the lives of her colleagues." (Waugh 1992, 120)

Maude Abbott was a great Canadian medical pioneer. She was underappreciated by her own school in her time, although late in her life her many great achievements were recognized by McGill. She was an innovator, and played an integral role in the advancement of women in medicine. She was a devoted and meticulous worker who left her mark on medicine in numerous ways including her scientific and historical research, her teaching, and her many literary works, most notably, her extensive work on congenital heart defects. It is on the shoulders of great pioneers like Maude Abbott that our profession stands, and we should try to always remember and appreciate their great efforts.

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DR. MURRAY LLEWELLYN BARR: DISCOVERER OF THE BARR BODY

By

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Preceptor: None

ABSTRACT

Born in 1908 in Belmont, Ontario to Irish immigrant parents, Dr. Murray Llewellyn Barr spent the majority of his life in Ontario. He attended the University of Western Ontario, graduating with a B.A. in 1930, and went on to receive his M.D. in 1933. Intending to pursue a career in clinical neurology, Dr. Barr taught anatomy at the University of Western Ontario and began his research work on neurons.

During the Second World War, Dr. Barr spent time in Canada and in Britain serving in the medical branch of the Royal Canadian Air Force. In 1945 he retired with the rank of Wing Commander, at which point he returned to the University of Western Ontario as a teacher and researcher with academic interests in neuroanatomy.

While he contributed greatly to the field of neurology, Dr. Barr is best known for his work with his graduate student Mike Bertram; work that originated in the field of neurology, but turned into a significant discovery in the field of cytogenetics. Studying the motor neurons of cats, Barr and Bertram discovered a stained mass in about half of the cells. This mass was only ever seen in the cells of female cats. Because of this, Dr. Barr named the mass “sex chromatin,” but it is now widely known as the Barr body. This discovery has contributed greatly to the understanding of many genetic disorders, especially those associated with mental retardation.

Dr. Barr’s contributions to medicine have been recognised with many prestigious awards including the Gairdner Award of Merit, the Joseph P. Kennedy Jr. Foundation International Award in Mental Retardation (presented by President John F. Kennedy), and a nomination for the Nobel Prize in Physiology and Medicine. Dr. Barr continued his research and teaching until his retirement in 1977. He died on May 4, 1995.

Dr. Murray Llewellyn Barr, a Canadian scientist, became known world wide for his contribution to the world of cytogenetics by a simple observation made in the lab and enough curiosity and reasoning to piece together what it meant. The discovery of the Barr body, later found to be an inactivated X chromosome, was made by chance while observing cat neurons for cytological changes due to stimulation. Dr. Barr, a medical

graduate of the University of Western Ontario, had a true passion for neurology and teaching, which he combined in the beginning, and again at the end, of his career at the University of Western Ontario. The significance of Dr. Barr's discovery must be considered in the context of knowledge of the time: in 1948 karyotyping of cells was not possible, and the normal chromosome complement was believed to be 48 instead of 46 chromosomes as is now known. The discovery of a cytological characteristic capable of distinguishing between male and female gender by microscopic examination led to inquiry into and a better understanding of a number of genetic syndromes. It had uses as far reaching as "gender verification" testing performed for the Olympic Games up until 2000, raising the question of what really defines gender.

The Barr family first emigrated to Canada in 1820 from Northern Ireland and settled in a farming community in eastern Ontario. Murray Llewellyn Barr was born to William Llewellyn and Margaret Barr on June 20, 1908. Less than three years later tragedy befell the family with the death of William in 1911. Margaret Barr sold the farm and moved with Murray and his older sister Daisy Alberta (born 1897) to the village of Belmont where they lived until 1920. For Margaret, the greatest concern was the education of her children, and so in 1920 the family moved to the nearby city of London, Ontario. Here Murray attended to London Collegiate Institute. While Murray had considered becoming a minister, at the London Collegiate Institute he was greatly influenced by his science teacher, and so began his lifelong passion for science.

Upon his graduation Murray started at the University of Western Ontario enrolled in a Science and Medicine Program. Even at this early stage Murray excelled in all that he did starting his university career with a scholarship in French based on his senior matriculation exams. Throughout his university career Murray continued to excel and broaden his interests receiving awards in English literature, a gold medal in the Honours General Science Programme, as well as recognition for his excellence in physiology and the "Class of 1917" prize for his performance as a clinical clerk. Murray was also a part of the student government and began writing for student publications at this time, thus began his lifelong interest in the history of medicine. Murray graduated with his Bachelor of Arts in 1930 and his Medical Doctorate in 1933.

Upon receiving his M.D. Murray went to Eerie, Pennsylvania to do his general internship at Hamot Hospital. While Dr. Barr's decision to go to Eerie was likely for financial reasons, it proved to be an important decision on a more personal level as Eerie was where he met a nurse, Ruth Vivian, who was to become his wife and lifelong partner. One year later, in 1934, Dr. Barr came back to Canada to set up a family medicine practice in Ontario. This was in the midst of the Great Depression, the effects of which were felt throughout the country. Finances were tight and often times Dr. Barr found himself accepting offerings of produce and services in place of money from patients.

Dr. Barr's real passion was neurology, and in order to facilitate following a career in this field he became a voluntary demonstrator in the physiology lab of Dr. Miller at the University of Western Ontario. Although the salary was a modest \$1800 a year, when

the University offered Dr. Barr a position as an instructor in neuroanatomy in 1936, Dr. Barr willingly accepted. Dr. Barr said of the position:

... it would be at least a beginning, and I hoped that an opportunity in clinical training might open up eventually. Instead, when I took up the post on July 1, 1936 it was the beginning of a life-time career in the basic-sciences at the University of Western Ontario.

In 1936 Dr. Barr was commissioned as Lieutenant in the 15th Ambulance Royal Canadian Army Medical Corps. He gradually moved up in rank and in 1939 enlisted and transferred to the medical division of the Royal Canadian Air Force. He served for five years, both in Canada and in England. One of Dr. Barr's duties during this time was to assess flight crews and determine when they were fit to return to duty. Surprisingly, this would later come to play a role in Dr. Barr's discovery of the Barr body and his subsequent shift into the field of cytogenetics.

In June of 1945 Dr. Barr was released from active duty with the rank of Wing Commander. Upon his return to the University of Western Ontario where he was appointed as an Associate Professor of Neuroanatomy, he resumed his research and made plans for doctoral study under Dr. Hebel Hoff at McGill University. Once again, his plans to pursue a PhD were cut short- this time by an offer from the University of Western Ontario to undertake the teaching of neuroanatomy and histology to the medical students.

While teaching at the University of Western Ontario, Dr. Barr resumed his neurological research, this time with the intent of determining if cytological changes could be detected in neurons following prolonged activity. The research required a few specialized pieces of equipment and before any work could begin funding had to be found. The \$400 necessary was quite a substantial sum at the time, but luckily the money was obtained, although not through the usual sources of funding. As Dr. Barr related in a reminiscence of his work:

The money came from the Institute of Aviation Medicine, R.C.A.F., which now seems an unlikely source, especially in view of the subsequent direction of the research. But at that time the long night flights by R.C.A.F. bomber aircraft, and the attendant aircrew fatigue, were recent enough to provide a connection, albeit remote, with the planned experiment. More pragmatically, my continued association with the R.C.A.F. and aviation medicine through the U.W.O. Squadron and a Reserve Medical Unit, as well as the Panel on Aviation Medicine, Defense Research Board of Canada, probably did the cause no harm.

At this time E.G. (Mike) Bertram became a graduate student under Dr. Barr's supervision. The hypoglossal nerve of the cat was used as the neuron of choice because of its accessibility as well as the large cell body. The neurons were stimulated in the animal for eight hours, the animals sacrificed at growing intervals after stimulation, and

the neurons examined for cytological changes. Among other observations, Mike Bertram noted the presence of a chromatin mass that was originally called the “nucleolar satellite.” This observation did not call any special attention until a specimen was found which lacked this nucleolar satellite. After discovering another specimen like this, Dr. Barr reviewed the records and found a correlation between the presence of the chromatin mass and the gender of the animal. It seemed incredulous that cytological sexual dimorphism would have been undiscovered to this point, so nervous tissue of further animals were studied, as well as human neurological tissue. The dimorphism proved to be present in all of the samples examined- female tissues contained the chromatin mass while male tissues lacked the material. From his observations, Dr. Barr hypothesized the chromatin mass to be the heterochromatic portions of the two X chromosomes present in females. While not entirely correct, the link between the chromatin mass and the X chromosome was made, and thus the chromatin mass came to be known as “sex chromatin.”

Once this sexual dimorphism was confirmed in a variety of tissues across many species, Dr. Barr decided to study the clinical application of the discovery. The first condition studied was hermaphroditism. Skin biopsies from three types of hermaphrodites were studied- female pseudohermaphrodites having ovaries only, male pseudohermaphrodites having testes only, and true hermaphrodites having both ovarian and testicular tissues. Skin biopsies were delivered to Dr. Barr’s lab from around the world. While the majority of the samples were from the Americas and Europe, samples came from as far as Africa and Australia. The results were as predicted; female pseudohermaphroditism is commonly due an endocrine disorder of females, and all of these biopsies resulted in the typical female presence of the sex chromatin. Male pseudohermaphrodites were all found to be lacking sex chromatin, and among the true hermaphrodites some samples were cytologically male, while others were cytologically female.

Shortly after these results, Dr. Barr was invited by Dr. Lawson Wilkins to speak at the John Hopkins Hospital about his work. Following the presentation Dr. Barr joined Dr. Wilkins, a pediatric endocrinologist, at his clinic. While at the clinic they saw a girl with Turner’s syndrome. Turner’s syndrome is now known to be a genetic disorder, one of the symptoms of which is ovarian dysgenesis. Because of the involvement of the sex organs in this disorder, Dr. Wilkins suggested testing for sex chromatin, which was done shortly after this trip. In the words of Dr. Barr:

They arrived in groups of three as a rule; each specimen had a number and I was told only that they were from a Turner’s syndrome patient and normal persons of either sex. (Dr. Wilkins may have had doubts about the reliability of the test, or perhaps he was just following sound research methodology.) When the biopsies had all been reported on, I was informed that those from girls with Turner’s syndrome has male-type nuclei, indicating that they had only one X chromosome, and that the other’s conformed with the donors’ gender.

Other researchers reported these findings that same year of 1954. With future advances in karyotyping, it was eventually discovered that patients with Turner's syndrome had a chromosome complement of 45 X0, and therefore patients were missing one X chromosome.

At about this same time, at a meeting of the American Association of Anatomists it was suggested to one of Dr. Barr's graduate students that a more simplistic approach to obtaining a sample may be from the buccal epithelium as opposed to skin biopsies. This was tested in the lab and it was found that the buccal smear produced consistent accurate results. This opened the door for many future studies as well as some controversial testing.

A sample was received from Italy from a patient with Klinefelter's syndrome. This is another genetic disorder which results in males with, among other characteristics, testicular dysgenesis. Surprisingly, this sample tested positive for sex chromatin- there appeared to be an extra X chromosome present. Further testing in Klinefelter patients was done with the same results. These results were published in 1956. Not many years later, when karyotyping became possible, patients with Klinefelter's syndrome were found to have a chromosome complement of 47 XXY.

Klinefelter's was known to be associated with mental retardation, and with the less intrusive sampling offered with the buccal smear, it became feasible to do more large scale testing for presence of sex chromatin. Dr. Barr obtained permission to conduct these tests in institutions for the mentally retarded in Ontario. While mental retardation is not seen in Turner's syndrome patients, buccal smears were performed on both male and female patients of these institutions. As Dr. Barr expected, Klinefelter's syndrome was present at a higher frequency than in the general population. More unexpectedly, some of the male, as well as female, patients were discovered to have more than one chromatin mass present in their cells. Dr. Barr hypothesized that this may be an indication of multiple X chromosomes being present, and again future karyotyping proved this to be a correct assumption.

It was at a meeting of the American Genetics Society at Pennsylvania State University in 1959 that Dr. Barr was approached by a researcher by the name of Susumo Ohno who had discovered what the sex chromatin really was. Dr. Ohno arrived the night before the keynote address Dr. Barr was to give, but Dr. Barr made arrangements to allow Dr. Ohno to present his discovery at the conference. Dr. Ohno had discovered that in males and females only one X chromosome is euchromatic, while the other X chromosome in females is heterochromatic and comprises sex chromatin. It was Dr. Mary Lyon who discovered, in 1961, that an X chromosome within females is randomly inactivated in every cell of the body, thus giving rise to sex chromatin. Dr. Lyon is also credited as calling sex chromatin the "Barr body".

Testing for the presence of the Barr body has had an impact on science and society in other ways as well. When tissues were first being tested to determine if the Barr body could be used to differentiate between sexes, there were some abnormal tissues found.

While benign tumor cells were found to have the expected test results, cell samples collected from human teratomas were often found to have multiple Barr bodies present. This was believed to be due to aneuploidy in the cancer cells. Dr. Barr also conducted research with Dr. David Carr into the incidence of early spontaneous abortions. This led to the discovery that many of these fetuses contain an abnormal chromosome complement.

A man with strong family values, Dr. Barr and his wife Ruth had four children, all of whom continue to live in Ontario. The Barr's had three sons, Hugh, a neurosurgeon, Robert, a hematologist, and David, a building contractor, and one daughter, Carolyn, a nurse. Ruth Barr suffered a debilitating stroke in 1990, and Dr. Barr continued to spend time with his wife until he entered a retirement community due to a decline in his health. Dr. Barr passed away in 1995 from complications due to cancer. His death was only months after that of his beloved wife Ruth.

Dr. Barr's accomplishments were recognized with many awards and honorary degrees. Among the more notable awards were the Joseph P. Kennedy Jr. Foundation Award presented to him by J.F.K. in 1962, and the Award of Merit from the Gairdner Foundation in 1963. Dr. Barr is also an Officer of the Order of Canada (1968) and has a lecture series, the Murray L. Barr Lectureship in Human Genetics, that still continues.

While the use of testing for the Barr body has become outdated in the realm of scientific research, until very recently it has been in use in a controversial way in the world of sports. In 1968 the International Olympic Committee deemed it necessary for every athlete registered in a woman's competition to undergo "gender verification" in order to qualify to compete. It was at first proposed that testing would be carried out by means of physical inspection, although this quickly progressed to determination of sex by the presence or absence of the Barr body in a buccal smear. Should this test give indication that the competitor was in fact male, further testing would be done to verify the results. While data on the number of athletes failing the Barr body test is not publicly available, the testing procedure sparked many debates over the legitimacy of this process with the opposition arguing that test results bear significant psychological weight for those being tested and do not accurately determine what the committee has set out to determine- are any competitors in women's events at an unfair advantage?

From the observation of a staining mass in the nucleus of a cat neuron has come a discovery that greatly impacted the burgeoning field of cytogenetics and had such far reaching impact as gender testing in the Olympic Games from 1968 all the way until the Sydney Games of 2000. In spite of the impact of this discovery, Dr. Barr remained true to his modest nature. It has been noted by those who knew Dr. Barr that he always referred to the chromatin mass as "sex chromatin" and never the "Barr body." And while his research had an undeniable impact on the understanding of cytogenetics at the time, Dr. Barr never considered himself to be a true cytogenetics researcher. Instead, he remained true to his original passion for neurology and after his productive foray into cytogenetics, returned to his neurological research and teaching at the University of Western Ontario.

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DR. JOHN DOSSETOR: A NEPHROLOGIST WITH A GREATER VISION

By

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ABSTRACT

In 1998, the University of Alberta Bioethics Centre was renamed in honour of the celebrated nephrologist and bioethicist, Dr. John Beamish Dossetor. It seems strange to us now, but at the start of his career, the concepts both of nephrology and bioethics were still very much foreign to the medical world. Dr. Dossetor's experiences founding nephrology, particularly in Canada, proceeded to inspire him to contribute to modern bioethics.

In 1957, after Dr. Dossetor completed a term as Chief Medical Resident at the Royal Victoria Hospital in Montreal, McGill expressed a need for kidney doctors, so he trained to become one of their first doctors capable of answering consultations regarding acid base, electrolyte, and kidney disturbances. In 1958, when a woman presented in acute renal failure, Dr. Dossetor realized that the safest option would be to transplant a kidney from her identical twin; thus he coordinated the first kidney transplant in the Commonwealth. By 1963, he was directing renal and urologic research at the Royal Victoria Hospital, and overseeing Canada's first cadaver kidney transplant program, while pursuing important transplantation immunology research. In 1968, after being appointed a Career Investigator of the Medical Research Council of Canada, he accepted a position as director of the nephrology division at the University of Alberta. Dr. Dossetor's interests let him to co-found the Kidney Foundation of Canada, and become involved in many other organizations.

With the rapid advance of technology, Dr. Dossetor began to face increasing numbers of ethical dilemmas, including a patient who found someone willing to sell a kidney. This stimulated him to study bioethics in 1985, and, a year later, direct the University of Alberta's new Joint-Faculties Bioethics Project. His many achievements and engaging personality have been an inspiration to countless others, leading to his appointment as an Officer of the Order of Canada in 1995.

Introduction

Dr. John Beamish Dossetor is an extraordinary physician who not only to has a wonderful personality, but also manages to excel in all areas, whether that be clinical work, research, teaching, administration, or balancing those responsibilities with a personal life. He has played a key role in shaping not only the field of nephrology, but also the field bioethics in Canadian medicine. One of the first nephrologists in Canada, he was a pioneer in bringing kidney medicine to the country, and coordinated the first kidney transplant in the Commonwealth. He has conducted significant research in the area of transplantation immunology, and his leadership has left a legacy of organizations and programs that still exist today. Dr. Dossetor has also striven to meet the growing demand for bioethics, making important contributions to that field, and directing the University of Alberta's Joint-Faculties Bioethics Project until his retirement.

Early Life

John. Dossetor was born to Australian parents in India in 1925. He was educated in Wiltshire, England at Marlborough College before entering Oxford University, St. John's College as an Open Scholar in Natural Science in 1943. Three years later, he completed an Honours degree in Physiology and proceeded to St. Bartholomew's Hospital in 1947 to complete his clinical training and medical degrees from Oxford University and London University.

In 1951, Dr. Dossetor was called for military service, and served until 1953 as a medical officer in the Brigade of Gurkhas, a Nepal-based part of the British Army. During his experiences in India, Nepal, and Malaya, Dr. Dossetor recalls some of his first exposures to weighty ethical issues. As there was no medical coverage for the local people, Dr. Dossetor and the other medical officer felt justified in providing a broad range of free services for patients every morning, underneath an appointed tree. "We were the surgeons, the anaesthetist, the physician, the lab person, the whole lot rolled into two." (Dossetor, 2003) One day, despite not being trained for the procedure, he attempted to operate on a lady with an enormous goitre, who subsequently died. He realized that as a physician, he wielded a great deal power, particularly over those who had little else to rely on. Dr. Dossetor resolved to be more aware of this responsibility, and to learn as much as possible about medicine. In particular, he decided to integrate research into his medical career.

Another brush with ethics did not take long to present itself. In 1954, he returned to London to complete his residency training at Hammersmith Royal Postgraduate School under Professor Dame Sheila Sherlock, known internationally as the "Queen of the Liver" thanks to her many studies involving percutaneous liver biopsy. Dr. Dossetor was made completely responsible for two wards, which included protecting the interests of the patients during the research that was conducted: "The duty of the house officer was to defend the patients against the zeal of Sheila's registrars in their fiendish search for truth!" (Dossetor, 2004) Unfortunately, a study conducted at the hospital during his time

there was later listed in Henry Beecher's classic paper describing twenty-two examples of unethical research:

Example 14: In this study of the syndrome of impending hepatic coma in patients with cirrhosis of the liver certain nitrogenous substances were administered to 9 patients with chronic alcoholism and advanced cirrhosis: ammonium chloride, di-ammonium citrate, urea or dietary protein. In all patients a reaction that included mental disturbances, a "flapping tremor" and electroencephalographic changes developed. Similar signs had occurred in only 1 of the patients before these substances were administered. (Beecher, 1966)

This study enjoyed the dubious honour of sharing company with studies where mentally handicapped children were fed infectious agents, a woman was injected with a melanoma from which she subsequently died, and effective treatment was withheld from patients. Dr. Dossetor realized that while at one time, no one thought twice about these studies, there was a growing demand for ethical research practices in medicine. A demand he would help to satisfy later in his life.

Canada's First Nephrologist

The Chief of Medicine of Bartholomew's Hospital, Ronald V. Christie, who had moved to McGill University as Chief of Medicine, told Dr. Dossetor of a teaching fellowship that had become available there, and gave him 24 hours to make a decision regarding it. Dr. Dossetor soon agreed to come to Canada for a year. The paltry pay of \$200 a month was offset by the fact that his wife-to-be had just moved to the relatively nearby New York City. He completed the fellowship, spent a year as the Chief Medical Resident, and remains in Canada to this day.

Upon completion of his residency, Dr. Christie asked Dr. Dossetor what he planned to do to justify his continued presence in the hospital. "Liver disease!" (Dossetor, 2004) was Dr. Dossetor's quick reply, but Dr. Christie did not feel that they were prepared for a hepatologist, so he suggested studying the kidney instead. Dr. Dossetor, an opportunist, agreed, and was sent by bus to Chicago for a week, to learn what was known about the kidney at the time. He studied under R.M. Kark and C.L. Pirani, famous for their development of a percutaneous kidney biopsy technique.

Along with Guy Lemieux of Hôpital Hotel Dieu de Montreal and Michael Kaye of the Montreal General, Dr. Dossetor became among the first doctors in Canada to call themselves "nephrologists," before the specialty was even recognized by the College of Physicians and Surgeons.

The First Kidney Transplant in Canada

Dr. Dossetor and Dr. Robert O. Morgen soon formed a renal service, "inspired by a questionable capacity for treating acute renal failure by hemodialysis, a conceit in manipulating electrolyte imbalance, and proven dexterity in wielding the renal biopsy

needle” (Dossetor, 1991). On a Monday late in the spring of 1958, Dr. Dossetor was covering call for Dr. Morgen, who was enjoying some end-of-the-season skiing in the Laurentians. In fact, Dr. Dossetor had agreed to extend his cover for an additional day, which happened to be the day that a young, 15-year-old lady was admitted to the Montreal Neurological Institute in convulsions. She was severely hypertensive and uremic. An open renal biopsy confirmed a diagnosis of chronic pyelonephritis and renal failure.

The patient was named Moira Johnson, and Helene Desjardins, the resident, discovered the existence of an identical twin, Nola Johnson, and suggested the possibility of a renal transplant. A mere two years earlier, the first identical-twin transplant had been conducted in Boston, followed by an article on eight such cases with inspiring results. At the time, experiences with dialysis had been discouraging, so it was considered the greater risk and not a treatment option. The girl’s mother, supported by her closely knit family, was resolved to have her daughter stay at the Royal Victoria Hospital rather than attempt the operation in Boston. Before the transplantation procedure could take place, family court had to grant the parents permission for the nephrectomy, “a mutilation procedure,” to be performed on the healthy twin, and skin grafts were exchanged to demonstrate that there was no rejection. A surgical team was assembled which consisted of Dr. Joe C. Luke, a vascular surgeon and Dr. Ken MacKinnon, a urologist. Although, the presence of a nephrologist in the operating room was unusual, and considered a “loose cannon on the deck!” Dr. Dossetor supported by Drs. Rohn C. Meck and Robert Morgen were also included. (Dossetor, 1991) A special resident was assigned to carry out three hourly fluid and electrolyte balances several times daily on an enormous wall chart, using a slide rule, and three nurses were assigned to the patient for good measure. Amazingly, the procedure progressed smoothly. Dr. Dossetor was elated:

It was one of the things I’ll never forget, the speed at which urine came out of the ureter when the vascular anastomosis had been finished but the rest of it hadn’t been tidied up and already there was a flow of clear, golden fluid. That was an exhilarating moment for us all actually, everybody there. (Dossetor, 2003)

The initial diuresis was 800 ml in the first hour, and the postoperative course was without incident, although the topic of another two publications. The kidney recipient lived another 25 years, and Dr. Dossetor remains friends with the donor. This was the first solid vital organ transplant in the Commonwealth.

Kidney Transplantation

By 1963, Dr. Dossetor was director of renal and urologic research at the Royal Victoria Hospital, and was responsible for Canada’s first cadaver kidney transplant program which he oversaw for the next 6 years. While survival rates were not impressive, in the mid-60s, this was the largest program of its kind in the world.

Dr. Dossetor drew much of his inspiration for his research from the annual meetings of the Society of Clinical Investigation. At the 1963 meeting, Scribner’s Seattle group

demonstrated that it was possible to maintain someone with minimal renal function for over a year with the use of their Quinton Teflon-silastic radial arteriovenous shunt. Suddenly, long-term dialysis became a reality. While many others, such as Dr. Michael Kaye of the Montreal General Hospital, were opting for maintenance hemodialysis, Dr. Dossetor, based on his experiences with transplantation, employed a policy of maintenance hemodialysis pending cadaveric kidney transplant, which, indeed, remains the current standard of practice.

A Symbiotic Relationship: The Cross-Circulation Experiment

In 1967, Dr. Dossetor was the first to note, in perhaps the only published paper with no references, what was later termed the blood transfusion effect. His analysis of 59 kidney transplants showed that patients who had undergone multiple blood transfusions associated with long periods of hemodialysis seemed to have a more favourable outcome after cadaveric kidney transplantation. This inspired further research, and similar findings were presented by Paul I. Terasaki's group to the Fourth International Congress of The Transplantation Society in San Francisco. In the wake of the discovery of hyperacute rejection and the harmful role of antigens and antibodies in that phenomenon, these findings were met with much astonishment and disbelief. By 1978, Opelz and Terasaki had shown that transplant recipients who had previously received more than 20 blood transfusions were associated with a one and four year survival of 71 and 65% respectively, compared with 42 and 30% for untransfused patients (Opelz, 1978). Thus, the blood transfusion effect was used to good effect for many years.

This finding also led to another fascinating incident – a cross-circulation experiment that Dr. Dossetor performed in 1967. Since there were no transplantation programs east of Montreal in Canada at the time, it was not unusual for patients from the Maritimes to be referred; however, it was deemed impossible to manage such patients after transplantation if they were not available for follow-up. Consequently, when a physician called about a woman from Burgeo, a part of Newfoundland only accessible at certain times by sea, he was told that nothing could be done for her. Being a deontologist, he put her on a plane to Montreal with a note saying, "Please see and advise." It had been confirmed that not much could be done for her other than to dialyze her a few times and send her back, when a resident noticed that she had the same blood group as another patient dying of alcoholic cirrhosis. If multiple blood transfusions were beneficial for potential transplant recipients, then cross-circulation would maximize the benefit, as well as sustain both vital end-organ failures. Similar setups had been used in the past for unusual situations, such as life-saving congenital heart surgery where parents were used for donor circulation before the advent of the bypass membrane oxygenator.

A consent form was drawn up between the two families, with the understanding that "[t]hey would live symbiotically for as long as possible. In the event that one died, the vital organ which the other needed would be transplanted, be it liver or kidney, in the hope that by then some form of immunological tolerance would have been established." (Dossetor, 1991). The patients were placed on a sensitive bed scale, and straight silastic catheters for interpatient arteriovenous cross-circulation were set up. Flow was adjusted

via a screw clamp. During the first week, there were two 36- and 24-hour cross-circulation sessions, during which the condition of both patients improved dramatically. Both ladies would emerge from her hepatic or uremic coma. This continued for a short time until the lady with liver failure died of a massive gastrointestinal hemorrhage. As it was Labour Day, and the transplant surgeon was in Algonquin Park, there was a delay in arranging for the transplantation, but it took place nevertheless. For 19 days the patient experienced oliguria. Finally, diuresis occurred and she returned to normal renal function in about a week. The patient was followed up annually, and lived another 9 years in Newfoundland. She subsequently had another child whom she named Victoria after the hospital. Unfortunately, when a similar situation arose a few years later, a proposal for cross-circulation was turned down by the new ethics committee.

Professional Involvements

One of Dr. Dossetor's patients, Morty Tarder, died from Goodpasture's syndrome at the unfortunate and young age of 26. His father, greatly devastated, asked Dr. Dossetor if anything could be done to prevent this in the future. After thinking about this for some time, Dr. Dossetor suggested he help think of ways to raise money for research. The father was enthusiastic. He formed a lay group, which, with the assistance for Dr. Dossetor and Guy Lemieux, was the beginning of the National Kidney Foundation of Canada in 1964. In their first few years they raised \$3000 a year, a figure which has now grown to nearly \$3 million a year.

It was around this time that Dr. Dossetor was also involved in founding the Canadian Society of Nephrology. Originally, in 1964, the Canadian Urological Society invited the nephrologists to join them as a medical branch, and Dr. Dossetor and five other colleagues were given honorary membership and attended their meeting in St. Andrews, New Brunswick that year. However, the nephrologists had diverse interests, ranging from calcium metabolism to endocrinology to hypertension, which did not necessarily coincide with the interests of the urologists. A decision was made to form a Canadian society for nephrology. The first meeting was held in 1965, and by 1967, a charter had been drawn up. By this time, 60-70 people identified themselves as nephrologists.

As a tribute to his prolific efforts, Dr. Dossetor is also considered a founding member of the Canadian Society of Immunology, the Canadian Transplantation Society, and the Canadian Bioethics Society. His professional involvements demonstrate his broad interest, and ability to excel in diverse areas.

Adventures in Tissue Typing

In 1968, Dr. Dossetor was appointed a Career Investigator of the Medical Research Council of Canada. He decided to put a greater focus on research, and moved to Edmonton, where Walter McKenzie, the Dean of Medicine at the University of Alberta, wanted to see kidney transplantation in the city and was able to get the government of Alberta to supply \$300,000 for a lab in transplant immunology. Irwin Diener, a basic immunologist from Melbourne, Australia, was also recruited to Edmonton, so the unit

was able to have both a more clinically-focused and a more basic research-focused director, which the MRC was pleased to fund for a further ten years.

The 1970s were witness to an astonishing expansion of knowledge about the main histocompatibility complex (MHC). Dr. Dossetor, in particular, was involved in finding homozygous typing cells, which were homozygous for a single DR antigen, and needed in order to identify the DR antigen system of HLA. These homozygous typing cells were more frequent in isolated human populations, so, in the early 1970s, Dr. Dossetor made several expeditions to Igloolik, an island in Hudson's Bay, and to Inuvik, Aklavik, and Tuktoyuktuk, at the Mackenzie River delta. During one visit, Dr. Dossetor was forced to unload a propeller driven plane in -50°C weather in the slipstream created by the aircraft, as it could not be shut down in that weather. Notably, Dr. Dossetor was able to find one family whose parents were homozygous for the same haplotype, and remarkably, all siblings tested identically serologically.

Another population that was studied were the Darisleut Hutterite Colonies near Edmonton, which were all descended from the few founding families who came from Russia in the mid-19th century. A survey of hyperglycemia and hypertension was conducted in exchange for lymphocytes.

Not all of Dr. Dossetor's research was benign. On one occasion, he attempted to bypass the ethics board by performing an experiment on himself, and the results were unexpected:

Unfortunately the lab had misread part of the test in my case so that when the serum was run into my veins I developed an anaphylactic reaction. I've said this a number of times. If you ever want to see the head of your department and the dean of your faculty in short order, this is one way of doing it. (Dossetor, 2004)

Dr. Dossetor's years with the MRC Transplantation Group were prolific, resulting in approximately 180 publications in about 12 years. Not only was he able to direct immunogenetics research and immunologic monitoring of transplant patients, but was also involved in teaching, as part of his positions as Professor of Medicine and Director of the Division of Nephrology and Immunology.

Bioethics and Beyond

Dr. Dossetor's experience with bioethics was longstanding. Aside from his early experiences in the military and on the wards with Sheila Sherlock, during his time at the Royal Victoria Hospital, he was responsible for consultations at the Allen Memorial Institute, where the infamous Ewan Cameron carried out his now universally condemned electroconvulsive therapy research on psychiatric patients. Dr. Dossetor was also exposed to many of the ethical questions regarding resource allocation raised by the advent of dialysis. During the earliest days of its introduction in Seattle, a committee of laypersons was formed to determine who would and would not receive this life-saving

but expensive treatment. Similarly, many at first found the concept of the cadaveric transplantations that Dr. Dossetor was carrying out to be gruesome.

In 1984, Ike Bryldt, an Edmonton patient awaiting kidney transplantation announced his willingness to pay \$5000 for a kidney. Some 150 to 300 people from across Canada offered to provide a kidney, before Dr. Dossetor pointed out that this was against the law. Bryldt proceeded to ask for a kidney out of love, whereupon he was still able to find six people willing to perform the donation. Dr. Dossetor refused to participate in the transplant, but was forced to question the role that physicians and the medical world played in making policy decisions.

Following this incident, in 1985, Dr. Dossetor devoted a sabbatical year to studying bioethics at the David Roy Institute for Clinical Research in Montreal, with Al Johnson at San Francisco, the Hastings Centre in New York, and the Kennedy Institute Course in Georgetown. He drew up a proposal for a bioethics initiative at the University of Alberta, which the Dean accepted. He returned to direct the University of Alberta's Joint-Faculties Bioethics Project, which, following his retirement to Ottawa in 1995, was renamed after him.

Conclusion

In 1995, Dr. Dossetor was recognized for his achievements in medicine and bioethics, and appointed an Officer of the Order of Canada. In 1999, he was also honoured with the Presidents' Award from the Canadian Society of Transplantation. He continues to be an active force, having recently been appointed ombudsman and resident consultant in publication ethics for the *Canadian Medical Association Journal*. His current responsibilities include helping to resolve ethical dilemmas and claims of unfair behaviour.

Although he is perhaps best recognized as a founding nephrologist and the coordinator of Canada's first kidney transplant, Dr. Dossetor's broader interests in research, leadership, and bioethics are a testament to his greater vision. Both nephrology and bioethics barely existed at the start of his career, yet now they are well established domains. Dr. Dossetor's has left Canadians with vast legacy of contributions and lasting achievements. These and his vibrant personality are sure to be remembered for a long time.

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MICHAEL SERVETUS: THE MAN, THE MYTHS, THE MARTYR AND THE MAKING OF MEDICAL HISTORY

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ABSTRACT

A child prodigy who studied at three different colleges and wrote a book taking direct aim at established religious dogma before the age of 20. A man forced to flee to a different country through fear of religious condemnation. A name and profession change before the age of 25. A man forced to relocate a second time, to a third country, after refusing to bow down to French Parliament. A person who wrote yet another book drawing the ire of both Catholic and Protestant religious authorities. An individual who was captured, jailed, and then escaped while being burnt in effigy. A character that returned to the site of his greatest injustice only to be incarcerated and burnt at the stake. Seemingly less consequential, this person also lived as medical doctor to the aristocrats, who, buried in all his religious ramblings, is generally regarded as being the first to accurately describe the lesser (pulmonary) circulation of the human body.

This life story sounds better suited to represent a series of sub-plots in a high-priced Hollywood action movie than the real life story of one Michael Servetus. Servetus was a man born to raise controversy. Whether it was his disapproval of childhood baptism and the representation of the Trinity, or his challenging of long held Galenic teachings of blood circulation, Servetus was not one to back down from his convictions.

Branded a heretic in his time, and later a martyr, Michael Servetus is now commonly recognized as being brilliant, unrelenting, arrogant, fearless and well ahead of his time in terms of questioning religious creed. These facts often distract his followers from his most influential, and nearly lost, discovery; that being his accurate description of pulmonary blood flow in human physiology.

Michael Servetus was a man of conviction and opinion. Better recognized today as a strong character in challenging religious doctrine, Servetus' contributions to the field of medicine are often overlooked or ignored completely. This decreased level of respect or recognition for his medical findings can be attributed to many factors including how he lived his life, how he was thought by many to be a fanatical religious heretic and how his writings were nearly lost forever as a final affront to all information which he believed.

Were it not for a few followers and fellow scholars who were able to read beyond Servetus' theological beliefs and egotistical ramblings, it may never have come to light that buried deep in his definitive book, *Christianismi Restitutio*, Servetus provided one of the first and most accurate descriptions of the lesser circulation since the time of Galen.

It is often hard to describe the life of one individual without describing the context in which they were able to grow, develop and change. In the case of Michael Servetus, the time of his birth, the actions of his contemporaries and the teachings of his predecessors were likely all influential in the outcome of his life. It is commonly acknowledged that Galen, the "father of medicine", is believed to have held medical advancement back for 1500 years. While not necessarily a product of his own teachings, Galen's followers thought him so correct that no one dared challenge his methods during the next one and half millennia. Galen, born in 129A.D., wrote prolifically on a variety of topics and established new scientific medical methods during his service to the Roman Empire up until his death (disputed 199AD-217AD). In relation to Servetus, Galen's proposed view of the lesser circulation was almost entirely different and considered sacrosanct at the time of Servetus' first publication. Contemporaries of Servetus such as Andreas Vesalius, born in Brussels in 1514 and best known for his anatomical text, were some of the first people to "push the envelope" and challenge classic Galenical wisdom, albeit not to the extent that Servetus would do later. Another contemporary in theology, John Calvin, born in 1509 born in Noyon in Picardy, would have probably the biggest impact on the course of Servetus' last few years of life and his greatest publication. Finally, one must consider that Servetus was born in the era now known as the Renaissance. This was a time in human history when free minds were thought re-born, new ideas proposed and old dogma challenged for the first time since prior to the Dark Ages. However, there were also those who still stuck firm to ancient teachings and wished to maintain the order of the day by whatever means (and force) necessary. The days of barbarism, oppression of ideas and aristocratic elite had not yet fully left the face of Europe.

Born a son to a wealthy family in 1511 in Tudela, Navarre province, Spain, Michael Servetus, was raised in the small village of Villanueva de Sigena near Saragossa for much of his upbringing. While seemingly a trivial point of his life compared to his future adventures, the site of Servetus' childhood would later play an important role in one his of many transformations. Servetus' life as a young boy in Spain was typical of a young man from a wealthy family for his time. He studied at several universities and colleges in his early to mid-teens, including the College of Huesca, the University of Saragossa, and later at the University of Toulouse in preparation for a career in law. Servetus, however, even at such a young age, had already the seeds laid within him to seek much greater challenges. His focus slowly shifted from the study of the law to that of scripture. He became enraptured with producing his own interpretation of the scripture, or at least in pointing out its flaws. This dream was further strengthened in 1529 after he had fallen into the company of a monk named Juan de Quintana. With Quintana's place in the court of Emperor Charles V, he was able to take Servetus with him to view preparations for the coronation ceremony of the Emperor in 1530. Little did Quintana know that his misadventure in bringing Servetus to Bologna, Italy would set in motion a series of events that the Catholic and Protestant Churches, as well as Servetus himself would never

live down. After seeing the pomp and circumstance awarded the Pope upon his arrival, Servetus was forever turned against what he perceived to be the grievous errors of the Church and set about proving his own heresy as truth.

While still a teenager at the age of 19, Servetus published his first complete book entitled: *De Trinitatis erroribus libri septem*, or roughly translated, *Concerning the Errors of the Trinity*. While attaching his name to such a flagrant and touchy subject may not have scared Servetus, he clearly was not prepared for the aftermath. The book inflamed Catholics, Protestants and reformers alike, many of whom complained about the book's lack of insight and depth. Servetus himself eventually caved into pressure from those around him and printed a mild retraction entitled: *Dialogorum de Trinitate, libri duo*, translated as *Dialogues on the Trinity*. This retraction did little to quash the hatred of those who were already unimpressed with Servetus' previous work. As in line with his blind arrogance, the book was basically written to state that while Servetus still believed much of the message from his first book, he was ill-prepared and ill-researched to present a proper case. Needless to say, religious loyalists of both major religions in Europe were unimpressed, and Servetus had to undertake one of the first of his many personal transformations when he was forced to flee at the tender age of 20. Servetus disappeared from much of the public eye for the period of 1532-1536, during which time he was rarely seen in Lyons, France. During this time, harkening back to his childhood hometown, Servetus took on his first pseudonym, being called by those who knew him Michael Villanovanus. While keeping his public persona to a minimum during this time, possibly to reduce the ire surrounding his previous works, the fire to convince the masses on the errors of the Church had not died, just been quieted in Villanovanus.

Michael Servetus embarked on a seemingly new career path during the years 1536-1537 (and possibly as early as 1532). During this time, Servetus started to pursue a medical career in Paris under the guidance of Joannes Guinterius and many other geniuses of medicine in France at the time. To this day it is still uncertain as to when, where and who granted Servetus his medical degree, and it is suspected that he may never have received an official degree at all as his name appears nowhere in the ledgers of Paris University. Nevertheless, there is little dispute that Servetus did complete a course of medical studies of approximately three years length and was often described as a "brilliant" student by his contemporaries. Servetus' one and only offering to strictly medical literature was presented when after his first year of medicine, he felt himself sufficiently versed to write a paper entitled: *The Syrups*. This pamphlet provided what is acknowledged as a direct translation of Galenical teachings rather than new insight into medical knowledge. This paper served more as an ego stroke to Servetus as he claimed, "...you who are going to...restore health to the human body. Observe the teachings of this book..." By 1537 Servetus was himself lecturing students in Paris, and never one to stare trouble in the face and turn the other cheek, soon found himself again in trouble with lawmakers who, had they know his true identity would surely have burned him at the stake in an instant. Those who held Servetus in ill regard actually managed to convince the Inquisition, which was in the middle of their pursuit of heretics, to hear the case of one Michael Villanovanus. The heresy evident in his first book aside (which in truth, was unknown to his colleagues, and seemingly to the Inquisition as well), Servetus was challenged by his fellow

professors on his refusal to stop teaching judicial astronomy. Judicial astronomy, for those unfamiliar, teaches that medical treatment and indeed many of the mysteries of life can be accounted for by the movement and location of various celestial bodies. Servetus, ever calm, faced the Inquisition under his assumed name, defended himself and managed to have his case thrown out. However, his fellow colleagues were dissatisfied with the result of the Inquisition hearings, and proceeded to have Servetus brought up before French Parliament. In this case, Servetus allowed legal counsel to be his guide, and while found guilty, faced no more jurisprudence than being told to recall all his pamphlets and stop predicting the future. Servetus, soon left Paris prior to finishing his medical degree, but not before making one of the greatest discoveries of medical science, which would not come to light for several more years.

After Servetus left France, he practiced general medicine in a somewhat nomadic fashion in various villages throughout France, again managing to stay moderately quiet and self-contained for the years of 1538-1541. In 1541, Servetus would make his second transformation, on this occasion, to full-time physician and medical consultant. It was at this time that Servetus' brilliance and free spirit were recognized by Pierre Palmier, who was Archbishop of Vienne and Primate of all France. Servetus openly accepted the offer to settle long-term in Vienne, whereupon his demeanor appeared less fanatical and combative. It was observed that Servetus became much more subdued during this time period. His medical counsel was provided to the elite of France (including Palmier and many other high-ranking officials), but also to the poorest of the poor in the town of Vienne. He established himself as a humanitarian within a few short years of practice, and his selfless dedication to treatment during the plague of Lyons in 1542 could only be viewed as coming from a person who exemplified the true meaning of physician. It is often thought that the antagonistic and egotistical persona of Michael Servetus was dampened by his surroundings and by those with which he worked during the 12 years he spent practicing medicine in and around Vienne. However, the fire that burned deep within Michael Servetus to set religious wrong doings right could not be concealed forever. Servetus was given the task of revising and translating the Bible of Pagnini, which served to rekindle his religious drive. His version and notes (especially regarding Hebrew) for that Bible were actually seized and branded heresy. It was during this time that Servetus also met some local printers, especially Frellon, who would ultimately serve as a means to his end, quite literally.

It was through Frellon that Servetus began correspondence with the man who Servetus first considered a sympathizer, but who was in fact, his arch-nemesis: the widely acknowledged leader of the Protestant Revolution, John Calvin. The year was 1546, and Servetus passion for religious reckoning had been ever increasing and he thought to himself 'who better to submit part of his new work than John Calvin.' In Calvin, Servetus saw a man of change and progression, one who (at least in Servetus' mind) would be able to clearly see the extensive errors inherent in what was then the modern version of Christianity. To Servetus, the grievous errors of the Trinity and parts of the baptismal ritual were blatantly obvious, and any person of education and consequence should have been able to see that Christianity needed to return to its simpler roots. Calvin, corresponded cordially, but tersely, with Servetus at first, suggesting that he stop his

intended publication and direction of thought. However, the persistence of Servetus at this point was unstoppable, as he continued to send Calvin letters attempting to change his mind and even part of his unfinished manuscript (with which he offered to come to Geneva to meet Calvin in person). Calvin had heard enough at this point to know that Servetus was someone whose ideas he feared very much, and he went as far as to suggest to a contemporary that were Servetus to come to Geneva, "...had I any authority here, I should not suffer him to go away alive." This rejection by Calvin did not set back Servetus in any fashion, as he still sought to publish his book. This task proved more difficult than first believed, as most printers dared not risk the wrath of the Inquisition in printing Servetus' book based on what they saw as the supreme heresy inherent within. Through all these tribulations, Servetus persevered and eventually managed to have his magnum opus printed anonymously at a private printer in Vienne in 1553. This book, one of the most rare in the world today, was entitled "Christianismi restitutio," or roughly translated, "The Restitution of Christianity." The arrogance (or genius) of this work can be extracted from the title alone, let alone the contents inside.

Servetus sought to reclaim some of the dignity he had lost with his previous religious writing with his new book, but no sooner than the first 1000 copies had been printed (which was a large amount for the time) than Calvin had found his very own copy. Almost immediately after its publication, Calvin denounced Servetus to the French Inquisitors. During the proceedings of Calvin's quest to have Servetus arrested, the desire of the Inquisition to capture the criminal were dulled greatly compared to the fervor with which Calvin sought him. The main Inquisitor searching for Servetus, Matthieu Ory, used many months of chasing, searching, elaborate traps and cleverly disguised villains. He eventually managed to produce a scheme leading to Servetus' arrest on April 4th, 1553. Servetus' was immediately convicted, although the terms of his imprisonment were less than maximal security. He was given a room, free reign to walk in the garden and his attendant was allowed to see to his needs while confined to the Archbishop's palace in Vienne. As his final fate was set to be delivered, and within three days of his capture, Servetus' brilliance was exemplified as he masterfully convinced his captor (Bouin) to give him the garden keys while in nightdress. He has masterfully placed his clothes under his gown, and proceeded to jump the garden wall, cross the river and find a sympathetic soul prior to the city gates being locked. Servetus had escaped his fate for a brief time, but the Inquisition was infuriated. Servetus was burned in effigy along with 500 of his books on June 17th, 1553.

Servetus may have escaped the Christian Inquisitor, but he had not escaped his own blind pride. For reasons that as of yet remain unclear, in August 1553, Servetus entered Geneva on a Sunday (the holiest of days and a mandatory Church session) and proceeded to be recognized in Calvin's own city. Calvin immediately had Servetus imprisoned in a terrible dungeon, a preface to one of the sorriest and saddest miscarriages of justice in human history. From the moment he first contacted Calvin, there was no real hope that Michael Servetus would be vindicated in this matter, and in fact was given only a token opportunity to present his own case. On October 27th, 1553, Servetus was called before the tribunal to hear his inevitable verdict, and immediately afterward the procession formed. Mere hours later, Servetus, along with all but a few of his writings, was burned

alive at the stake and died in the pain of a green bark fire at the age of 42. Calvin had finally delivered his justice.

After this life story, the contributions of Michael Servetus to medical science may appear trivial. In fact, Servetus' theological disposition, along with the destruction of all but three copies of the "Restitutio" nearly led to what could be considered his most significant finding being lost forever. It is commonly acknowledged that the first accurate description of the pulmonary circulation as we know it today was produced by William Harvey in 1628 in his publication "On the Circulation of Blood." While Harvey may not have heard of Servetus or his writings when he made the discovery for which he was immortalized, a simple paragraph on page 171 in the fifth book of "Restitutio" shows evidence contrary to the claim that Harvey first discovered the lesser circulation. This paragraph reads as follows:

The substantial generation of the vital spirit is composed of a very subtle blood nourished by inspired air... It is generated in the lungs from a mixture of inspired air with elaborated, subtle blood which the right ventricle of the heart communicates with the left. However, this communication is not made through the middle wall of the heart as is commonly believed, but by a very ingenious arrangement, the subtle blood is urged forward by a long course through the lungs; it is elaborated by the lungs, becomes reddish-yellow and is poured from the pulmonary artery into the pulmonary vein. Then in the pulmonary vein it is mixed with inspired air and through expiration it is cleansed of its sooty vapors. Thus finally the whole mixture, suitably prepared for the production of the vital spirit, is drawn onward from the left ventricle of the heart by diastole.

This description was a direct affront to the 1500-year-old teachings of Galen that the vital spirit passed through invisible pores in the heart septum instead of via Servetus' method. It was a glorious scientific leap that contemporaries such as Vesalius had failed to make, along with other physicians for the previous one and a half millennia. Nobody even openly admitted this knowledge, almost lost forever as a result of its scarcity and the writings in which it was surrounded, until its first public account by Wotton in 1694.

Branded a heretic in his time, and later a martyr, Michael Servetus is now commonly recognized as being brilliant, unrelenting, arrogant, fearless and well ahead of his time in terms of questioning religious creed. These facts often distract his followers from his most influential, and nearly lost, discovery; that being his accurate description of pulmonary blood flow in human physiology.

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“DIAGNOSIS: TOO MUCH BLOOD” THE USE OF LEECHES FOR MEDICAL BLOODLETTING

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ABSTRACT

Bloodletting, a practice since the times of Hypocrites and Galen was first based on the concept that during illness, the four humors: blood, phlegm, and black and yellow bile were imbalanced. Since blood was considered the dominant humor, bloodletting was performed to rid the body of its excess blood. In the nineteenth century, diseases were understood to be a combination of symptoms; inflammation being defined as redness, swelling, pain and heat. Bloodletting of the inflamed area was used to relieve these symptoms. Bloodletting tools have been discovered dating back to the Stone Age. However, by 200 B.C.E. a different, less painful and, in some cases, more effective method of bloodletting was in use: leeching.

The use of leeches in medical practice was very common during the medieval and early modern periods but reached its peak in France during the early 19th century. Leeches were particularly useful for bloodletting in areas not easily reached by other tools such as the rectum and the esophagus, when the surgeon desired to remove only a fixed quantity of blood, and when patients were unable to withstand other methods of bloodletting due to weakness or otherwise. Generally, the leeches would be placed as near as possible to the site of complaint, for example, on the temples for headaches, on the epigastrium for gastrointestinal inflammation, and on the vulva, groin and thighs for menstrual disorders.

Leeching developed considerably during this period. Physicians learned to thread leeches with string before applying them to the esophagus due to a number of deaths by suffocation after the satiated leech detached itself. They also learned that leeches could transfer infectious diseases such as syphilis between patients. By the 1870's, the use of leeches had passed out of fashion. Recently, however, they have been reintroduced into surgery for their decongestant properties.

The Practice of Bloodletting

Bloodletting, a practice since the times of Hippocrates and Galen (Upshaw and O'Leary 2000) was first based on the concept that during illness, the four humors: blood, phlegm,

and black and yellow bile were imbalanced. Since blood was considered the dominant humor, bloodletting was performed to rid the body of its excess blood. Galen advocated bloodletting for everything from sciatica, insanity, hemorrhoids, liver disease, and pleurisy to even hemorrhage (Upshaw and O'Leary 2000, Mory *et al* 2000). In the nineteenth century, diseases were understood to be a combination of symptoms; inflammation being defined as redness, swelling, pain and heat. Bloodletting of the inflamed area was used to relieve these symptoms. This practice was even advocated by William Osler, who in 1912 wrote: "To bleed at the very onset in robust healthy individuals in whom disease sets in with great intensity and high fever, I believe is good practice" (Kerredge and Low 1995).

Bloodletting tools have been discovered dating back to the Stone Age. Many methods of bloodletting were developed, most popular of which included such physical methods as scarification with wet cupping, which involved opening a blood vessel with a lancet and cutting through capillaries just beneath the skin. Cups would then be applied to the wound, and suction created with an accompanying syringe would cause bleeding (Seigworth, 1980). Venesection was the most common method of bloodletting, with blood drawn from either the cephalic, median, or basilic veins of the arm. Arteriotomy was sometimes performed, primarily when the veins seemed relatively empty compared to the arteries, usually on the superficial temporal artery and its branches (Seigworth, 1980). However, by 200 B.C.E. a different, less painful and, in some cases, more effective method of bloodletting was in use: leeching.

The History of Leeching

'Leech' is a variant of the Anglo-Saxon term *laece* meaning 'one who heals'. It was used to describe both physicians and blood sucking worms - the taxonomic genus for leeches, *Hirudinea*, was derived from this term. The earliest record of leeches being used for curative purposes is a painting in an Egyptian tomb dating back to 1500 B.C.E. (Fields 1991). Compiled between 500 B.C.E. and 200 B.C. and written in Sanskrit, a medical encyclopedia from India also mentions leeches (Fields 1991). Nicander of Colophon, a Greek poet and physician, described the use leeches medicinally in 200 B.C.E in his poem *Alexipharmaca* (Major 1954, Mory *et al* 2000, Upshaw and O'Leary 2000, Thearle 1998). They were first used for bloodletting purposes in 1st century B.C.E. by Themison of Laodicea (Thearle 1998). References to leeching in medical practice are found in texts from the ancient, medieval and early modern periods, by Greek, Roman and Arabian physicians, including such riddles as "I bite unfortunate bodies with three-furrowed wounds and bestow a cure from my healing lips" which was translated from a Latin text written by Aldhelm of Malmesbury in 7th or 8th century C.E. (Cameron 1993). During these times, however, venesection was still the most common technique for bloodletting.

Leeching was a practice of the great Arabic physician Avicenna (d. 1037). He believed that leeches drew blood from deeper sources than did wet cupping (Mory *et al* 2000). Avicenna provided guidelines for the use of leeches and suggested that they should not be taken from unhealthy water or used if their excrement was black and muddy. He was also the first to recommend that a thread should be drawn through the tail to prevent the

leech from crawling into any unreachable areas such as the anus or nose (Mory *et al* 2000).

The use of the medicinal leech, *Hirudo medicinalis*, reached its greatest peak in France during the 1820's and 1830's, a time when Paris was a centre for medical advances. The French physician Francois Jean Victor Broussais, a surgeon in Napoleon's Grande Armée, was largely responsible for this increase. In a time where many were attempting to develop a classification of diseases, Broussais believed that diseases originally arose from an inflammation of the gastrointestinal tract. This inflammation brought about irritation or disturbances of other organ systems by means of 'sympathy', a concept involving neural and circulatory connections (Payton 1984). To alleviate this underlying inflammation and cure the patient of his or her presenting disease, he believed that the body had to first be weakened (Fields 1991). Broussais advocated a starvation diet as well as local bleeding using leeches, which would affect the "sympathy" and alter the activity in the affected regions (Payton 1984). He was very convinced about his theory; so much so that he reportedly had fifteen applications of 50-60 leeches in a span of eighteen days when he himself was ill (Payton 1984).

Many physicians in France as well as other European countries and North America (who used *Hirudo decora*, a leech species that made a smaller and shallower incision and drew less blood), accepted Broussais' ideas about leeching and began using leeches to treat many ailments. Soon a widespread, lucrative trade industry of leeches developed that has been compared with aspirin and the current pharmaceutical industry (Payton 1984, O'Hara 1988).

In Britain, at the start of this enormous wave of leech utilization the leeches were harvested 'by the children of the poorer peasantry' who acted as human bait for hungry leeches by wading in water inhabited by the blood-sucking creatures (Carter 2001). Soon, however, the demand for leeches was beyond that which this method could supply. By the middle of the nineteenth century leeches were being collected by a well-documented technique, 'leech-fishing' whereby drawing nets filled with bait were dragged through swamp water (Payton 1984, Carter 2001). This method caused a dramatic decline in the leech population in Western Europe and soon leech farms were developed to deal with the low numbers of leeches in the natural environment (Thearle 1998). Leeches could be bought from farmers who had decided to pursue commercial hirudiculture. Medical faculties and hospitals as well as some governmental agencies, however, were concerned about having a sufficient supply and developed their own farms. These farms required a large amount of blood to satisfy the appetites of so many leeches. Old cows, donkeys, and horses have all been reported to have been dragged into these farms to provide sustenance for the leeches (Carter 2001, Payton 1984).

Importing leeches from Germany and Poland was another primary means of leech accrual (Sawyer 1999, Carter 2001). By the late 1840's leeches were imported from Turkey and Egypt and by the 1860's even Australia was exporting leeches to Europe and North America (Carter 2001). During its greatest height, leech import exceeded 600,000

monthly (Carter 2001). Between 1800 and 1900, it is said that one billion leeches were imported to France (Fields 1991).

The Anglo-French colony, Mauritius, satisfied its need for large numbers of leeches through an extensive leech trading industry that was developed in the southern Indian Ocean. Leeches traveled by ship for periods of four to six weeks from Pondicherry, India to Mauritius. Very little is known about the leech dealers or how and where they obtained their leeches. The leech species traded in Mauritius was not the common European leech, *Hirudo medicinalis*, but rather a leech species indigenous to India, *Hirudinaria manillensis* (Sawyer 1999).

Just as quickly as the popularity of leeches rose, it fell. By 1879 the leech industry had declined dramatically; for example, one of the major leech importers was selling one-tenth as many leeches as it had formerly sold (Carter 2001). Leeching became rather unfashionable by 1900 but was still used occasionally until the 1940's (Fields 1991).

Characteristics of Leech Use

The leech has three jaws with which it bites its victim's skin. The resulting mark has been described as resembling the Mercedes-Benz emblem. Leeches have been found to feed for approximately half an hour and consume 15 ml of blood before becoming satisfied and detaching themselves. Knowing what quantity of blood would be extracted from their patient made leeching a very attractive method of bloodletting for some physicians. The quantity of blood leeches ingest is equivalent to nine times their body weight and often satiates them for a year (Lent 1996). Another feature of leeching that was at times beneficial was that leech bites would continue to bleed after the leech had been removed. In 1955 Haycraft discovered that hirudin was present in leech saliva (O'Hara 1988). Hirudin is an anticoagulant that inhibits the conversion of prothrombin to thrombin. Thus, a leech wound continues to lose up to 50 ml of blood in a span of 24 to 48 hours (Mory *et al* 2000, O'Hara 1988). Leech saliva also contains many other chemicals including a vasodilator and a local anesthetic, which makes the bite from a leech essentially painless – another attractive feature of bloodletting with leeches as opposed to venesection.

The technique for attaching a leech to a specific body part varied slightly by location but if external, often involved placing the leeches in a wine glass to support them while they were drinking their fill. They were encouraged to bite by ensuring that the area had been washed with soap and water and closely shaved or by rubbing the area of interest with sugar-water, milk or blood (Carter 2001). To increase the vigour with which the leeches bit, they were dipped in 'diluted wine or warm full-strength porter' (Carter 2001). If they attached themselves to a less than desirous location, salt was the remedy of choice.

Leech use was not without risk, however. Sometimes, when they detached themselves after being placed in the throat, they suffocated the patient or they were swallowed and reattached to the lower esophagus. A similar situation occurred in other areas such as the rectum and vagina. Soon it was discovered that threading silk through the leeches' tail so

that it could be pulled out of the dangerous area once it had completed its feeding greatly reduced this unfortunate outcome (Carter 2001). Problems also came about due to the anticoagulant properties of leech bites. Life-threatening situations sometimes developed when small children continued bleeding profusely after leech application (Carter 2001). Infection occasionally arose after leech therapy which has been found to be due to the leeches' endogenous gut flora, *Aeromonas hydrophilia*, which has a symbiotic relationship with the leech and aids in the digestion of erythrocytes (Thearle 1998).

Since fresh leeches were both expensive and at times hard to obtain in the mid-nineteenth century, some physicians began reusing their leeches. Sharing leeches can be likened to sharing blood through an open wound and thus, predictably, there were reports of diseases such as syphilis being transferred between patients who shared the services of the same leech (Carter 2001). Methods were devised to increase the productivity of individual leeches. Their digestive tracts were cut open so that ingested blood immediately leaked out, making their thirst for blood insatiable. A technique whereby leeches that had fallen off a wound were immersed in vinegar and then clean water was found to make them once again lively and ready to suck (Carter 2001).

Specific Historical Uses of Leeches

As described above, leeches were particularly useful for bloodletting in areas not easily accessible to other tools such as the rectum and the esophagus, when the surgeon desired to remove only a fixed quantity of blood, and when patients were unable to withstand other methods of bloodletting due to weakness or otherwise. Leeches were used to treat many common disorders and diseases including mental illness, epilepsy, insomnia, headaches, obesity, tumours, gout, cirrhosis, bladder problems, bronchitis, laryngitis and menstrual disorders (Carter 2001, Mory *et al* 2000, O'Hara 1988). Generally, the leeches would be placed as near as possible to the site of complaint, for example, on the temples for headaches, on the abdomen for gastrointestinal inflammation, and on the vulva, groin and thighs for menstrual disorders (Carter 2001).

In 1818 William Brown described a procedure for applying leeches to the anus which he believed cured abdominal inflammations including hepatitis, enteritis, puerperal fever, suppressed menses and lochia (Carter 2001). The patient

'is seated on a perforated chair, which only uncovers the anus itself; the operator, stooping or kneeling, by means of a taper, sees the part to which the leech is to be applied; and, provided with a small round wide-bottomed bottle with a long neck, just large enough to contain one leech, he allow the animal to crawl out and fix itself on the part intended. The operator having applied one leech, withdraws the bottle, and proceeds to fix one after another till the desired number have been applied; a basin is placed under the chair into which the blood flows.' (Brown 1818, Carter 2001)

Leeches were also applied to mucous membranes to treat inflammation. Rather than place leeches on the temples and eyelids, in 1822 Phillip Crampton experimented with

placing the leech directly on the conjunctiva and found that it was actually more effective. This success led him to apply leeches to such areas as tonsils when they were inflamed, (this involved, after trial and error, the threading procedure mentioned above) and nostrils when treating nose-bleeds (Crampton 1822, Carter 2001).

By 1833, physicians had found that when a patient's intestines were inflamed it was sometimes not effective to place leeches just at the anus, but rather the leeches had to be positioned internally into the rectum. Thus, the technique described above was modified to deal with the internal sphincter mechanism which served as a hindrance to leech entrance into the rectum. A leech was placed in a grooved metal rod and

'the operator, holding the ends of the threads, introduces the instrument into the rectum, and pushes it up so as to cause it to draw up the leeches along with it into the rectum. When they have thus been conveyed up beyond the sphincter, the instrument is withdrawn, and the leeches are suffered to remain till gorged with blood and loosened from their hold, when they are drawn out by means of the threads which the operator retains outside the anus' (Osborne 1833, Carter 2001).

A similar technique was used in the 1840's to apply leeches to the prostate gland (Craig 1840, Carter 2001). Brown's method for treating suppressed menses was replaced in 1852 by a method devised by Samuel Ashwell. He recommended that leeches be applied to the uterine os by 'clever nurses' to stimulate menstrual flow (Ashwell 1852, Carter 2001).

Leeches were used in plastic surgery from 1827 to 1837. Johann Friedrich Dieffenbach, a respected and prolific surgeon in Berlin, greatly influenced this practice by describing his use of leeches in a number of cases including a 70 year-old man with lip cancer, two young men involved in fights; one with a gash on his cheek, the other with a mutilated nose and upper lip, and a 22 year-old woman with a degenerative condition which had lead to the loss of her nose and upper lip (Sawyer 2000). The reason the practice of leeching in plastic surgery was discontinued is not precisely known.

Modern Leech Use

After a long hiatus from surgical use, leeches are once again being used for their decongestant properties. The revival of leeching in plastic surgery dates to the mid-1970's (Sawyer 2000). They are most commonly used to relieve venous congestion associated with outflow obstruction in breast reconstruction, grafted skin flaps and occasionally periorbital hematoma, macroglossia, and purpura fulminans (Thearle 1998) where 'congestion may lead to edema, capillary and arterial slowing, arterial thrombosis, flap ischemia and eventual necrosis' (Upshaw and O'Leary 2000). Complicated varicose veins have been recently treated with leeches, which have been found to produce venous decongestion, reverse edema, and help heal varicose ulcers (Bapat *et al* 1998). Leeches have even shown to be a convenient method of treatment for infected thumb paronychia when camping (Thearle 1998).

Leeches have been used for the past fifteen years in microsurgery to help establish venous return flow in reattached fingers (Fields 1991, O'Hara 1988). When placed on the reattached appendage, they draw out congested blood from the site of arterial anastomosis and prevent clotting owing due to the anticoagulant, hirudin, in their saliva.

Hirudin may be a more effective anticoagulant than heparin and has been suggested as a potential treatment of coronary thrombosis and arterial thrombosis after angioplasty (Upshaw and O'Leary 2000). A synthetic form, hirulog, is available; however both forms are expensive and have a high bleeding risk. Other chemicals found in leech saliva are also being investigated as therapeutic use against many disease processes including atherosclerosis and even cancer (Lent 1996).

Although the uses for the leech have evolved throughout the past 2000 years, they still appear play an important role in medicine. Their innate physiological characteristics such as the chemicals in their saliva appear to make them a natural friend to medicine, particularly surgery. However, a so-called 'mechanical leech' has been developed which does the job of a medicinal leech but promotes more global decongestion than does leech therapy (Hartig *et al* 2003). Perhaps the leech will one day be retired from medicine in favour of a newer, less 'icky', and more effective alternative.

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BLEEDING OUT THE EVIL SPIRITS

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ABSTRACT

Who would have thought that the idea of liposuction would originate from the ancient practice of cupping? The art of cupping originated at the time of the ancient Egyptians and extended through most of the nineteenth century. Although intriguing the minds of many, several members in our culture now consider the technique of bloodletting absurd and repulsive. Despite the views on cupping today, it was then seen as a powerful curative practice and its' strong 3000 year history is irrefutable evidence.

Cupping was commonly used to “cure” various illnesses such as headaches, gout, arthritis, menstrual flow irregularities, lactating difficulties and several other conditions. Practitioners performed two types of cupping, wet and dry. Wet cupping involved direct bloodletting and was initially performed until the patient fainted. Thankfully this was soon determined to be too dangerous and the amount of blood withdrawn was reduced to “just the right amount to rid the evil spirits!” Dry cupping focused on producing a blister, and was aimed more at bronchial illnesses.

One would believe that only the feeble-minded would resort to such a cure, however this was not the case. Many noblemen over the years have partaken in this treatment. Further, many stated that even animals use this sort of treatment to relieve symptoms. Depending on the culture, the belief was that the hippopotamus or goat repeatedly strikes their legs or head against sharp objects to release blood, thus alleviating any pain.

To the surprise of many wet cupping existed into the early twentieth century and dry cupping is still used today, in an era of chemotherapy and antibiotics. Eastern Asian medicine and immigrants from Eastern Europe still practice and believe in this treatment.

Both cupping and bleeding are amongst the oldest medical manipulations practiced by our ancestors. Although it has 3000-year history and was practiced through several different ages, it is now regarded by some as repulsive. However, the physician and his treatment should be judged in the light of the era of the disease. The premise was that the evil spirit of disease was trapped in the skull and could be drawn out. Similar to how trephining allowed demons to escape from the head, bloodletting was to facilitate the

release of evil spirits from elsewhere in the body. Cupping specifically was a procedure that was performed to alleviate the various illnesses encountered by mankind.

Herodotus, in 400 BC, records that bleeding and cupping were already used by the Egyptians whose physicians extensively recommended the application of cups to the body either for the extraction of blood or to produce blistering of the skin. The ancient Greeks used a gourd for cupping, and at the apex of the gourd was a small aperture where the lips could be applied for producing a vacuum. It was Hippocrates himself who gave instructions for the shape and application of the cups. He recommended that they should be small in diameter, conical in shape and light in weight, especially when the disease being treated was deep seated. If the disease were nearer the surface, the cups were to be wider. Galen was another advocate of cupping and this form of therapy was quite popular during late years of the Roman Empire. This treatment was also recommended by the Arab physicians of the Middle Ages. It was during this time that astrology became an important factor in the cupping procedure. Henry du Mondeville, surgeon to King Philip of France, wrote specific instructions for cupping: it should never be done in foggy weather or when the south wind blows, the humors are most abundant at full moon so it's advantageous to cup then, cups were to be placed at specific sites on the body depending on the illness, and if cupping was being done to relieve a headache, cold water should be thrown on the face to send the spirits back into the cup. Although the practice of bleeding originated among the Egyptians, cupping also had indigenous roots with many cultures and civilizations. Cuppers usually argued that the strange actions of the hippopotamus or the goat (the animals were culture specific) first suggested the usefulness of bleeding. It appeared that these animals would strike their legs or head against sharp objects for the purpose of losing blood, thus relieving any pain. Based on such justifications it seemed rationale to continue with this procedure. Today however, one would see such actions as frustrations due to pain, rather than self-induced bloodletting. Cupping was further validated with the introduction of the four humors: blood, phlegm, yellow and black bile. It was believed that an excess of one of these fluids caused disease. Hence bloodletting was to restore balance of the humors by draining the excess and thus maintain the equilibrium of a healthy body.

The initial practice of cupping employed the use of razor blades and scalpels in order to pierce the skin. Unfortunately this practice proved inefficient and painful as the punctures often needed to be repeated in order to obtain the 'correct' amount of blood. Thus in the sixteenth century Ambrose Paré, who is often considered the father of surgery, invented the first mechanical scarifier. This was a metal box that contained several spring-mounted lancets that could be made to strike the skin simultaneously causing multiple small linear incisions. Usually seven rows of blades were used which projected from the surface of the box to a length of one quarter of an inch. Different lengths were occasionally used depending on where the cup was to be applied. Caution had to be taken to not set the depth of the lancets too deep; a superficial incision would be as ineffective as one too deep. Lancets set too deep would often pierce into fat, which would protrude into the incisions and obscure any blood flow. Unfortunately even with these precautions in place, coroners at this time saw many deaths associated with lancets cutting into the spine or the ribs. George Washington was regrettably the victim of such

a death. Suffering from acute laryngitis, his physician at the time decided to cup over the throat. However the lancets were set too long for this specific region and actually punctured his trachea, causing death a mere 24 hours later! Due to the invasive nature of this procedure, physicians were constantly reminded of its dangers. It was important to keep the instruments clean since any rusting of the blades would cause tearing of the skin and unnecessary pain. As a result, physicians would often grease their apparatus with mutton fat and test the spring lancets on a fresh piece of bread. Although the risks of cupping were evident to society at this time, it continued to persevere as a highly regarded therapeutic intervention. Society basically saw it as more of a danger to not be bled than to have experienced bloodletting:

“We can bleed oftener than we can purge or vomit, with safety..., that in being too saving of our vital fluid, as we fondly call it, we often cherish a snake in our bosoms.”

Cupping was used to reduce headache, restore appetite and improve digestion, remove tendency to faint by drawing ‘matter’ to the surface, increase secretions, promote menstrual flow, hasten the crisis of disease, remove too strong a desire to sleep, cure gout and arthritic pain, lessen edema, alleviate congestion of the lungs and subacute pleuritis, help women who were having difficulty lactating by placing the cup directly on the breast, and if it was applied behind the ears it was intended to produce a natural and refreshing repose. Generally two types of cupping were used: wet and dry. It was Paré who differentiated these two approaches. As he stated, wet cupping allowed for skin to be scarified and subsequent blood loss, dry cupping however produced blistering of the skin to draw out the evil spirits and did not involve any blood loss.

Wet cupping was used for the extraction of excess blood and other fluids in order to restore equilibrium of the four humors. Up to 20 ounces of blood could be withdrawn from a local site, five cups with four ounces each. Initially practitioners followed an English custom in which patients were bled until “a change in the constitution of the patient” was noted. This so-called ‘change’ which was considered curative, was in fact due to the patient fainting because of significant blood loss! This practice quickly declined as many physicians realized the dangers of such a ‘cure’. This type of cupping was an especially complex procedure and done by only a few ‘experienced’ practitioners. In addition to the cups, a vacuum was needed to produce suction as well as a scarificator to actually produce the bleeding. Several methods could be used to expel air from the cups. One way was to throw pieces of lighted flax or paper into the glass and then turn it quickly over onto the specific site. As the hot paper cooled, the developing suction would draw skin up into the glass. However this had the disadvantage of sometimes scorching the patient with the hot ash as it fell onto the skin. Hence a better method was invented, the lighted torch. Nonetheless, this took skill to ensure that the rim of the cup was not heated excessively, thereby preventing any burning of the skin where the cup was applied. A third method used to create a vacuum was to use an exhausting syringe. If animal horns were being used in place of cups, often a hole made at the tip was used for mouth suction and later plugged with wax. Despite the mode of suction, the general procedure remained the same. First the scarificator was set in place while both the site

and the cup were warmed in water. Cups were then placed on the skin with one edge raised approximately one and a half inches. It was usually the lighted torch that was then placed under the center of the glass for two seconds and then quickly withdrawn to create a vacuum. The vacuum created would also pull the glass away from the operator's fingers. The skin then rose slowly into the glass, occupying one-third of the volume. The glass was left on for a minute then removed, and the scarificator with its lancets would pierce through the skin. The scarificator would rapidly be removed to minimize injury and the glass reapplied so that blood could flow into the evacuated cup.

In contrast to wet cupping, dry cupping was used for the production of a blister. Whereas wet cupping seemed to discontinue near the same time as venesection, dry cupping continued as a counter-irritant in the treatment of pneumonia and rheumatic conditions well into the first half of the twentieth century. Counter-irritation was the belief that cupping would by its own irritating action alleviate any irritation (such as inflammation) of the underlying deeper structures. More specifically, dry cupping would draw underlying blood and fluid away from the inflamed area and guide it to the surface of the skin, thus relieving congestion of the deeper organs. John Hunter both recommended and used bleeding in his practice. He believed in cupping as a treatment for inflammation and saw bleeding as one of the standard methods of 'weakening' inflammation. He did however recommend moderation in that one should only take away that amount of blood that would lessen the harm of the inflammatory process. Louis (1835) studied the effects of dry cupping in the treatment of pleurisy, pneumonia, and pericarditis. However he discovered that it had no evident influence on the course of the disease. He stated,

"And how then can we believe that the effect of a blister is to check on inflammation, when this blister is one inflammation superadded to another?"

Surprisingly however, despite these observations dry cupping seemed to have continued as a counter-irritant until the chemotherapy and antibiotic era.

As time passed, both wet and dry cupping remained relatively unchanged. Brass cups and the horn were introduced, but glass cups remained the primary choice. The advantage of glass was that it was neat, clean, light, and most importantly it allowed the operator to see how much blood was being drawn. An attempt at modification was again made with the invention of combining the scarifier, vacuum, and glass into one device which allowed the blood to be drawn in a single operation. However this proved to be ineffective because of its heaviness and unreliability because it had a tendency to stick to the patient's skin. Hence over the years it appears as though the simple glass cupping method was the method of choice for both patients and physicians.

Nonetheless modern practitioners often wonder why this procedure persisted for as long as it did. In order to understand this, one must carefully look at those illnesses which elicited the most fear in the society of the bloodletting era. From 1803-1817 endemic cases of typhus were seen. Typhus was characterized by a low fever and a low pulse, thus since it was not too aggressive of a disease a treatment as drastic as bloodletting was not required. During 1817-1829 there was an epidemic of "relapsing fever" in which

patients suffered from a high fever and a high pulse. It was this more serious condition which promoted the practice of cupping. Wet and dry cupping had become such a mainstay treatment that one medical student remarked:

“...there was hardly a morning that some twenty or thirty unfortunate creatures were not phlebotomized largely. The floor was running with blood; it was difficult to cross the prescribing hall for fear of slipping...Never has more blood flowed from the veins and arteries of mankind, under the authority of medicine.”

However in 1831 typhus again reappeared, thus calling for the decline of cupping. Although physicians did not use this treatment in their practices it was still regarded as a highly valuable treatment. Proponents of cupping, specifically Edinburgh’s scientists, were called upon to explain this apparent paradox. In order to save face in the medical profession, these men could not admit to having used a ‘wrong’ treatment for so many years. Thus to defend their decision, the “change-of-type” theory of disease was invented. This theory maintained that it was the shift from typhus to relapsing fever that demanded the arrest of cupping and not that physicians had been incorrect in using cupping. It was near this time of the early 19th century that an increasing number of physicians stopped the practice of wet cupping, yet dry cupping continued to provide relief in various bronchial complications.

After 2000 years of ‘success’, cupping received even more criticism in the late nineteenth and early twentieth centuries. Evidently its existence was not quick to fade, but rather persisted beyond what physicians today would have expected. One of the rationales used today is that cupping was a method by which to appease the mind of a vulnerable patient. Few physicians today argue that cupping did have some medical merit in that the acute withdrawal of blood may have stimulated the body’s defense mechanisms.

Even today, one can see correlations between cupping and modern-day practices. Closed suction techniques are now used to extract poison and blood from artificial cutaneous wounds in the operating room. In certain countries in emergency situations, snake venom is often sucked and spit out from the wound to limit its spread into the bloodstream. Women having trouble lactating often express their milk with a breast milk pump, thus creating a suction to promote milk flow not unlike the suction used to extract blood. Even more recent is the method of liposuction to remove excess body fat.

The art of cupping originated at the time of the ancient Egyptians of the river Nile and extended through most of the nineteenth century. Although it was considered by many to be a crude and perhaps even barbaric procedure, one cannot deny the fact that it appeared to have relieved the suffering of many patients. Indeed, it did not have all the curative elements that it claimed, but at the same time it cannot be considered a complete medical mockery. Its long use further argues that one cannot ignore the impact it has had on medicine today and should be noted as a significant chapter in the history of medicine.

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R.T.H. LAENNEC: CLINICO-PATHOLOGICAL CORRELATION AND HOW A ‘CYLINDROMANIAC’ CHANGED MEDICAL PHILOSOPHY

By

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ABSTRACT

With his invention of the stethoscope in the early nineteenth century, René Théophile Hyacinthe Laennec revolutionized medical philosophy and his influence is still visible today. Laennec had been a student of Jean Nicolas Corvisart des Marets, a post-revolution physician in France who was fascinated with the technique of percussion described by Auenbrugger in 1761. On a more grandiose scale, the development of the stethoscope had not only been influenced by Corvisart’s teaching but by everything from the French Revolution to children playing in a hospital courtyard.

Laennec’s stethoscope suddenly made it possible for a doctor to tell someone they were ‘sick’ in the absence of any symptoms and brought pathological anatomy to the forefront of medicine at that time. Anatomical changes were correlated to disease states and quickly the definitions of individual diseases, which had previously been based on constellations of symptoms, were altered to reflect these new associations. Surprisingly however, even as he seemed to be anatomical medicine’s greatest champion, Laennec held doubts about it and had firm beliefs in the influences one’s mental state had on health and disease. Although largely ignored at the time due to the enthusiasm over the possibilities the stethoscope presented, he was a proponent of listening to the patient’s story in addition to his chest before succumbing to tuberculosis, one of the first diseases his invention helped re-define.

René-Théophile-Hyacinthe Laennec was born in the year 1781 in Quimper, Brittany of Western France. Though he only lived to the age of forty-five, and his life spanned the tumultuous period of the French Revolution, the first Empire and the Restoration, his work on mediate auscultation and the invention of the stethoscope earned him the reputation as “the founder of modern medicine” and even “the French Hippocrates” (Duffin 1998).

Laennec’s turbulent life was preceded by an equally chaotic childhood. The oldest of three siblings, by the time he was five years old his mother had passed away and as his lawyer-poet father had been deemed incapable of caring for his children. As a result,

Théophile (as he was called by his family) and his brother were sent to live with a paternal uncle who happened to be a physician, while his sister was sent to be cared for by an aunt. It was during this time that the French Revolution was taking place and Louis XVI was executed. Théophile attended school and in 1795, at the age of fourteen, Théophile enlisted in the revolutionary army as a surgical aide. It is thought that this experience is what swayed Théophile to a life of medicine. As the revolution had resulted in the closure of the medical faculty in Nantes, he set off for Paris to study medicine in 1801 (Duffin 1998).

The Paris school, like the rest of the country had undergone a transformation. With the revolution's ideals in mind, teaching emphasis shifted from textbooks and nosological tables to hands on learning, dissection and experimentation. New faculty had been brought in and the very foundations upon which medicine had been taught for centuries were changed. Philosophically, the shift could be viewed as a move towards positivism, towards Hippocratic observations and away from the time-honoured but 'overly theoretical' teachings of Galen (Duffin 1999). Instead of reading and memorizing constellations of symptoms, students were encouraged to learn on the wards with patients and goal of medicine put more emphasis on maintaining health, not just repairing disease. Paris medicine's golden rule was 'read little, see much, do much' (Porter 1998). Hospitals, which were once sites of refuge for the ill, became an extension of the classroom (Duffin 1999).

Before the revolution, anatomy had very little clinical relevance to medicine. There were two reasons for this: first, doctors could not diagnose internal anatomical changes until after a patient had died and second, diseases were diagnosed based on the subjective symptoms they produced in the patient, not the anatomical lesions they produced (Duffin 1999). Basically put, to be considered sick, a patient had to experience symptoms. However, with the revived enthusiasm for thorough observation of this time, French physicians imagined that the symptoms and structure could be correlated with extensive description of illnesses during life and after death, thus eliminating the second issue, the first, on the other hand, would not be addressed until Laennec's discovery of the stethoscope (Duffin 1999).

Similar to anatomy, surgery was completely separate from medicine prior to the revolution. When the new Paris medical school re-opened its doors in 1794, surgery, which had been taught to apprentices until that time, was now formally taught in the university (Duffin 1999).

All of these factors came together to provide a fertile academic foundation for 'anatomo-clinical' discoveries and the beginning of the pathological revolution. Forward thinking individuals like Xavier Bichat believed that defining diseases by their symptoms created confusion and the way to make things clear was to start 'cutting bodies open' (Porter 1998). Spurred on by such thinking, journals were founded to provide a forum for physicians to relate their discoveries to one another and the supply of cadavers ran short quickly (Porter 1998).

One doctor at the forefront of this upheaval of medical philosophy was Jean-Nicolas Corvisart des Marets, a new professor of internal medicine in the Paris school. Corvisart was also Napoleon's personal physician and he became Laennec's teacher in medical school (Duffin 1998).

Before Corvisart, physical examination was confined to the external and diagnosis relied on the history obtained from the patient. In the early 1780's, he learned of a technique described by the Austrian physician Leopold Auenbrugger in a largely ignored work, 'Inventum Novum' published nearly twenty years earlier. Auenbrugger's work described percussion, and had been inspired by his innkeeper father who tapped on barrels of wine to determine their volume. Corvisart experimented with the technique for twenty more years tapping on chests and examining cadavers before publishing a translation of the treatise along with the results of his own clinical experience (Duffin 1999). Enthusiastic about correlating symptoms with lesions found in the body postmortem – the smoking gun, Corvisart looked for more ways to extend his gaze into the body. Aware that certain heart conditions produced sounds audible outside the patient, he would place his ear directly chest in order to characterize the sounds (Porter 1998).

Laennec excelled under Corvisart's supervision. His seven years already spent in the study of medicine provided him with an excellent basis and was quickly publishing his own discoveries in pathological anatomy in Corvisart's new 'Journal of Medicine' (Duffin 1999). Before he graduated in 1804, he had already written what later proved to be the first description of peritonitis, taught courses in dissection and won first prize in both medicine and surgery (Duffin 1999). However, it would take twelve years and the ousting of Napoleon before Laennec would be awarded an official position in the Necker hospital, widely believed to be due to his political views as he supported a return to the monarchy, a view not popular in post-revolution French medicine (Duffin 1999).

It was Laennec, not Corvisart, who capitalized on the opportunities provided by auscultation. The defining moment of his career came within a year, in 1816 when Laennec was examining a young female in whom he suspected a heart problem. Owing to her stoutness, little information could be obtained through percussion and the patient's age and sex prevented him from placing his ear directly on her chest to listen as Corvisart had described. Recalling that sound could be transmitted through a tube, he tightly rolled some paper and placed it against the patient's precordial region and was able to hear the heart with much greater clarity than he ever had by direct application of his ear to the chest (Duffin 1998). Instantly, Laennec tells us in his book, 'De l'auscultation mediate', he grasped the significance of his discovery, stating how it would be the key for studying all movements capable of producing sound in the thoracic cavity (Porter 1998).

Laennec operated by clinico-pathological correlation, carefully recording the history and physical findings obtained through percussion and mediate auscultation through his 'cylinder' as he called his first stethoscope early on. In order to accurately describe what he heard, Laennec had to invent many words, several of which are still recognizable and used today such as rales, crepitations, murmurs and pectoriloquy. When a patient died, the autopsy was correlated with the clinical findings and within three years, he had

established the anatomical significance of most of the normal and abnormal breath sounds (Duffin 1999).

Laennec developed exquisite skills for the diagnosis of pulmonary ailments such as bronchitis, pneumonia and especially tuberculosis. The use of his stethoscope allowed Laennec to bypass the patient's unreliable account and thus render diagnosis more objective (Porter 1998). Laennec himself admitted that of all the sensations reported by patients, 'none suffices to characterize disease of the heart', and so 'for certain diagnosis we must recur to mediate auscultation' (Porter 1998).

Suddenly, diseases changed. They were no longer characterized by the progression and constellation of symptoms they produced but by the internal changes detected on physical exam. Terms for diseases were introduced that accurately represented the internal pathological changes such as bronchiectasis and pulmonary edema while consumption quickly became known by the more accurate term, tuberculosis. Anatomy had suddenly been made to fit into clinical medicine as physicians could detect internal changes before the patient died or even experienced symptoms. The interesting fallout of this was that a patient no longer needed to feel sick before a doctor could tell them they were. Some doctors even predicted that all diseases could be lined to internal organic change, a philosophy that was pervasive in medical research until the early nineteenth century (Duffin 1999).

Despite his enthusiasm and the fact that many of his peers thought Laennec was over reliant on his new invention to the point that they nicknamed him 'cylindromaniac', Laennec had doubts about anatomical medicine and specifically the tenet of organicism that the anatomical change was the cause of the disease. He held the belief that a person's mental state could influence their health and there must be some other cause of disease that precedes the physical changes he observed with the stethoscope. He cautioned against relying too much on organic explanations and urged physicians to look deeper for other causes (Duffin 1999).

Laennec, Corvisart and their colleague Gaspard Bayle achieved diagnostic eminence through painstaking examination of more bodies than any physician had ever seen (Porter 1998). It is through this type of work that the medical 'gaze' develops according to Foucault in his work 'The Birth of the Clinic'. This gaze allows the physician to see through illusion and the surface distractions created by symptoms to the underlying reality and hidden truth (Foucault 1975). This gaze and the detachment it implies helps free clinical medicine from the subjectivity of symptoms to become a science utilizing objective signs to detect and characterize disease, an idea very popular in this period of positivism.

As the idea of pathological medicine grew in popularity, medical teaching continued to evolve. Medical students were trained relentlessly to interpret the sounds, sights and smells of disease. Clinical judgment consisted of the interpretation of what the senses perceived the sole purpose of which was to designate a particular disease. In the end,

other departments of medicine which were seen as less objective were considered secondary, a trend which lasted for nearly a century (Porter 1998).

There is no denying the impact that Laennec and his stethoscope had on medicine, which persists to this day. Despite critics who go as far as to claim that medicine's loss of empathy for the patient began with Laennec, few inventions have resulted in such dramatic improvements in patient care. Laennec's work resulted not only in the development of a tool which allowed physicians to effectively 'see' the state of the internal organs of their patients, work that continues to this day through the extension of imaging modalities such as MRI and CT scan, but also in a shift in how diseases and their management were viewed. No longer does a patient need to feel bad before we can determine the causal condition and attempt to reverse it. And in my opinion, this is a shift that few patients or doctors would reverse if they had the opportunity.

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THE HISTORY OF TWIN STUDIES: A BUMPY PAST AND A BRIGHT FUTURE?

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ABSTRACT

Throughout history, people have been fascinated with twins, and why not, twins are fascinating people! In ancient cultures, there have been many famous twins, including Hercules and his lesser-known twin brother, as well as the famous ancient Roman twins, Romulus and Remus, and the Egyptian twins of Cleopatra. However, twin studies is a relatively new discipline, started in the 1800's by Sir Francis Galton. Many other famous, and even infamous, scientists who were fascinated by twins and what they could learn from them followed Galton. Other key people in the history of twin studies include the famous Nazi doctor Josef Mengele, British scientist Sir Cyril Burt whose work is still controversial as well as the "Jim Twins" and the Swedish coffee/tea twin study from the 1700's. A brief look at the direction of twin studies now and in the future will be discussed.

Introduction

Throughout history, people have always been fascinated with twins. In Ancient Greek mythology, twins had a special importance and were often given god-like status. Hercules, the mythical warrior and demi-god, was a twin, although it was believed that he was the son of Zeus while his lesser-known twin brother Iphicles was the son of a mortal (Dasen, 1997). As well, the two sons of the god of war, were twins in ancient Roman mythology. In historical ancient Rome, Caesar Marcus Aurelius had twin sons, and the birth was considered so memorable that he had coins commissioned to celebrate the event (Dasen, 1997). Notably, the two most famous Roman twins were Romulus and Remus, twin brothers who were raised by wolves and founded the city of Rome. In Ancient Egypt, famous twins were the twin son and daughter of Cleopatra and Marc Anthony. They were so revered that they were named after the sun and the moon (Dasen, 1997).

There are also many examples of twins in Biblical literature. Genesis 25:21 is the story of the birth of twins to Isaac and Rebekah. These twins were very different in their appearance, suggesting dizygotic twins but in the story one of the twins grabs the heel of the other during delivery, suggesting that the twins were in one amnion (Blickstein, 1998). As this is the only account of the birth of these twins, it is impossible to determine if they were monozygotic or dizygotic. The Genesis account also relates the story of the

grandson of Isaac and Rebekah being the father of another set of twins, which may be one of the first recorded instances of having a family history of twins.

Twin studies as a discipline is fairly new, beginning mainly with the work of Sir Francis Galton. The main purpose of twin studies is to determine the effect that environment plays in a particular disease or trait and the role that genetics plays. Since monozygotic (identical) twins have the same DNA as they came from the same zygote the only difference between the two will be the environment that they grew up in. Most twin studies look at twins at various stages of life and compare the incidence of a specific disease between the two twins. If most sets of twins have both of them with the disease, then it is assumed that the disease has a predominantly genetic cause. If there is virtually no concordance between the twins such that one twin has the disease but the other does not, then it is presumed that environment is the largest factor in causing the disease. Twin studies are especially useful if twins are reared in separate environments so it is very easy to determine if genetics or environment was the cause but it is increasingly more difficult to find twins who have been reared apart.

Development of Scientific Twin Studies

Sir Francis Galton

While people have been fascinated with twins, the actual start of twin studies did not really begin until the 1800's with Sir Francis Galton. Galton has been considered the father of twin studies as he was one of the first to begin objectively and scientifically studying large numbers of twins. Galton was born in 1822 near Sparkbrook, Birmingham (Galton, 1908). Galton was well educated but much of his scientific interest began at home where his grandfather and father were both very interested in the scientific process and his father had all the latest in technology, including microscopes and telescopes. This scientific interest extended to all members of his family with one of his cousins being Charles Darwin. Galton initially was educated as a physician. In 1838 he was an indoor pupil in the Birmingham General Hospital where he started in the dispensary but then eventually joined the surgeons for rounds, operations and post-mortems. To better understand the medicines he was dispensing, he began trying small doses of all the medications in the pharmacy, starting with A, but he stopped when he got to Croton Oil since it had an adverse effect even in small doses. In 1850 Galton attended Trinity College for only one term. After his father's death in 1844, he had enough money that he left the medical profession. However, the medical training and experiences that he had helped him with all of his future endeavors and especially with twin studies.

Galton had many other accomplishments aside from his work on twin studies. In 1850 he traveled to South-West Africa and attempted to chart some of the area there (Galton, 1908). He then went on to do some work with the British Association and was President of Departments, Lecturer and General Secretary over his lifetime. He later on became the President of the Royal Society. Galton also helped do some work with meteorology and he was the first to describe the "Anti-Cyclone". He began looking at fingerprints to see if they have any anthropological significance and while he didn't find this, he found that

they were useful for identification and revolutionized crime fighting and his legacy still continues to this day. Along with his work with geography, he devised the stereoscopic map in 1863, which was used to give a good approximation of mountainous country. He also devised the method of percentiles.

Sir Francis Galton began looking at heredity in 1865 by obtaining multitudes of exact measurements of at least two generations of families (Galton, 1908). Through these studies, he wanted to know the relative powers of nature and nurture so to answer this question, he began to study twins. Galton wanted to look at the similarity in body and mind of same-sex twins (Forrest, 1974). He eventually collected questionnaires from 94 sets of twins and found that there was a striking similarity in 35 pairs, indicating that these were most likely monozygotic twins. Through meticulously studying these questionnaires, Galton found that susceptibility to illness was similar in these 35 pairs. Some of his interesting findings were that in one set of twins, both had toothaches at the age of 23 and had the same tooth extracted. In another set, one had rheumatic ophthalmia in Paris while the other suffered from the same complaint at the same time in Vienna.

Galton was also very interested in the personality characteristics of the twins he studied (Forrest, 1974). He found that in terms of taste and disposition, 16 were very similar and the other 19 were fairly similar but showed differences only in the intensity of the characteristic. However, he did find that handwriting was very different amongst the twins, which disproved one of Galton's theories that handwriting could be used as a tool for psychological diagnosis. In 20 of Galton's sets of twins there were very sharply contrasting characteristics and he observed that there wasn't a single case where the personalities became more similar through the same nurture or environment. Galton used all of this evidence to conclude that nurture can only provide instruction and professional training but heredity provided the dominant role, but only within narrow environmental limits, such as being in the same rank of society and in the same country.

While Galton did begin the traditional study of twins, his first aim was to establish if the tendency to give birth to twins was itself hereditary or controlled by nature (Burbridge, 2001). From extensive family histories of twins, Galton found that the chance of an uncle or aunt of a twin being a twin himself or herself was 2.5 times that of the general population (Galton, 1875) proving that even the tendency to have twins was hereditary.

Sir Francis Galton's interest with heredity also led to his work regarding eugenics (Galton, 1908). He believed that certain members of society should not be allowed to propagate but that the human race should be furthered by allowing the productivity of the fit so that only the greatest traits are carried through into the future. However, there appears to be no real evidence that eugenics actually could be attained and many people disregarded this notion until the Nazi regime and the hope of creating the perfect Aryan race.

Dr. Josef Mengele

Another name synonymous with twin studies is Dr. Josef Mengele, the Nazi “Doctor of Death”. Mengele performed numerous experiments on twins while he was working at the Nazi concentration camp in Auschwitz. Mengele was born in 1911 in Gunzburg, Germany into a wealthy family (Aziz, 1976). He studied philosophy in Munich at the age of 19 and it was during his time in university that he heard Hitler give a speech in 1933 and immediately joined the Storm Troopers, as he was so inspired by what Hitler had to say. In 1938 Mengele received his medical diploma and joined the S.S. Mengele had a fascination with twins that stemmed from his research at the Institute of Biological Heredity and Race Hygiene in Frankfurt. The goal of this institution was to scientifically prove the theories of racial purity of the Aryan race. The key to this research was in twin studies as the scientists concluded that identical twins, which have the same hereditary characteristics, were physically and psychologically very similar proving that all the characteristics are inherited. Mengele was also interested in determining how twins were born so that he could devise a way for all the Aryan women to have twins, thus increasing the population of the Aryan race at double the rate of the other ethnic groups.

Mengele began working at Auschwitz in May of 1943 and was quickly appointed to be the Chief Medical Officer of Auschwitz-Birkenau (Aziz, 1976). This allowed him to do experiments without much interference from his superiors. Mengele would have any twins that passed through the gates at Auschwitz removed from the crowd and given preferential treatment, such as comfortable bedding, increased amounts of food and a reprieve from the hard labour of the camp.

Once he had the twins, Mengele performed numerous experiments on them, doing every procedure known at that time (Aziz, 1976). He performed blood tests, lumbar punctures, as well as detailed comparative drawings of hands, feet and other anatomical features. He did person-to-person transfusions, tried to change the eye colour of people, and would remove or change the organs of the twins. He also wanted the twins to die at the exact same moment so he could ensure all of the variables would be the same when the autopsies were performed. To this end, he would often kill the children at the same moment using various methods, such as directly injecting chloroform into the hearts of the twins. The value of human life was so low in these death camps that any hypothesis that was posed could be tested regardless of the senselessness of the experiment.

After the war, Mengele became somewhat of an enigma as he was able to elude prosecution for his crimes despite repeated attempts by governments all over the world (Aziz, 1976). He was able to escape the country through false papers that he acquired supposedly from the Jewish mafia. He was sighted on several continents, ranging from various countries in Europe, to Egypt, and to different countries in South America. The extent of his atrocities in the Nazi camps was so bad that in 1974 the price on his head was still one hundred thousands marks. The exact circumstances surrounding his life and presumed death remain a mystery to this day. Unfortunately, the idea of eugenics did not die with Dr. Mengele.

Sir Cyril Burt

Another infamous name in twin studies is that of Sir Cyril Burt. Burt was a British researcher who looked at correlating hereditary with various indicators of ability, such as intelligence, in an attempt to continue the work in eugenics of one of his mentors, Sir Francis Galton. Burt was born in 1883 and in 1908 completed his formal education and took up his first psychological post (Hearnshaw, 1976). This was a golden era for psychology, as the area was rapidly expanding with many new theories being generated. Burt was influenced directly by Galton, as by a stroke of luck Galton lived only a short distance from Burt's family, and they were in contact with each other.

Burt was convinced that both talent and character were largely inherited. He thought the use of quantitative studies would help to prove his theory (Hearnshaw, 1976). He wanted to make a study of individual psychology and the individual differences between men. Throughout his career, he was often embroiled in controversy over the use of intelligence testing, but while he was alive there were only a few people who suspected that his scientific work was not legitimate. It was not until after his death that the true discrepancies in his work became apparent.

When Burt's work was published, it was considered to be valid and many people later went on to use his data to support their own theories. In 1943, Burt published an article on ability and income (Hearnshaw, 1976). The study contained 156 dizygotic twins, 62 monozygotic twins, 15 of whom were reared apart. Burt claimed that the results had been previously published in L.C.C. reports and in theses, but there was no trace of the results or any reference to the results found. As well, none of his post-graduate students worked on twin material for Burt. In 1955, a mere 12 years later, the twin population in Burt's studies had increased by 16 dizygotic twins and 42 monozygotic twins, with six more being reared apart. At that time, it was an incredible feat to get so many twins enrolled in his studies in such a short period of time, especially in the category of monozygotic twins reared apart, which is a very rare category. Burt claimed that he was helped by his research assistant, Miss J. Conway, but the details were very sketchy about the investigation itself. Later, in 1957, he presented a lecture on "The Inheritance of Mental Abilities" and had over 30 cases of monozygotic twins reared apart, but had the same correlation numbers as his 1955 article. There were also two articles by his research assistant, Miss Conway, that had 42 pairs monozygotic twins that were reared apart, which is double the number of people in this rare category in a mere three years.

In 1966, Burt used his own name again in an article on "The Genetic Determination of Intelligence: A Study of Monozygotic Twins reared together and apart", where he had 53 pairs of monozygotic twins reared apart (Hearnshaw, 1976). All the numbers in the groups had changed, with some groups getting larger and oddly, some groups became smaller. In many cases, the correlations reported remained identical to his earlier research to the third decimal point despite the fact that the number of subjects in each group had changed.

Criticisms began to arise that there was a lack of precise detail regarding the methods used to collect the data, there were conflicting and contradictory statements in the varied

reports, and the correlation coefficients were too consistent even when the sample sizes changed (Hearnshaw, 1976). There was even controversy surrounding his research assistants, Margaret Howard and Miss J. Conway, as it is possible that they never existed. Some people thought they remembered the research assistants but were very vague about their memories of them and it was only after hearing about the controversy in the press that they remembered about the women (Fletcher, 1991). It is now thought that Burt fabricated the existence of the research assistants and used their names as pseudonyms under which he wrote letters and papers so that it seemed that more people were supporting his own theories. It is now theorized that Burt worked backwards to make the observations fit the answers or may have fabricated the data to fit the predictions of his favourite genetic theories (Hearnshaw, 1976). It is also possible that he did most of his twin study papers as a response to attacks by his critics and may have falsified the data to prove that he was right. What is known is that most of his data was collected before 1950, most of this before the 2nd World War so it is quite possible that he fabricated data that was published after 1950.

Famous (but non-scientific) Twin Studies

The Jim Twins

This is a study of one pair of monozygotic twins that were reared apart from birth in two very diverse environments and then later reunited. The Jim twins were born in 1940 and separated shortly after birth (Smithsonian, 2003). One twin was raised Jewish in Trinidad and the other was raised as non-Jewish in Nazi run Czechoslovakia. They were reunited in 1979 and psychologist Thomas Bouchard studied the similarities between their lives. Some of their similarities were that both were named Jim by their adoptive parents and each had married two times, the first marriage to a woman named Linda and the second to a woman named Betty (Redden, 2003). One Jim named his son James Allen, while the other Jim named his son James Alan. They both had a carpentry habit and had built identical benches around trees in their yard. They had each voted for the same candidate in the previous three presidential elections and each Jim left love notes for his wife around the house. They both had identical medical histories, with both of them getting migraines since the age of 18. The “Jim Twins” became instant celebrities and had articles written about them in *People* and *Newsweek* magazines as well as being guests on *The Tonight Show*. While this is an interesting case study, it is impossible to gather scientific data based on a single set of twins.

Swedish Coffee/Tea Study

King Gustaff III of Sweden carried out one of the first recorded twin studies in which he attempted to determine if drinking coffee was bad for health (Breimer, 1996). A pair of monozygotic twins had been sentenced to death for murder and the king changed their sentence to life imprisonment if one of the twins was willing to drink tea three times a day for the rest of his life and the other would drink coffee. The twin who drank tea died first at the age of 83 and the coffee drinker lived beyond that but the actual age was never known as the king was murdered before the twins died. The result of this study was that

coffee was the less dangerous of the two choices of beverages. However both twins lived to a very old age for the time and with only one set of twins in the study, the results can not be considered valid.

Present and Future Twin Studies

While twin studies have had a bumpy past, they are of incredible use to the scientific community. Twin studies are useful in determining what components of disease are genetic and what are environmental, thus giving a chance to determine nature versus nurture. By comparing twins that have been reared apart, a very rare but valuable group, the influences of very different environments on the same genetic background can be assessed. There is also a role for twin studies that look at twins that have been raised in similar environments. This is an effective way to look at the progression of disease or what diseases each twin gets, which can help to show the different environmental exposures that cause disease. But what is the usefulness of twin studies now that the genome has been sequenced? This is going to be an exciting time for twin studies as it is quite possible that twin studies will have an even more important role as the gene or genes responsible for different diseases may be elucidated by studying the genomes of a twin who has the disease and a twin that did not get the disease.

Conclusion

Twin studies have had a very exciting and controversial past, especially since the discipline only began in the late nineteenth century with Sir Francis Galton. Twin studies have survived the brutal experiments of Dr. Josef Mengele and the controversy of Sir Cyril Burt. The result of these dark stains in the history of twin studies have radically altered the discipline as many ethical rules have been laid out to protect the twins involved in the studies, and all people involved in human trials in medicine. There have been some very interesting informal twin studies throughout time, especially the Jim Twins and the coffee-tea study in Sweden. Twin studies are still an integral part of understanding disease processes and the future of twin studies looks very exciting indeed! Twin studies is a fascinating discipline and will continue to be in the foreseeable future.

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FORENSIC MEDICINE IN CHINA

By

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Preceptor: None

ABSTRACT

The Chinese tradition of forensic medicine developed separately from both the Western tradition and medical practice within China. Important in the early rise of forensic medicine were beliefs about human nature and jurisprudence, and the already bureaucratic governmental structure in China. Beginning with early writings over two thousand years ago, the practice of forensic medical investigation has been highly scientific and played a key role in the investigation of deaths. The Chinese are credited with developing the first systematic treatise on forensic medicine in the world in the form of “The Washing Away of Wrongs” in 1247 CE. This work laid the basis for forensic medicine in Japan and Korea, and was the exclusive text in China for almost seven hundred years. Only after European practices of autopsy were adopted did the practice of forensic medicine in China become fully integrated into the medical system.

Over the past ten to fifteen years, forensic medicine has become increasingly prominent in popular culture. Millions of North Americans tune in weekly to get a glimpse of criminals being caught and the innocent exonerated. It appeals to both our sense of justice and our curiosity. Granted, the field is often highly glamorized in the popular press, but the concept of the meticulous investigator leaving no stone unturned is not a new one. Forensic medicine as a science has been practiced in China for many centuries. The primary investigative tool was an exhaustive examination of the body and its environment. The autopsy, a staple of Western practice, had no role until recent times.

Contributing Factors

Several social, philosophical and political factors contributed to the early rise and structure of Chinese forensic medicine. From the beginning, forensic investigations were essentially separate from the medical profession (Gwei-Djen 1988). Chinese physicians were of a low class and not usually called upon to give a medical opinion in matters of suspicious death – they dealt with the living (Gwei-Djen 1988). Furthermore, the *wu tso* (a slave-class undertaker) and the *tso pho* (a woman, usually the midwife, who examined female corpses) had no medical training (Gwei-Djen 1988). Matters of health and welfare among the scholarly classes were handled by consulting fellow scholars rather than the physicians (Gwei-Djen 1988).

In contrast to the West, where divine justice was a familiar and key concept, Chinese philosophy was less based in religious considerations, and therefore the idea of a higher form of justice was not prominent (Gwei-Djen 1988). One school in particular is associated with the development of forensics. The legalist school, originating more than two millennia ago, proposed that the population at large was stupid, predisposed to evil and acted from largely selfish motives such that all laws had to be clearly stated and not subject to interpretation (Gwei-Djen 1988). Legal concerns were twofold: that murderers would try to make a murder appear accidental, and that the opportunists would try to make an accident appear as a murder so as to discredit someone. The moral imperative of clearing the names of the innocent was also incorporated. The combined goals of identifying the guilty and protecting the innocent promoted the detailed investigations to ensure that the correct person was punished to the full extent of the law. The legist school was the official policy of the Qin state (221 BC) (Gwei-Djen 1988).

Another factor was the highly organized political structure of Chinese government. The country was divided up into counties, and each county had a sub-magistrate who was in charge of the victim, be they living or dead (O'Neill 1976). His function also included searing and arresting the accused (O'Neill 1976). Wu tso were brought in to do the drudge work, and physicians were consulted in cases of disease (O'Neill 1976). As the system evolved, careful documentation had to be made for every case and signed off by the presiding official as being factually correct with copies sent to a variety of levels of government (O'Neill 1976, Gwei-Djen 1988).

An important feature of Chinese forensic medicine is the lack of dissection and internal examination. The Chinese view of the body and its disorders was built on an elemental theory similar to those used in other cultures, and like other cultures, rejected the idea that dissection was necessary to the understanding of the body (Smith 1951). There was also the belief that mutilation of a body continued even after death, which certainly impaired the development of surgery (Ackernecht 1982), and may also have inhibited use of the internal examination. In any event, the energies of the investigators were focused on detailed external observations.

The result of the interaction of these factors was a system developed out of the drive to accurately punish criminals through the use of careful observation and documentation by governmental officials as part of the larger bureaucratic system of the Chinese government.

Early Writings

The first writings on forensic investigation date back to the time of the Warring States (475-21 BCE) with “The Book of Rites” and “Lü Shi Chunqiu” which urged officials to view injuries, analyze findings, and judge cases (Hua 1987)). The next key period was the Qin state (252-21 BCE) with “Dialogue to Law” and “Feng Zhen Shi.” These works were concerned with criminalistics and forensics (O'Neill 1976). Although findings such as the tell-tale neck marks made by hanging were known (O'Neill 1976), other investigations were clearly hampered by a lack of medical knowledge (Gwei-Djen 1988).

Forensic investigation was following a highly scientific approach by the first century CE as was demonstrated by the story of Zhang Ju and the pigs (O'Neill 1976). Zhang Ju was a first-century magistrate called upon to judge a case of a woman charged with killing her husband and then setting fire to the house with his remains (O'Neill 1976). Zhang Ju had two pigs, one living and one dead, burned to demonstrate that the living pig had ashes in its nostrils (O'Neill 1976). The woman's story was proven false and she was convicted of murder (O'Neill 1976).

Sun Tz'u and the "Washing Away of Wrongs"

The most significant period in the development of forensic medicine in China was the period of the Song dynasty (960-1287 CE). By 1000 CE, all suspicious deaths were examined, with violent deaths reported and re-examined (O'Neill 1976). By 1174 CE, a standard form had to be filed in triplicate with the information of the name of the prosecution, presiding official, assistant, warrant, time of arrival on scene, number of wounds on the deceased, and cause of death included (O'Neill 1976). At this point, the *wu tso* removed the body, anointed it with wine or vinegar to uncover the injuries, and marked the wounds under supervision of the investigator (O'Neill 1976, Gwei-Djen 1988). Doctors were brought in to examine living victims (O'Neill 1976). Anterior and posterior body diagrams were introduced in 1204 CE so that the coroner could mark the wounds accurately (Gwei-Djen 1988).

It was during the Song dynasty that the definitive work of forensic medicine was written. Sung Tz'u was a public official who consolidated all previous learning and practice into a single systematic treatise on forensic medicine in 1247 CE (Giles 1924). The work devotes a section to nearly every type of death with case studies and approaches to the investigation of each (Giles 1924). From the very beginning of the work, a meticulous approach is stressed.

If death has just taken place, first examine the top of the head, and the back, the ears, the nostrils, the throat, &c., and all places where anything might be inserted... Moreover, deaths from self-strangulation, throat-cutting, taking poison, burning, drowning, and the like, produce very different results, and only the most minute investigation of every detail will ensure a complete and reliable verdict (Giles 1924).

Among the theory and techniques included are two noteworthy examples. The first concerns the concept of "vital spots," or places on the body where it is particularly susceptible to internal injury and death without obvious external signs. There were sixteen anteriorly and six posteriorly. Modern medicine has confirmed many of these, which include the fontanelles of the skull, occipital and cervical regions, just superior to the sternum, the perineal region, and the scrotum (Gwei-Djen 1988). The second concerns the examination of bones for fractures. Bones were prepared by burning off the flesh, and then viewing them on a bright day under a red-colored umbrella (Gwei-Djen

1988). Bone bruises would show red traces, and fracture edges would have a red halo (Gwei-Djen 1988). This method also distinguished pre and post-mortem fractures because there would be no red on fractures sustained after death (Gwei-Djen 1988).

More Recent Trends

After the publication of Sun Tz'u's work, it was recopied many times. Together with a later work "The Cancelling of Wrongs" written in 1308, translations appeared in Japan and Korea, forming the basis of forensic medicine there (Gwei-Djen 1988). China preferred Sung Tz'u's work and adopted it as the definitive manual until 1927 CE (Smith 1951). The work was so comprehensive that it basically shut down further experimentation in the field, much like Galen's work did for Western medicine in the Middle Ages (Smith 1951). In fact, new findings would not be accepted if they contradicted the text (O'Neill 1976).

The Xin Hai Revolution of 1911 change the situation significantly. The Criminal Procedure Law of 1912 permitted internal examination of bodies (Hua 1987). It was at this point that the medical profession became involved in investigation through the internal examination of bodies (Hua 1987). While either the coroner or the doctor could perform the external examination, only doctors could do an autopsy (Hua 1987). The demand for such investigation became so great that the first department devoted to instruction of autopsy techniques was founded in 1930 by Lin Ji, a physician who studied in Germany (Hua 1987). At the peak of this period, every physician with hospital privileges was required to take training to serve the judicial system (Hua 1987). Others from senior middle schools were tapped to become technicians for the courts (Hua 1987). Coroners received six months of intensive training (Hua 1987).

Unfortunately, the school failed after only a few years, and the founding of the Republic in 1949 led to a period where use of forensic medicine waxed and waned repeatedly (Hua 1987). After a period of relative unpopularity, the science experienced an upswing in the mid 1980s (Hua 1987).

Comparison with Western Forensic Medicine

The rise of forensic medicine in the Western world occurred at a different rate and sequence. It was largely unknown in Greece and Rome and had limited use in Hellenistic Egypt (Gwei-Djen 1988). The Justinian Code (529-64 CE) urged the cooperation of medical experts in various legal problems such as pregnancy, sterility, impotence, legitimacy, rape, poisoning, and mental disease (Gwei-Djen 1988). This was regarded as the highest point in forensic medicine prior to the Middle Ages, but no systematic treatise existed (Gwei-Djen 1988).

There is a lack of any reference to medico-legal doctors through the Middle Ages, and no developments are recorded until 1507 CE (Gwei-Djen 1988). In the Germanic territories, expert medical testimony was used to guide verdicts in murder, wounding, poisoning, hanging, drowning and other such crimes (Smith 1951). As with the rest of medicine,

Vesalius' "De Fabrica Humani Corporis" of 1543 CE revolutionized the system and put the tools of dissection back into physicians' hands rather than those of the prosecutors (Gwei-Djen 1988). The first comprehensive text on forensic medicine was printed in 1602 by Fedele called the "De Relationibus Medicorum" (Smith 1951), followed by the "Quaestiones medico-legales (1621-35)" by Zacchia which marked the beginning of forensic medicine in Europe (Gwei-Djen 1988). It has been theorized that the lack of a comprehensive text on forensic medicine in Europe spurred the development of the field as physicians sought to explain the mechanics of crime (Smith 1951).

Conclusion

The Chinese tradition of forensic medicine is a rich one beginning far earlier than the tradition in Western medicine. From very early on, it was a highly scientific practice driven by the desire to ensure that only the guilty were punished for crimes. In contrast to Western practices, which included physicians from early on, the Chinese tradition only included physicians in post-mortem examinations once Western practices were introduced into the Chinese system. Indeed, the emphasis placed on external examination of the body and the scene of the crime is very similar to the approach employed in North America today.

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FORENSIC BALLISTICS

By

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ABSTRACT

Forensic Medicine was founded in the 5th Century, when the Germanic and Slavic people overthrew the Roman Empire in Western Europe. A few barbaric tribes such as the Lombards and Vandals emerged. These demolishers of culture and civilization were also pioneers in the determination of the cause of death using medical expertise. A direct consequence of their influence was the Wergeld concept, literally meaning “man money” or “blood price” as it is more commonly documented in literature. It is a sum of money paid by the criminal or suspect to the victim and in case of murder, to the victim’s family. The price paid was determined by two factors, the type of injury inflicted and on whom the assault was committed. For instance, if the wounds exposed brains or bowels, a higher amount would have to be paid as opposed to just bloodshed. The social status of the victim also played an important role in determining the price paid. For example, if the injured was of a higher class, the price would have been higher as opposed to the injured being a slave or serf. This system led to the necessity for evaluations of wounds in the courts by a medically competent person.

The application of forensic medicine was also used during the time of Christ in the determination of suicide. There was a primitive belief that the act of a suicide was caused by the individual being possessed by evil spirits and upon death these spirits were passed on to other community members. Thus, in a sense, it was regarded as a transmittable disease that was best stopped. In the Greek community, suicide was regarded as an act of rebellion against the Gods and the punishment in that case would be denial to funeral rights, a heavy penalty to pay. In Rome, citizens who committed suicide were viewed as traitors of the government and condemned. In all three instances, the determination of the cause of death would require the expertise of a knowledgeable medical practitioner.

As history turned its pages, the art and practice of forensic medicine not only developed within the areas where it was first applied but even spanned the globe to the far reaches of China. In 1248, Hsi Duan Yu published the first recorded application of medical knowledge in crime solving with his book “Washing Away of Wrongs”. This book distinguished drowning and strangulation from death by natural causes.

1507 marked the beginning of forensic pathology in modern Europe with the emergence of the Bamberg Code. Twenty-three years later, Emperor Charles V issued the *Constitutio Criminalis Carolina*. Both these documents highlight the significance of forensic pathology by requiring that medical testimony be a major part of courts, especially in trials where manner of death was questionable. Records show that wounds were opened to show depth and direction, although complete autopsies were not performed in all cases. Throughout that century, forensic pathology progressed tremendously and was often utilized by law enforcement to help solve crimes, differentiating between various causes of death including homicide, poisoning and asphyxiation.

The dawn of firearms brought about the necessity for a subdivision of forensic medicine namely forensic ballistics. It involves the identification of fired bullets, cartridge cases or other ammunition components as having been fired from a specific firearm. In 1835, Henry Goddard, a policeman made a mold of the evidence bullet and observed that the bullet mold produced the exact same flaw in all bullets cast from it. These flaws are distinct markings called striations and can be described as abrasions or scratches on a bullet produced by the harder surface of the interior of the gun against the softer bullet surface. In 1900, an American physician, Dr. Albert Llewellyn Hall found that the microscopic striae on bullets from different guns varied in appearance. Referring to these very striations, in 1926, Major Calvin Goddard, an American expert stated in an article in the *Journal of Criminal Law and Criminology* that “Every pistol barrel...contains minute irregularities which are peculiar to it alone, and which will never be reproduced in any other. These irregularities leave their mark...on every bullet fired from this barrel, and they constitute to all intents and purposes, a fingerprint of that particular barrel.” Sir Sidney Smith reasserts this point by stating that “A cartridge case at the scene of offence could prove as incriminating as if the murderer had left his visiting card”.

Besides striations, some guns also leave rifling marks on bullets. These marks refer to the series of spirally cut grooves in the anterior of the bores of handguns and rifles, which either rotate right or left. The purpose of rifling is to impart a spin to the bullet in order to stabilize it during its flight. The *Minnesota vs. Edward Lawlor* case in 1897, marked the dawn of identification of rifling marks on a bullet. In the city of Winona, 3 men fought over the affections of one woman, resulting in one man being shot dead. The question was which one of the two men shot had shot him. The guns confiscated from the two men were a .32 caliber Smith & Wesson revolver and a .32 caliber Hood revolver. The expertise of a qualified gunsmith was used in this case to examine the fatal bullet as well as the two suspect revolvers. Upon examination, only one of the revolvers had true rifling marks that led to his testimony stating that the bullet could not have been fired from the revolver with the rifled barrel, but might have been fired from the unrifled gun.

In 1900, a significant article entitled “The Missile and the Weapon” written by Dr. Albert Llewellyn Hall was published in the June issue of the *Buffalo Medical Journal*. This article described in detail the measurements of land and groove markings and bullet diameters as well as documented the variation of bullet shape and style between

manufacturers. He also discussed the examination of gunpowder residue in barrels of firearms and the changes that take place over time after the weapon is fired.

By the early 1900's, the science had progressed to a point where bullets and cartridge cases could be identified and linked to a particular gun. Another prominent figure in the history of Forensic Ballistics is Edwin John Churchill, a gun maker who established a business in The Strand, London and became a gun expert frequently consulted by Scotland Yard. From the frequent experiments carried out by firing bullets into sheep's heads which he conveniently obtained from the butcher's next door, he was able to make thorough observations pertaining to powder marks, penetration and the destruction of tissue, and eventually determining if the bullet wounds were self-inflicted or otherwise. In 1903, he provided expert evidence in one of the most notorious cases Clavering, Essex had ever witnessed. The remains of Camille Cecille Holland, a 56 year-old wealthy spinster were discovered in a drainage ditch at the Moat Farm, Clavering, Essex. A post-mortem revealed that she had been shot in the head. Churchill examined the ammunition found on the farm and upon conducting experiments on sheep's heads, was able to produce the same skull fractures as the bullet found in Miss Holland's skull. He testified that the bullet was fired from a revolver recovered at the Moat Farm, at a distance of six to twelve inches. This evidence incriminated Samuel Herbert Dougal, a serial womanizer who charmed the moneyed spinster, only to murder her within three weeks and proceeded to forge her signature to obtain large sums of money from her bank account. Dougal appeared before Mr. Justice Wright at Chelmsford in June 1903 and was found guilty of the willful murder of Miss Holland. He was hanged at Chelmsford prison on July 14th 1903.

Observation has proved to be one of the most vital skills in forensic ballistics and with the invention of the comparison microscope in 1925, the product of a collaborative effort of 4 gentlemen, Charles E. Waite, a para-legal, John H. Fisher, a physicist, Philip O. Gravelle, a chemist and Calvin Goddard, a medical doctor from Johns Hopkins Hospital, this skill was augmented to a higher level as miniscule observations and comparisons could now be made. It was Gravelle who mistrusted his memory. "As long as he could inspect only one bullet at a time with his microscope, and had to keep the picture of it in his memory until he placed the comparison bullet under the microscope, scientific precision could not be attained." Almost immediately, this "silent detective" was brought to Europe by Sir Sidney Smith and A. Lucas and to England by Robert Churchill, the nephew of the renowned gun maker, Edwin John Churchill. This valuable piece of equipment is currently used for bullet and cartridge case comparison and identification and can be found in almost every forensic ballistics laboratory.

One of the most famous cases Robert Churchill was involved in occurred in Essex. In the early hours of Tuesday, September 27th 1927, the body of Constable George Gutteridge was found lying in a country lane near Howe Green, Essex. He has been shot four times, twice in the left cheek and once in each eye. At the scene, two .45 bullets were found and upon post-mortem, two more were covered. It was construed that a car was pulled over by Constable Gutteridge that night and as he was about to record its details, was shot. His murder was connected with the theft of a blue Morris-Cowley that had been reported

stolen that night. The stolen vehicle was found abandoned in Stockwell, London and in it, an empty cartridge case. The evidence was handed to Churchill for examination and with the aid of the comparison microscope he managed to establish that they had been fired from a Webley revolver. With all the evidence put together, Frederick Guy Browne, a well known London criminal was implicated and was arrested as he returned to his premises in Clapham. He was found in possession of a number of loaded firearms including twelve .45 cartridges and a fully loaded Webley revolver, which he claimed had been obtained from William Kennedy, his associate after the murder had occurred. William Kennedy was eventually arrested and when interviewed, admitted being present at the murder but maintained that Browne had killed Gutteridge. Browne denied any involvement in the crime, but to no avail as Churchill's examination of the weapons recovered from Browne was able to prove, with the aid of the comparison microscope that the empty cartridge found in the vehicle was fired from the exact same Webley revolver seized from Browne- a damning piece of evidence. Both men were convicted and headed for the gallows.

In principle, the way we identify bullets and cartridge cases with all the modern technology available to us today vary very little from what was done in the past. The first step of the process involves test firing bullets into tanks about three feet wide, three feet high and 10 feet long filled with water for soft metal bullets and thick cardboard or cotton batting for harder bullets. Fired standards will then be compared to evidence bullets using the comparison microscope.

The services of forensic ballistic experts have been needed time and time again in crime-solving over the last century. Firstly, they compare and match bullets to a particular firearm. For instance, if more than one bullet or cartridge case and a single evidence gun are available, the gun would be test fired. The fired standards would then be compared to the evidence bullets or cartridge cases to determine if they were fired from the same gun, and if so, whether or not it they had been fired from the evidence gun. In another example, only one evidence bullet but more than one evidence gun available. This would require the test firing of the evidence guns and the comparison of the fired standards to the evidence bullet to identify from which gun it had been shot from. (Minnesota vs. Lawlor, 1897.) Ballistics experts can also provide you with an accurate estimate of distance of shooting. In order to measure muzzle-target distance, the gun is shot at varying distances at a target and the target would then be examined for the size of the hole made as well as the diameter of the gun powder residue. The detection and analysis of gun powder residue are done by swabbing the clothes of a suspect to match the type of bullet used. Last but not least, the fascinating procedure of restoring obliterated serial numbers is also performed by forensic ballistics experts in the analysis of evidence. Serial numbers are stamped onto every bullet. However, these numbers may be obliterated for a variety of reasons, the most common being that the bullets are old by the time they are found. However, the stamping process goes deeper than just the surface. The examiner applies a solution of copper salts and hypochloric acid that temporarily brings up the number, making it available for a photograph before disappearing again.

One of the early major victories in this field was won in 1929. On February 14th 1929, gunshots were heard at a red brick warehouse in Chicago. Upon investigation, the neighbors had seen a car leaving with 3 police officers and 2 civilians earlier that day. At the scene, 7 unarmed men were shot in the back multiple times. The wall the men had been lined up against was a gory mess. This caused an outrage among the people as they were under the impression that the police had done the job. Forensic ballistics experts including Calvin Goddard were called in to assist in the investigation. Their primary focus was to clear the police of any wrong doings. Upon forensic ballistics investigation, the guns used by the police force from eight different manufacturers did not match any of the bullets recovered from the murder site, indicating that somebody had impersonated police officers to commit the murders. This event turned out to be a gang war between Al Capone and George “Bugsy” Moran. The men had been lured to the warehouse under false pretenses that a truck of hijacked whiskey was coming in. Moran was to be one of them but he was a few minutes late, just shy of being victim number eight. The murder weapons were identified as .45 caliber Thompson submachine guns and were matched to the guns owned by Al Capone. However, in this case, a verdict was not secured because Al Capone was in Florida with an airtight alibi.

Even from the time of Christ, we have witnessed the exciting and significant impact of forensics in various aspects of criminology. Throughout the last century, the science of forensic ballistics has progressed at such rapidity, from bullet molds to the comparison microscope and has been utilized time and time again in the solving of countless crimes in which its victims could not speak. However, with the help of experts of this field, the evidence did.

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FORENSIC ENTOMOLOGY: TAKING ADVANTAGE OF THE CIRCLE OF LIFE

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Preceptor: None

ABSTRACT

Insects: nuisance or scourge? How about ally? The field of forensic entomology proposes that insects can be a crime-solving tool. From ancient China to 19th century France to present day California, high profile cases have been solved using the silent testimony of insects. Based on their lifecycles and growth rates that can be reliably correlated to environmental factors, hexapods have been used to work out mysteries of death and decay. Recently, the popular television drama CSI has led to an interest in a new audience than before – this is no longer the exclusive domain of nerdy scientists or mystery authors.

Still, this field struggles to gain the respect and credibility that other specialties such as ballistics or DNA sampling enjoy. The challenge lies, in part, in getting the public to move beyond their visceral reaction to wriggling maggots to understanding the information that they alone can provide.

Introduction

For most people, insects are little more than a nuisance, something to be avoided or controlled. One of their major roles in our ecosystem, the decomposition of organic material, is viewed with suspicion and disgust; rarely is maggot used as a term of endearment. And yet, without these industrious workers, we would be unable to survive – organic material would not be recycled and we would be surrounded by putrefaction. Entomologists have long admired the work done by arthropods in many spheres, but it is only in the last few centuries that we have begun to appreciate their usefulness in solving crimes.

Some background as to how insects work to decompose bodies is necessary before a discussion of some of the historical advances that have allowed this field to develop. I will then examine some current uses of forensic entomology and some considerations for the future.

The Basis of Forensic Entomology

Forensic entomology is not restricted to the use of insects to study crimes. There are many non-insect arthropods, such as mites, which are invaluable in the decomposition of a body. However, most research centers on the evaluation of flies (Diptera) and beetles (Coleoptera), which are insects. These are used because they are generally the first to arrive on the scene (Marchenko, 2001), they are fairly easily identified to species level at many stages of development and because they have predictable patterns of succession.

Insects go through discrete stages of development throughout their lifespan. Diptera and Coleoptera are holometabolous insects, meaning that they go through an egg stage, a number of larval stages (instars), a pupal stage, and finally an adult stage at which time they are sexually mature and able to produce offspring. Each species has its own preset number of stages and length of time required for each stage to progress to the next. While these may vary between species, they are fixed for that species, making the development of an individual insect predictable if it can be identified to species and if that species has been sufficiently studied.

Insects are also ectothermic creatures, relying on ambient temperature and humidity to determine metabolic rates. As such, insect development can be predictably regulated by environmental factors. The time necessary to complete stages of development can be expressed as accumulated degree hours (ADH) or accumulated degree days (ADD) (Catts and Goff, 1992). These concepts express the fact that development is a product of both time and temperature. There are varied and complex ways to calculate these, especially from real-world data as compared to the constant values of a laboratory. It is sufficient to understand that each species has a set number of ADH or ADD to complete a developmental stage (UC IPM). Given accurate identification and sufficient understanding of that species, insects can provide a reliable timeline based on stage of development, a combination of which stage they are in and how far developed within that stage.

In addition to information regarding an individual insect or species of insect found on a corpse, there is also a wealth of information to be gained by looking at the composition of species found on that corpse. Insects follow a predictable pattern of succession, although the species represented will vary by region. Over time, a body goes through stages of decay. At first it is fresh, but within a few days it will begin to produce an odour. Fat becomes rancid after three to six months, and caseous post-fermentation products are found after roughly one year. This stage is followed by ammoniacal fermentation and complete dessication (Erzinclioglu, 1983). Paralleling these stages of decay are stages of insect succession. First to arrive are the necrophages, the insects that will consume the corpse itself. These are followed by the omnivores, insects that will consume both the corpse and the necrophagous insects. Next come the predators and parasites, who feed on the insects that have already arrived, or use their larvae as hosts in which to lay eggs. Finally come the incidentals, organisms that use the new environment created by the body. These may include spiders that use bones to anchor webs or soil-dwellers that take advantage of the alkalinity produced by a decomposing body (Catts and Goff, 1992). By

examining the composition of the group of arthropods present on a body, an investigator can get an estimate of the time elapsed since the body was exposed for decomposition.

A caveat to this is that weather, season, and location will all affect the group of arthropods that will be found at any particular scene. Such variables as rain or sunshine will select out creatures that are able to travel or survive in those conditions. Many insects go into a hibernation-like state called diapause over the winter months when temperatures are lower and the number of daylight hours decreases. Activity in these times of arrested development will be decreased and therefore calculations will need to be altered to take this into consideration.

A final consideration in understanding how we obtain information from insects is how studies have been conducted in the past. Obvious ethical and social considerations prevent researchers from leaving human remains exposed to the elements to investigate the patterns of succession and amounts of time required for insects to decompose a body. Studies have been conducted on a number of animal cadavers, and the one found to most closely resemble human decomposition is a pig weighing roughly fifty pounds (Anderson, 1993). Pigs have skin and subcutaneous tissues that are relatively close to humans and are comparably hairless. A pig around fifty pounds simulates reasonably well the size of an adult male torso, making data obtained more readily transferred to humans. An obvious drawback is that there may be problems extrapolating information to smaller corpses, such as those of women and children.

History

The oldest documented case of forensic entomology took place in 13th century China (Benecke, 2001). A death investigator attempting to solve the slashing death of a man in a rural village called for the men to bring forth their sickles. While clean to the naked eye, flies swarmed to one particular sickle, presumably attracted to the microscopic blood that remained there. The man who owned that sickle then confessed to the murder.

Nothing more is heard about forensic entomology until the mid-19th century, but one critical scientific discovery was made in the interim. In 1668, Francesco Redi proved that flies arise from maggots, and not spontaneous generation. This crucial discovery paved the way for the interpretation of life cycles. In Paris in 1855, Dr. Bergeret d'Arbois investigated the discovery of a child's body hidden behind the mantle of a home. By looking at the different insects colonizing the body and estimating their life cycles, he determined the child to have been dead since 1848. The former occupants of the house were then investigated and tried.

In Germany in 1881, Dr. Reinhard conducted the first systematic study in forensic entomology. He exhumed dead bodies from a cemetery and examined the fauna that was on them. In 1889, Klingenhöffer and Maschka detailed the posthumous bite patterns of cockroaches and ants.

In 1894, Mégnin published “La faune des cadavres”, a work describing the succession of insects in waves. This work served to advance the science of entomology and to popularize the concept. From this work, many were inspired to increase the systematics understanding and categorization of insects, leading to more accurate identification of insects that were found and prediction of their life cycles. Two such researchers were Villegneuve and Johnston in Montreal, who published a work in 1895, that at once supported Mégnin’s conclusions and called on investigators to pay particular attention to the variability that comes with locality.

In 1899-1900, von Niezabitowski published a work that established that humans and other animals share the same insect fauna after death, paving the way for animal experiments to be performed with the expectation of data that could be extrapolated to humans.

In the 1920s, numerous species lists were published and shared, allowing again for more accurate species identification. As more systematic ecological studies were performed, data became more reliable. Throughout the 1940s and 1950s, sparse case reports of forensic entomology emerged, as scientists were more willing to use this emerging science to support other forensic evidence gathered at crime scenes. The number and quality of these case studies increased through the 1980s. In 1948, Hall published rearing data on several species, permitting their use as indicators.

In 1985, Greenberg proposed the concept of degree hours, bringing about a new way of quantifying insect development (ABFE). In 1986, Kenneth Smith published “A Manual of Forensic Entomology”, the first book to comprehensively discuss this branch of science, and still considered to be an excellent resource.

Current Uses

The primary use for forensic entomology is the determination of the post-mortem interval (PMI), or time of death. There is little use for forensic entomology in this sense within roughly 72 hours of death, as other forensic indicators are equally or more accurate for determining time of death (Anderson, 1993). However, after this time, forensic entomology gives one of the more accurate indicators of PMI. It is crucial that specimens be collected from as many body parts as possible and that the area around the body, including the soil it is resting on if it is found outside, be examined (Erzinclioglu, 1983). Pupae may be mistaken for mouse droppings, or larvae may be mistaken for fibers, depending on the size and species of insect present. When possible, it is ideal to have a forensic entomologist present to do the collection, but properly trained criminalists can also do an adequate job. In addition to proper collection of the samples, documentation of location, vegetation, temperature, weather, body position, etc must also be done. These can all be crucial variables since insects show great regional variability and dependence on the environment for growth and development. It is important to note that the interval determined is for the time that the body was accessible to insects, not necessarily the time since death. If a body was tightly wrapped, kept in a refrigerator, or otherwise inaccessible for some period of time, insect activity will only reflect the time

that it was free for colonization (Catts and Goff, 1992). It is, however, interesting to note that clothing will not delay insect invasion – a body must be very tightly wrapped to keep insects out (Marchenko, 2001).

A second area in which forensic entomology is important is determining if the location is primary or if the body has been moved. This can be determined if the composition of insects on a body shows vastly different fauna (i.e. urban and rural insects on the same body) or by examining variations in developmental patterns. In one case, a body had been buried, exhumed, and reburied. The times between the first and second burial could be determined by the ratio of larvae to pupae. The suspect had established an alibi for the first date but not the second, and was therefore able to be charged with the crime (Anderson, 1993). Initial location or hiding place can also be identified if insects found are specific to a region or area. DNA analysis of samples taken from insects can help to establish their region of origin, allowing investigators to pinpoint where a body may have been (Marchenko, 2001).

Investigation of wounds can be important in determining cause of death, and insects can again be of invaluable assistance. Campobasso and Introna (2001) describe how an area that is disproportionately advanced in putrefaction may indicate a portal of entry for insects, such as an area of antemortem wounding. In many of the case studies published, insects are attracted to a particular area of the body first, indicating wounds that may be too small to be noticed by the naked eye, but that attract necrophagous insects. Wounds that are sustained after death are also likely to bleed less profusely and therefore be of less interest to insects. In this manner, there can be some distinction made as to the timing of wounds. Another area of interest is the ability to recover DNA from semen that has been ingested post-mortem by insects. If a corpse is discovered long enough after death that the semen itself is not recoverable but sexual assault is suspected, the larvae of the blowflies that have fed on that area can be examined for the DNA of the perpetrator (Clery, 2001).

A final emerging area is that of entomotoxicology, the study of how insects are affected by the substances in the host on which they feed. This is a reliable method of evaluating substances in a body once other tissues, such as blood, urine, and internal organs are no longer available. There appears to be bioaccumulation of materials, such that whatever is ingested by necrophagous insects is also found in the predatory insects which feed on them. There appears to be a reliable correlation found between the amounts of the substance in the insects and the levels in the host, providing a way of determining whether a lethal dose was the cause of death, or if there were sufficient quantities to contribute to the death of the host. Substances that have been documented include metals (mercury, arsenic), organophosphates, barbiturates, benzodiazepines, tricyclic antidepressants, opiates, and cocaine. Some of these substances, particularly at lethal doses, can have effects on the developmental rate or activities of insects, a variable that must then be factored into calculations regarding PMI. For example, stimulants such as cocaine and amphetamines have been shown to speed larval development, while opiates slow development. Malathion (an organophosphate insecticide) delays insect colonization of a body, perhaps not surprisingly. Antidepressants appear to prolong the

post-feeding wandering period of larvae, delaying entry into a pupal stage (Introna et al, 2001). Any of the above changes can significantly alter the time of death calculations leading to an erroneous estimation of time of death.

Case studies abound as to the uses of forensic entomology. Unfortunately, most of the data published is in the form of case studies or case series, making some of the data hard to extrapolate. There is also difficulty since there is great regional variability in data, such that case studies from Italy may not be applicable in Columbia, while studies from Columbia will certainly apply differently in the United States or Canada. There is also a wealth of information published in languages other than English, which makes research and the sharing of information difficult (Keh, 1985) (Vincent et al., 1985).

Future Directions

Scientific advances are making possible the use of forensic entomology for cases that do not include dead bodies. There have been case reports of using insects to estimate an interval of child neglect or abuse (Benecke and Lessig, 2001) (Anderson, 1993). There is interest in investigating insects as the primary cause of death in such incidents as single vehicle crashes. An example might be a bee sting provoking an anaphylactic reaction that caused a driver to crash. Other areas that are not medicolegal include the use of entomology to track importation (legal and illegal) of produce and vegetation.

Increasing accuracy and availability of information also brings challenges. As professionals are being called to testify as expert witnesses, it becomes important to establish what credentials are necessary to be termed an expert witness. There is currently no universally accepted credentials or designation that can be given to prove that a person is a forensic entomologist, although that is a work in progress with the American Board of Forensic Entomology.

As general public acceptance grows, it becomes increasingly important to ensure that the quality of evidence retrieved be as good as possible. Since there is a shortage of forensic entomologists (only 68 registered in the world), it is impossible for every crime scene at which entomological evidence might be important to be examined by an expert. One solution to that is continued education of local or regional investigators by professionals on collection procedures so that the raw data will later be available for further analysis if that is warranted. Another growth area is inclusion of entomology in the general forensic investigation. There is ample opportunity for entomology to fit in to the rest of forensic pathology, as long as the roles of each individual are clearly understood (Campobasso and Introna, 2001).

Conclusion

Public interest in forensic entomology is growing, as evidenced by the popular television drama CSI, which has featured cases solved with entomological evidence. The use of forensic entomology evidence in other high profile cases also helps to boost the public's understanding of this branch of science. However, forensic entomology has some

distance yet to go to be fully accepted. This is demonstrated by the Westerfield case in California in 2002. In this murder trial, four forensic entomologists testified, each giving slightly different but mostly concurring opinions that would appear to exonerate the defendant. The jury, however, after being bombarded with many days of testimony on accumulated degree days and waves of succession, appears to have abandoned the entomological evidence completely and decided the case without it. It would appear that most people are not quite sure what to make of this area of study. There is an attraction-repulsion effect (Catts and Goff, 1992) that makes the study of maggots consuming dead people at once interesting and disgusting. There are also many variables that make precise calculations in real-world cases very difficult. However, as evidence continues to mount and we become desensitized to the concept of studying insects as they decompose bodies, there cannot help but be further advances and refinement of the techniques that are currently employed.

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THE BATTLE FOR STALINGRAD: A REQUIEM FOR THE ENDURANCE OF THE HUMAN SPIRIT UNDER INHUMANE CONDITIONS

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ABSTRACT

At 03:15 June 22, 1941, the German Wehrmacht invaded Russia and initiated the sequence of events that would bring a slow and painful death to Nazi Germany. The Battle for Stalingrad acted as a fulcrum where momentum, first in favour of the Nazis, turned slowly in favour of the Red Army. Hitler instructed his senior staff that the war against Russia was to be carried out with “utmost ferocity”- subsequently a war was waged against citizen and soldier alike with unprecedented terror. During the Battle for Stalingrad the Red Army captured 91 000 German soldiers and the first German Field Marshal ever to be captured in history fell into the Soviet hands.

As historically grand as these events may have been the truly epic story, which has unfortunately slipped largely into obscurity, was the intense human suffering that was borne by all individuals-German or Soviet- during the Battle for Stalingrad. Both the Red Army and the German Army had stretched themselves so thin that supplies for treating the wounded were in desperate short supply. The suffering of the surrounded German 6th army was unparalleled: starvation, hypothermia, typhus, and diphtheria were but a few of the scourges facing the German army during this time. The Russian Army was perhaps better off where food was concerned, however, Stalin’s contempt for human life made the Russian soldier’s duty one of self-sacrifice bordering on suicide. Allowing this tragedy to slip into our unconscious leaves the door open once again for the possibility that life could be afforded such disdain...lest we forget.

With the brilliant opening success of Operation Barbarossa, the loss of a fully equipped 300 000 man army would have been the farthest thing from Hitler’s mind. Hitler had constructed Operation Barbarossa, which was launched on June 22, 1941, at exactly 03:15, to bring Russia under German control; Hitler saw Nazi Germany eventually dipping its feet in the Pacific- only Russia stood in the way. Of course this should not have surprised Russia at all, in 1920 Hitler had expressed in *Mein Kampf* his intention to march eastward. Stalin, however, invested his trust in the deceitfully negotiated Soviet-German non-aggression pact. The non-aggression pact was sought by the Soviets even

before the Germans invaded Poland in 1939, and in earnest thereafter. The pact divided Poland between the Soviets and the Germans and allayed, at least temporarily, Stalin's fears that he would be attacked- why Hitler, of all people, could be trusted!

The initial success of the German Wehrmacht was due in part to Stalin's recent military purge. During 1937-1938, a period known as the Great Terror [during the Great Terror 20 million Soviets lost their lives, including thousands of military officers], Stalin eliminated every single officer in his army that was even remotely competent in a bid to secure his rule and preempt any who would challenge. Defending Russia was an army incapable of the most basic of military maneuvers. Under these conditions the stage was set for the most formidable army of its time, the German Wehrmacht, to wreak havoc virtually unopposed. Sadly in those first days it was the Soviet civilians and not the soldiers who suffered the most. The German army was stoked by Hitler's declaration that the war was to be fought with the utmost ferocity. Hitler was quick to extend immunity to all soldiers operating in the Barbarossa Theater for any atrocities they might commit. One atrocity fed the next until the cruelest punishments were commonplace. In Minsk 280 civilians were released from the local jail only to be lined up in front of a freshly dug ditch and shot; the ditch did not fill with the convicts alone so more civilians were gathered by the Nazi SD at random to be shot in an attempt to fill the ditch. Soon other Soviet civilians were being randomly organized, lined up before a ditch that they were forced to dig, and machine-gunned below the waist to ensure a slow painful death. Orders found on a German lieutenant during this time read "You have neither heart nor nerves; they are not needed in war. Free yourselves from your feelings of compassion and sympathy- kill every Russian, every Soviet person. Don't stop, whether you have an old man, a woman, a girl, or a boy before you- kill!" The complete disregard for the Soviet people was a grave mistake on behalf of the Nazi regime. The Soviet people would have gladly welcomed a liberating force; after all, the Soviet people had been oppressed and persecuted for years under Stalin. Hitler's decision to rule the conquered Soviet people with a "steel gauntlet" whisked away his potential ally- the Soviet people. German soldiers paid the price for this oversight: the Soviet people became daring and motivated partisans. Partisans were responsible for much destruction behind German lines. On one occasion partisans derailed a hospital train filled with German wounded and vented their growing hatred for the German occupiers by burning them to death with paraffin. On another occasion partisans poisoned the water of a German army barracks. Hitler set the tempo of hatred for the war and Stalin responded in kind by remarking "The Germans want a war of extermination against the peoples of the USSR. Well, if the Germans want a war of extermination they shall have it. Henceforth our task consists of annihilating to the last man all Germans who penetrated the territory of our country. Death to all Germans..."

Operation Barbarossa bogged down in the autumn of 1941, the result of mud, cold, exhaustion, and growing resistance. The Germans made it to the outskirts of Moscow before winter brought the German advance to a stand still. The summer had been filled with victory for the Germans: 2.5 million prisoners, twice that figure killed on the battlefield, and huge amounts of war material was gained from the Russians. With victory appearing imminent the German army no longer even offered medical treatment to their

Soviet prisoners. One German soldier recalls watching the distribution of food to a group of wounded Soviet prisoners that had severe injuries. He noted with horror that some of the prisoners were holding their own entrails in with their arms lest they tumble out to the ground, others had their faces melted away by flame throwers, one man without a jaw blew bubbles through his trachea with each breath; yet to his awe, they all came for food. The eerie silence of the suffering disturbed the watching soldier: the prisoners did not cry, moan, or curse. These silent prisoners regarded themselves as dead men and accepted the inhuman core of their captors.

The German Wehrmacht reemerged in the spring of 1942 to take the offensive after a long, cold Russian winter. Despite losing the element of surprise from the summer before and the improvement in the leadership of the Red Army, the German army still made progress in Russia. The Germans were able to capture another 240 000 prisoners, 1 200 tanks, and 2 600 artillery pieces. Hitler's plans for capturing Moscow had also changed. He now wanted to strike south deep into the Caucasus for the rich oil fields that the Nazi regime badly needed. By mid August the German Sixth Army had advanced to Stalingrad where the fate of Nazi Germany would be decided. The Germans vast manpower, superior air force, and state of the art weaponry bestowed a great advantage when they first rolled into Stalingrad and it was all the Russians could do to hold on. Stalingrad, situated alongside the river Volga, presented a difficult problem to the Russians because everything had to enter or leave Stalingrad via perilous voyage across the river Volga. This complicated the evacuation of the women and children when the Germans first invaded Stalingrad. As the women and children waited on the banks of the Volga, German Stukas dive-bombed the ferries and helpless crowds of people...the Volga was thick with bodies. At night Russian ferries laden with supplies and replacements would cross the Volga to be hastily unloaded at Stalingrad; the wounded would then have to be loaded and evacuated on the return trip. The Germans had their artillery trained on the site of the Russian crossing and kept a continuous rain of shells pouring into the area by day, while German bombers ensured the banks of the Volga did not rest by night. The 62nd army, commanded by Marshal Vasili Chuikov, was tasked with defending Stalingrad at all costs. In the early days of the battle for Stalingrad Chuikov noted with alarm the Russian wounded piling up on the Stalingrad side of the Volga. He inquired as to why the wounded were not being processed more efficiently and was told by medical staff that "We haven't slept for several days; in the daytime we are bombed, and at night so many wounded arrive that we don't know how to cope!" Sadly, the bottleneck at the Volga ensured that many wounded men who were boldly rescued from the front lines under heavy fire and brought to the banks of the Volga perished. They died from German shelling or rough handling by the Russian soldiers who threw the wounded onto the empty supply ships as quickly as they could to minimize the time spent in range of the German guns. Although reaching the east bank of the Volga as a wounded soldier was fortuitous, it was no guarantee of living. On the east bank thousands of casualties brought over during the night littered the landscape as far as the eye could see. The wounded cried out for water, food, and comfort but the ground medical personnel, too few in numbers, could not meet the many needs. From the Volga the wounded were transported to specialized field hospitals. The Russian doctors were among the finest but their efforts were hindered by the meagerly equipped hospitals. At these hospitals the medical

workers selflessly supplied all the blood required for transfusion; the medical workers often donated twice in an evening, leading to collapse. Eventually field-dressing stations were set up in Stalingrad. The Luftwaffe ignored the red crosses that marked the medical aid stations and severe casualties were sustained when they were bombed. Chuikov remembers his visit to a pump house that was converted into a surgical theater: "...two sheets which did for a door, behind which a bright light was burning...The doctor, seeing me, gestured to his assistants to straighten their coats. The coats had, of course, once been white, but were now covered with brown patches. Only their hats looked at all fresh." Chuikov examined the surgical register and noticed that the same surgeon had made all 200 entries, completing all the procedures without a break. Eisenberg was the lead surgeon for the Russian armies field hospital. Amazingly, the medical service for the 62nd army boasted the lowest mortality rate of all Russia's armies. Chuikov noted that this was due to the fact that "medical posts and skilled surgery were available for the wounded rapidly, directly behind the front line, that is, right in the battle torn city."

As the Germans fought their way into the urban parts of Stalingrad the fighting became hand-to-hand, continuing day and night. The attacks were brutal and often suicidal. As word of the horrific conditions in Stalingrad spread desertion and defection of Russian soldiers became a major problem. Armed guards were required to chaperone the new replacements being ferried across the Volga because many could not resist the temptation to jump overboard and try to swim to safety. Any who tried to escape the upcoming terror by jumping were shot by the guards in front of their comrades. One Russian commander tried to dissuade his troops from deserting by lining up his soldiers and shooting every tenth one. A new unit – SMERSH (Death to Spies) – was set up by the Russians to deal with desertion or any Russian soldier so cowardly as to retreat one yard. The Russians shot 13 000 of their own for retreating before the war was over. This unit had enormous power to deal with deserters or even those suspected of disloyalty and their families. Those convicted or suspected of such crimes were placed into penal battalions. The penal battalions were given the harshest and deadliest of military assignments. They were not issued arms until they were in the front lines and a group of machine-gunners kept them in their sights in case they displayed cowardice. The penal units also acted as "Tramplers", units that cleared mine fields with sophisticated mine clearing equipment such as feet. After a unit of Tramplers had cleared a minefield the ground was covered with their bodies.

Throughout the summer and fall of 1942 the Soviets had been preparing Operation Uranus, a plan to encircle the entire German 6th army- the army fighting in Stalingrad. Operation Uranus was launched in the early morning fog on November 19, 1942. The Red Army carried out the operation with stunning success and the 6th army became isolated. The pocket that was formed by the Russian army was ominously referred to as *der kessel*- meaning the Cauldron. All the terror the 6th army inflicted on the Russian people would be reciprocated a hundred fold within the Cauldron. Hitler refused to allow the 6th army to retreat and unwittingly ensured his own down fall. General Paulus, commander of the 6th army, had his requests to retreat denied in favour of a foolish promise put forth by Goering to supply the 6th army via the air. It was estimated that at least 500 tonnes of material would be required daily to sustain the 6th army. The

Luftwaffe was not able to uphold Goering's promise and could only supply an average of 60 tonnes per day in the first week. This worked out to only 20g of food per man per day. The diary of a German infantryman reads:

"December 7- Rations have been cut to such an extent that the soldiers are suffering terribly from hunger; they are issuing one loaf of stale bread for five men.

December 26-The horses have already been eaten. I would eat a cat! They say its meat is also tasty. The soldiers look like corpses or lunatics looking for something to put in their mouths. They no longer take cover from Russian shells; they haven't the strength to walk, run away and hide. A curse on this war..."

Starvation was not the only result of the air supply fiasco. The German army was desperately short of winter clothing and the Germans wore anything from towels to rugs that offered warmth. The temperature would often dip to -40°C and frostbite caused as many casualties as the Russians. One Doctor in the Cauldron noted that fingers and toes were often left behind in bandages while changing them. When the 6th army finally capitulated, many recall the macabre sight of thousands of Germans dressed in rags, hobbling on frozen feet wrapped with straw or strips of blankets. Chuikov remembered,

"All the privates and non-commissioned officers were emaciated, and their clothes were infested with vermin...Although the temperature was thirty degrees below zero some of them were barefoot."

To compare, a Russian soldier wore felt boots, two pairs of woolen socks, fur lined gloves and a sheepskin coat. A pathologist was sent into the Kessel because German soldiers began dying a mysterious sudden death for no apparent cause. The pathologist found hardly a trace of fat lining the organs, a glass like jelly in place of bone marrow that should have been red and yellow, and a small brown heart with an enlarged right atrium and ventricle. It was concluded that hunger, exhaustion, and loss of body heat were "... the cause for the sudden death of the used up bodies gone senile of what had been German soldiers."

The "vermin" that Chuikov noticed on the clothes of the Germans was lice. A German Doctor recalls scraping the lice off clothes and skin with a spatula and hurling them into the fire before he could operate. Eyebrows and beards had lice clustered on them like grapes. The lice gave rise to a typhus epidemic within the Cauldron. Some enterprising German doctors invented an inoculation against the typhus that required injecting an extract of lice guts. In addition to typhus, the German army also faced outbreaks of diphtheria, dysentery, and rats which all added to the squalid conditions facing the German soldier. One German soldier recalls that during the day they fought the Russians and during the night they fought rats. The remains of humans and horses caused the rat and mouse populations to explode. The soldiers attacked the rats with spades, knives, and rifle butts while the rats attacked the sleeping soldiers. One infantryman with

frostbitten feet awoke one morning to discover that a rat had eaten away two of his toes during the night.

Due to the bitter fighting, cold, and disease the number of wounded accumulated rapidly in the Kessel. All of the wounded soldiers had to be evacuated from Gumrak, one of the major airlift sites in the Kessel, creating a situation like the Russians faced earlier—everything entering or leaving the Kessel depended on air transport. The number of flights leaving Gumrak were inadequate to cope with the rapid influx of wounded. This created a desperate competition amongst the wounded to get onto one of the flights out. It was ordered that everyone leaving required written permission from a general, but it did little to stem the tide of wounded clamoring to get aboard one of the exiting flights. As soon as a plane landed, the rush of walking wounded proceeded towards the plane despite the efforts of military police to discern malingerer from wounded with drawn pistols. Often a shot would ring out after a bandage was lifted and no wound was found underneath. Men were so desperate to leave the Kessel that they would even try to hang on to the tail of the plane as the plane taxied and took off. Eventually their frozen hands would lose their grip and they would plummet to their death. Although the Germans were able to airlift a few thousand wounded out of the Kessel, Gumrak remained the epitome of human suffering: 50,000 wounded and dying men moaning or begging for medicine or food that was no longer available. These immobilized sick and dying died by the thousands when the Russians finally overtook Gumrak airbase. Artillery and tank fire ripped the field hospitals and their occupants to pieces. The Russian artillerymen were likely as blind to the red crosses as the Luftwaffe bombardiers were.

The Battle for Stalingrad ended February 02, 1943 with the capitulation of the remnants of the 6th army. Of the 300,000 men in the 6th army only 90,000 survived to be taken into captivity. Of those captured many were vengefully shot by the Russians and others died in the first few days of their captivity because they were simply too weakened by starvation, cold, and disease to endure the stresses of captivation. Of those who lived, less than 5000 survived the brutal Soviet forced labour camps to be repatriated to Germany. It must not be forgotten that, despite the horrific conditions that were imposed on the Russian and German armies, compassion and humanity were never fully extinguished. Lyuba Nesteranko, a female Russian nurse, died pouring blood from her chest after being wounded while bandaging a comrade. A starving German soldier traded his watch to one of his Russian captors in return for a small loaf of bread, which he selflessly shared with the five others with him. Russian nurses and Jewish doctors made the ultimate sacrifice when they selflessly treated German prisoners with spotted fever, which they themselves contracted. These men and women exemplify the ability of the human spirit to endure inhumane conditions. Stalingrad became a mass grave for untold scores of men, women, and children; it shall remain an emblem of what mankind is capable of when immersed in such total hatred. World leaders and citizens alike ought to keep the lesson of Stalingrad always in mind to prevent the opportunity that such hatred perpetuated by only a few could influence so many. It is a warning against following without question or believing without asking what *is* truth.

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INGENUITY FROM DESPERATION: MEDICAL OFFICERS IN WWII PRISON CAMPS IN SOUTH-EAST ASIA

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ABSTRACT

To say that medical supplies and nourishment in the Japanese Prisoner of War camps in South-East Asia were sparse is an understatement to the greatest degree. The survival of tens of thousands of men depended on the tremendous ingenuity employed by the Medical officers isolated in the dense jungles of Burma and Thailand. In a number of camps, a surprising symbiotic relationship developed between enemies for the purpose of mutual health benefit.

Being a prisoner of war in any conflict is not a welcome prospect, but since the turn of the century, prisoners have relatively been assured a basic level of respect and care – so long as they were captured by a Western nation. The Japanese signed the 1929 International Convention Relative to the Treatment of Prisoners of War but the parliamentary body refrained from ratifying it, as Japanese fighting men “do not expect any possibility of becoming prisoners” (Roland 2001, xiv). This put Japan in a relatively unique position among the nations involved in WWII, as they were technically not bound to any standard of care for their prisoners and were not concerned with what reciprocally happened to their own captured soldiers. Furthermore, due to their military success in catching the Allied powers off-guard in 1941, the Japanese ended up with over 130,000 POWs – a problem that the Japanese were clearly not anticipating (The Second World War Experience 2001). The result of these two factors was that POW camps were overcrowded, rations were significantly deficient nutritionally and calorically, medical supplies were often non-existent, and the prisoners were overworked and exhausted – ideal conditions for a whole host of diseases to run rampant through the camps. It was only through the dedicated and ingenious work of the Medical Officers in treating, and especially in preventing a variety of diseases and medical emergencies that just under three quarters of those men interred made it home.

One of the first diseases to emerge in the POW camps was dysentery; there were very few who did not contract it during their incarceration. With an acute shortage of water in many camps, it was obvious that the priority was to use water for drinking and not for washing - be it themselves or their few clothes. The difficulty of keeping clean coupled with the lengthy infectious asymptomatic period made it inevitable that so many would catch dysentery. The treatment for amoebic and bacterial dysentery is different, but it is very difficult to tell the difference without microscopy. Often, it was only the acuity and

instinct of the medical officer that was available to make the differentiation. For amoebic dysentery, the only treatments that were of any real use were emetine and stovarsol (Cooper 2000). When emetine was available, it was saved for those patients who seemed certain to die without it. In Burma, a Dutch chemist POW managed to isolate emetine from Ipecacuanha shrub, which was pure enough for injection (Duncan 1983). The Japanese further complicated things by refusing to supply emetine, claiming that without microscopy it is impossible to know for sure whether it was amoebic or bacterial dysentery. In Japan, a Dutch POW Medical Officer constructed a microscope using bamboo and lenses from field glasses to enable recognition of amoebic parasites (Duncan 1983). Sulfa drugs were effective in combating bacterial dysentery, but were simply not available in the mass quantities needed in most camps. The trickle of sulfonamides that were obtained were given as small doses in an attempt to stretch the supplies – the result was a dysentery that became more resistant. In the absence of drugs, a combination of warm tea enemas, magnesium sulfate, charcoal, and rice water was usually administered (Cooper 2000). Another strategy attempted was three days starvation plus a dose of Epsom salts, which would be effective in perhaps 1 in 20 cases (Audus 1986). The scarcity of medication spurred the medical officers to put a greater emphasis on prevention. Those affected with dysentery were segregated from the rest of the camp, and where possible, strict hand-washing policies were implemented. Men were educated about how dysentery spread, full latrines were torched and buried, and all that could be done was done to keep flies off food while being prepared (Bowie 1975). Ash was poured into the latrines nightly to cover the excrement and, in Chungkai, bamboo shoots filled with cresol were used as a hand antiseptic (Dunlop 1986). At the insistence of the medical officers, in some camps the Japanese prescribed a fly-catching program, whereby each man had to kill a quota of flies each day. At North Point Camp in Hong Kong, a packet of cigarettes was given for every 100 flies collected, which ended once it was discovered that some POWs were breeding flies (Roland 2001). Fortunately, these preventative measures were relatively effective and the number of dysentery cases did decrease. For most soldiers with dysentery, all that could be done was to wait for the agony to pass – to escape the pain either by full recovery or by death.

Nutrition was an issue in every Prisoner-of-War camp in South-East Asia. The diet consisted almost entirely of polished rice, and was about twenty-five percent deficient for men doing manual labour such as clearing jungle, blasting rock and laying railway sleepers (Cooper 2000). The prisoners were able to supplement their rations by buying eggs, vegetables, meat or fruit, but the supplies were short and irregular. No additional or special rations were allowed by the Japanese for sick men. In fact, the ration for sick men was often cut in half (Crawford 1983). In most camps, a proportion of the officer's pay (5-20%) would go towards the purchase of medical supplies for the camp and dietary supplements for the sick off the black market. Typically, men lost about 60-100 pounds while interred, emerging from captivity as skeletons of their former selves (Roland 2001). The severe vitamin deficiency present in most camps resulted in the emergence of a host of avitaminoses such as beriberi, electric feet and pellagra. Often the only therapy available was a supplementation of the diet and a variety of different methods were attempted to make up the lacking vitamins, protein and caloric intake. At Chungkai camp in Thailand, the eating habits of the cows that were pastured inside the camp were

carefully observed and a thick soup was then made from the grasses they favoured (Markowitz). Yeast was well-known to be an excellent source of B vitamins and a yeast centre was established at the Changi prison camp in Singapore mixing potatoes, sweet potatoes and rice with sugar or gula malacca. Each man was given 100 ml of yeast daily and it was considered that 600 ml of yeast a day was necessary for the treatment of beriberi (Duncan 1983). Also at Chungkai, it was noticed that when bananas became slightly rotten they exuded a beery smell - a good indication that yeast was present. A mixture of bananas rice, water and spit was used and, after a few days fermentation, a vitamin-rich beer was produced (Markowitz). In Japan, at the Omori prison camp, miso beer (beer brewed from fermented soybean paste) was brewed to supplement vitamin B. Each working POW was to receive 250ml of yeast solution a day, while those ill with beriberi were to receive 500ml (Roland 2001). Flowers, grass, weeds, snakes, lizards, rats and snails were all fair game to the hungry men. Some men went to the extreme of catching maggots in the latrines, washing them, fattening them up on rice and eating them for the extra protein (Roland 2001).

The actual treatment of the avitaminoses was, for the most part, limited to supplementing the diet with the missing vitamins but some more radical treatments were attempted. The edema associated with wet beriberi was often drained off in an attempt to stave off cardiac failure with small incisions and bamboo – one man had 40 such drainages before a satisfactory diet was established for the camp (Cooper 2000). To alleviate the intense pain of electric feet, patients would soak their feet in cold water, or sleep side by side, with heads in opposite directions, so they could rub each other's feet (Roland 2001). Alleviating the pain often was associated with extreme behaviour, with some POWs resting their feet against the low-voltage electric fence surrounding their camp, or stamping up and down all night on a concrete floor (Roland 2001). Medical therapy was relatively ineffective, but the pain was somewhat relieved with morphine. The problem was that it simply was not available in all camps – those that did have it would give injections every third night to stretch the supplies out. With the commencement of the yeast supplements, the incidence of the avitaminoses decreased substantially – the tragedy is that the simple preventative solution could not be implemented earlier.

Cholera was another plague that often spread like wildfire through camps, and would jump from camp to camp down a river. In the heat, millions of flies and maggots swarmed all over the decaying excrement and in turn swarmed all over food and the ill and dying patients. If cholera was suspected, isolation huts were erected away from the main party of men. When cholera struck the deterioration was very quick – a man could be well in the morning and dead by evening. The preventative measures were similar to dysentery but also consisted of informing camps downstream of an outbreak. The only successful treatment was saline intravenous drips and doctors improvised in many ways to give the dying men a chance. Hollow bamboo needles and pieces of stethoscope tubing were used to provide drips; many lives were saved in this way (Cooper 2000). In most camps, saline solution was made with rain water or with strained river water. In the large permanent camps, water was distilled by means of improvised stills and salt was added in calculated amounts. In the more remote camps, salt was almost impossible to obtain and rock salt was used in rough estimation instead (Dunlop 1986). Containers

were made by removing the bottom from an empty Japanese wine or beer bottle and closing the neck with a wooden cork with a hole in it through which a piece of bamboo was inserted. This was then connected by stethoscope tubing to a cannula carved from a piece of bamboo. A cut would be made in the vein and the cannula was inserted into the vein. By this means an intravenous infusion of saline could be given rapidly with hardly any side effects, apart from occasional rigors (Duncan 1983). The availability of intravenous saline with an amazingly dehydrating disease such as cholera was effective in saving hundreds of lives, but it was the preventative measures that were truly effective.

Diphtheria came to be a significant medical condition that affected western POWs in Singapore, the Phillipines, Java, and Hong Kong by mid-1942. There were no facilities for making a diagnosis of diphtheria, and although it was suspected, the diagnosis could only be made once the tell-tale membrane appeared. In the Philippines, there were initially 37 cases and only enough antitoxin for 10 patients. In other camps, there simply was none (Roland 2001). In these camps, the full course of the easily treated disease was observed, with paralysis of the diaphragm, vocal cord paralysis, quadriplegia and death, all in order (Bard 1987). The initial mortality in one camp was 73 percent and the little serum that was available was given to orderlies in order to ensure the continued functioning of the hospital (Crawford 1983). If there was enough antitoxin, patients were triaged carefully and serum was only given to cases less than 24 hours old (Jacobs 1984). Tracheotomies were preformed in those cases that required them, using pieces of hollow bamboo or tubing for the intubation. The lack of Japanese response to the outbreaks resulted in the POW Medical Officers fervently attempting to acquire serum on the black market (of which some were successful) or attempting unorthodox measures. One medical officer in Hong Kong, Maj. Harrison, gave transfusions of whole blood from patients who had recovered to four patients with acute severe diphtheria in the hope of transferring immunity, with two of the four successfully recovering (Roland 2001). At first, the Japanese claimed it wasn't diphtheria, but once faced with a large outbreak, took it seriously and isolated both those affected and, once identified with a throat swab, the carriers. This measure, although long overdue, was successful in preventing further outbreaks of diphtheria.

One of the most persistent and prevalent medical problems was that of tropical ulcers. Wearing nothing more than a loincloth, the legs of the prisoners were bare and unprotected against the thorns of new bamboo shoots, rocks and coral. The poor nutrition led to the immune status of the men being suppressed and soon after receiving a tiny scratch, infection set in and the small scrapes turned into tropical ulcers. As the weeping sores grew larger, spreading quickly over the leg, the stench from the rotting flesh attracted flies and, in those men too weak to swat them away, the hatched maggots would eat their way up the leg and into the marrow, causing a pain which could send the men insane (Cooper 2000). The lack of any sterile covering meant having to use old bits of rag or any old pieces of often infected mosquito net. When possible, the dressings would be boiled in an attempt to sterilize them. The Japanese in some camps provided a few antiseptics and small quantities of acriflavine, and boracic but there was no ointment to form a base – so the men scrounged axle grease from Japanese workshops for the MOs (Rivett 1954). Men would have to reuse the same bandage for months on end. Towards

the end of the war, as the dressings disintegrated, the used bandages were cut into pads and secured in place with rubber from rubber trees (Cooper 2000). One of the methods used to treat these tropical ulcers was called “gouging” - scooping out the bad flesh of the ulcer with a spoon, sharpened on one side. The ulcers were extremely painful, but this scooping out treatment brought excruciating pain beyond endurance. Anaesthetics were scarce and often could not be spared; men would scream in agony while this treatment took place but nevertheless lined up to have the procedure done (Philips 1986). In some of the larger permanent camps, skin grafts from the thigh were used to cover the cleaned wound successfully (Markowitz). Another known method was to hang the infected leg in a nearby river and fish would nibble at the maggots and dead flesh, helping to cleanse the wound in a much less painful fashion (Cooper 2000). Only a small percentage of the tropical ulcer cases required amputation, and was considered a last-ditch effort to save a prisoner. Amputations were carried out using no more than an ordinary meat saw or hack saw, and in most camps, some sort of anaesthetic was available. If they survived the operation, patients had to fight off post-operative infections, but successes were known and men wearing artificial limbs, made from bamboo, were a relatively common sight.

Malaria was another disease that virtually every POW had at one time or another. The main source of quinine (the only cure for malaria at the time) for the world was Indonesia, and once captured by the Japanese, quinine was available to Japan. Very little of this supply made it to the POWs who required it desperately on the Thai-Burma railway. In some lucky camps, the Japanese provided quinine to treat malaria and those affected would be kept to their hut for three to four days with a small supply of quinine and had to look after themselves through the sweats and the shivers which alternated throughout an attack (Badham 1999). The goal of those camps with quinine was merely to keep the afflicted alive, giving one or two tablets. Most men did not have mosquito nets, and those who did often had them appropriated by the hospital to maintain some sort of aseptic environment in surgery and in the hospital. The sap of the cinchona tree was just as effective as the purified quinine and was used by POW camps in the Philippines to successfully treat malaria (Jacobs 1984). One unique cure was a mixture of used battery acid and quinine sulphate, which was given by injection of about 1 grain of quinine per case; it was effective enough to save a patient with cerebral malaria (Roland 2001). In camps without quinine, starving the fever and plunging feverish soldiers into cold water were often the only recourses (Audus 1986). As the war progressed, prevention gained a greater importance. With each new camp, POWs would be sent out into the surrounding area to clear any and all potential mosquito breeding grounds with some success in reducing the incidence of malaria.

Flies, lice, bedbugs and mosquitoes were ever-present pests in most POW camps. For the most part, there were no delousing centres, and as a result those who were infested often had writhing lumps of lice hanging in such places as under the armpits. At the Senryo prison camp in Japan later in the war, POWs discovered a very effective way to rid themselves of lice – fleas. Fleas prefer to suck the blood of lice before humans, and were used for this precise purpose (Roland 2001). To treat scabies, heavy-duty scouring brushes were used to scour the skin and sulfur was then rubbed into the raw skin (Badham 1999). Tapeworms were very common, and their presence was often

grudgingly borne, although there is little doubt about their contribution to the malnutrition suffered by the POWs.

Of all medical procedures, surgery was the one of the most challenging in the POW camps. This was due to the fact that supplies were very limited and an aseptic operating room was just not possible. A variety of measures were used in an attempt to obtain as much sterility in the operating room as possible. In Burma, by distilling Burmese 'brandy' enough alcohol was made for use in surgery and to sterilize syringes. (Duncan 1983). Mosquito nets were used to exclude flies as much as possible, and water was sprinkled on the ground to keep the dust down. All instruments were boiled and hands were scrubbed as thoroughly as possible – surgeons often did not have the luxury of gloves. If available, several grams of sulfa drugs would be left in the abdomen upon closure to combat the risk of sepsis (Roland 2001). In the remote jungle camps, surgery was an even more extreme endeavor. Operating tables were constructed out of bamboo and emergency operations were conducted by candlelight. The supplies and instruments required for surgery were often ingeniously substituted with common items. Needles were reused again and again, often sharpened until there was almost nothing left, or were made from small bamboo shoots. Strands of hemp, wrapped around tongue depressors and sterilized, were used for skin sutures (Norman 1995). Parachute silk and silk thread were also used successfully for suturing (Dunlop 1983). Retractors were made from forks by bending the fork prongs backwards, and butcher knives and hack saws were used for cutting (Markowitz). Anaesthesia was available in some camps, but was carefully meted out. Most often, the only anaesthetic was what the surgeon had managed to bring with him into captivity. In some camps, novocaine was available on the black market – a typical going rate was three watches for 500 doses of it (Markowitz). Minor procedures, such as dental extractions, were usually done without anesthetic; the dentist's general rule was "don't come and see me unless you can't stand the pain any longer". (Roland 2001). Chloroform was very popular, as it could be carefully and easily meted out, and was relatively abundant in some camps (Dunlop 1983). Transfusions during operations were successfully carried out in a number of camps. Blood was defibrinated by a number of different mechanisms, the most common of which being simply stirring the blood with a spoon as it was received. From a pint of blood, a clot of fibrin the size of an egg would gather around the spoon; once defibrinated, the blood would be transferred into a bottle and transfused into the patient. At Chungkai, by the end of the war 3,800 blood transfusions had been given without a single fatality. One Australian patient received a total of 25 transfusions, which no doubt played a significant role in his surviving the war (Markowitz). In fact, transfusions were so successful that some camps had every POW blood-typed to facilitate emergency transfusions (Roland 2001).

Surgeries in POW camps were surprisingly successful. Taking stock after performing 1200 operations under the most primitive conditions, Capt. Markowitz concluded that his results were 75 per cent as good as those obtained in a modern New York hospital. (Markowitz) Needless to say, this is a truly remarkable achievement considering the circumstances.

The heroic actions of medical officers often go unnoticed in war. World War II was no exception, but the ingenuity and resourcefulness of the medical officers in South-East Asian Prisoner-of-War camps has not been forgotten. It lives on in the memories and the children of those who owe their lives to their heroic and often selfless actions. In the face of unbelievable odds, these doctors fulfilled their Hippocratic Oath to a degree that is seldom achieved. These doctors, often confronted with horrific illnesses they had previously only seen in textbooks, took what they had been taught and expounded upon it – these ingenious cures and approaches often made the difference between life and death for their patients. If one lesson can be learned from the medical experience of these POWs, it is the efficacy of prevention in ensuring the survival of the patients under their care. Whether it be in World War II POW camps, or in today's society, an ounce of prevention truly is worth a pound of cure.

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A BRIEF BUT SORDID HISTORY OF THE USE OF HUMAN CADAVERS IN MEDICAL EDUCATION

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ABSTRACT

Now, as in the past, gross anatomy marks a critical passage in the transformation of the medical student into a physician. Wavering between a traumatic ‘hazing ritual’ and an academic discipline, gross anatomy represents an opportunity for medical students to merge self-protective coping skills with humanistic principles. The history of human anatomy similarly treads a fine line between facilitating learning and gross professional and moral misconduct.

The dissection subjects of the early days of human anatomy were animals of all kinds. Dissection of humans was considered desecration, and was strictly prohibited by the Roman Empire. The Renaissance (1500 years later), a period of humanist rediscovery and increasing interest in science saw the incorporation of human dissection in anatomy lectures. As there was still no legal source of bodies, most of the specimens were undoubtedly executed criminals or victims of grave robbing, thus setting a precedent for anatomists for the next five centuries.

During the ‘heyday’ of modern anatomy (18th-20th centuries), the only legal source of dissection specimens were bodies of executed criminals. Even so, demand far exceeded the supply. Anatomists and medical students resorted to the clandestine ‘cadaver pipeline’—a black market of bodies, procured by resurrectionists. These infamous grave robbers and body snatchers rose to the limelight when William Burke and William Hare of Edinburgh, England were arrested for murdering sixteen people and selling their bodies to local anatomists.

The notoriety of Burke and Hare prompted drafting of the Warburton Anatomy Act of 1832, legislation allowing anatomists to dissect unclaimed pauper bodies, making anatomists happy (but not paupers). Other Anatomy acts followed, each attempting to curb rampant grave robbing that continued until the twentieth century. Unclaimed bodies remained the primary source of dissection material until the Uniform Anatomy Gift Act of 1968 was passed, allowing for donation of bodies.

Introduction to Gross Anatomy

Now, as in the past, gross anatomy marks a critical passage in the transformation of the medical student into a physician, perhaps even the student's first introduction into the study of medicine. Anatomy lab has always been regarded as a "highly charged and symbolically powerful" part of medical education (Dyer and Thorndike 2000). For many students this represents their first experience with a dead human being, and as such it can represent a significantly distressing ordeal, evoking a wide range of emotions including fear, horror, guilt, wonder, gratitude and sadness (Dyer and Thorndike 2000). In this role, gross anatomy has been described as having a function that was nearly a hazing ritual to the students (Dyer and Thorndike 2000; Stewart and Charon 2002). On the other hand it also represents an opportunity to learn to combine the necessary self-protective coping skills with the humanistic principles valued by medical schools and patients today. Ultimately it is a forum for exploring the meaning of being made out of flesh (Stewart and Charon 2002).

Over the centuries, anatomic dissection has been a recurrent feature of medical education as it is an excellent vehicle by which to learn anatomy, and more recently recognized as having social and psychological merit that can only come from first hand experience. Historically, the study of anatomy through dissection of human bodies has had a tumultuous path, strewn with obstacles produced by attitudes of superstition, prejudice, ignorance, piety/religion, and the social taboos of the time.

Galen's Contribution to Anatomy

Claudius Galen (130-200 CE) was a renowned physician and anatomist in the middle ages (Goddard 2003). This was not an inconsiderable task as dissection of the human body was as yet forbidden by the Roman empire (Goddard 2003). The belief at that time was that the material world was fleeting and unimportant, and as such the body was not a focus of rigorous study (Gregory and Cole 2002). Combined with the fact that dissection was culturally considered to be desecration, anatomic studies of humans were prohibited. Nonetheless, Galen, through his many dissections of animals of all kinds was able to publish 130 treatises on the anatomy of the human body, amazingly without ever dissecting a human body (Dyer and Thorndike 2000; Goddard 2003; Gregory and Cole 2002; Roach 2003; Rosner 2002). Needless to say, Galen's texts were laden with errors (Goddard 2003; Roach 2003; Rosner 2002), mostly because he felt that humans were anatomically identical to apes, especially if the ape had a round face (Roach 2003). Galen's texts were to remain the foundation of all anatomical teaching for the next 1400 years (Dyer and Thorndike 2000; Goddard 2003; Roach 2003; Rosner 2002). As Galen himself was a great advocate of direct observation in learning, having his texts be recited verbatim in place of independent study of anatomy for the next millennium and a half is rather ironic.

Vesalius and the Advent of ‘Do-It-Yourself’ Anatomy

Andreas Vesalius (1514-1564) is known as the father of modern anatomy, and for good reason (Rosner 2002). A product of the Renaissance, Vesalius was fortunate to find himself in a period of humanist rediscovery and increasing interest in science (Dyer and Thorndike 2000; French 1999; Goddard 2003; Gregory and Cole 2002; Roach 2003; Rosner 2002). As such, dissection was no longer considered quite so taboo. Anatomical education at the time often incorporated dissection into anatomy lectures, in order to highlight aspects of Galen’s texts. The esteemed lecturer sat upon his raised seat and directed a lowly barber-surgeon to conduct the grisly task of dissection. Sometimes, an exceptional (and lucky) student would be asked to take the place of the barber surgeon and conduct portions of the dissection. Vesalius was one of these fortunate students. It turned out that he liked dissection so much that he eventually became an anatomy professor himself. He performed his own dissections, and insisted his students do so as well. In doing so he was able to disprove a considerable portion of the Galenic doctrine (French 1999; Goddard 2003; Gregory and Cole 2002; Roach 2003). He published his own series of anatomic plates and philosophical dissertations entitled *De Humani Corporis Fabrica* (or ‘On the Structure of the Human Body’). Anatomy, through Vesalius became the “fulcrum of a major shift in medical education away from the study of ancient Greek and Latin texts and toward direct observation.” (Gregory and Cole 2002)

Another major, albeit less savoury change emerged with Vesalius’ new doctrine—a skyrocketing demand for (and inadequate supply of) cadavers for the purpose of dissection. Even with the shifting attitude of the Renaissance there were no legal sources of bodies. Undoubtedly, most of the subjects of Vesalius’ great text were the victims of grave robbing (Goddard 2003) or were executed criminals (Roach 2003), setting the stage for the shameful and sordid practice of obtaining cadavers for dissection which lasted until the early 20th century.

Grave Robbing, Body snatching and Murder – Anatomy in the Modern Era

The ‘heyday’ of modern gross anatomy (1700’s-1900’s) (Dyer and Thorndike 2000) was marked by substantial research and significant scandal, and could equally be called the ‘dark days’ of anatomy. The dramatic increase in demand for human cadavers for use in dissection, beginning in the mid 1700’s and continuing until the 20th century, combined with the scarcity of bodies available led to the ignominy of anatomy (and with it medicine) (Francis 2001; Goddard 2003; McDowell 2000; Rosner 2002; Tward and Patterson 2002). The only legal source of bodies for dissection was that of executed criminals. In fact, dissection came to be thought of as “supra-capital punishment” (i.e. a fate worse than death) (Tward and Patterson 2002). US judges had the discretion to add dissection to the sentence in death penalty cases (Goddard 2003). Even in the heyday of capital punishment, where stealing a pig was a capital crime, the demand for bodies far outweighed the supply.

Human dissection was peaking for the following reasons: 1) Physicians were regarded as knowledgeable, high class citizens (McDowell 2000), making the profession more attractive, driving up the number of interested medical students; 2) With the increasing number of medical students, the number of medical schools in Britain, America and Canada was rising (Francis 2001; Tward and Patterson 2002); 3) Anatomy was considered a vital portion of the medical curriculum, essential to developing and improving surgical skills and techniques (Goddard 2003) (surgery was becoming of major importance in medical care with the advent of aseptic technique and anaesthetics (Dyer and Thorndike 2000)); 4) The public was demanding more of physicians (meaning that they were required to be very knowledgeable in human anatomy (Dyer and Thorndike 2000)); and 5) The only means of learning anatomy was by dissecting a human cadaver.

Unfortunately, there was simultaneous revulsion of dissection by the populace arising from the belief that treatment of the body following death was linked with the fate of the soul, and access to an afterlife would be impossible if the body were dissected (Roach 2003; Rosner 2002).

At the same time students were required to perform dissections as part of their education (at one time students were required to dissect a minimum of 3 bodies each in order to become licensed surgeons (McDowell 2000)), and anatomy was a thriving field of research. In order to procure dissection material, anatomists were forced to take whatever specimens came their way on a “no questions asked” basis (McDowell 2000). As early as 1738, bodies were reported missing from graveyards (McDowell 2000). This was the beginning of the ‘cadaver pipeline’: a clandestine black market of cadavers supplied by resurrection men (also known as resurrectionists, sack-em-up men, grave robbers and body snatchers). The anatomists themselves (students and teachers alike) participated in this illegal procurement of specimens for their anatomic study (Francis 2001; Goddard 2003; Roach 2003; Rosner 2002). In fact, this was a common method for students to help defray the cost of their tuition (Francis 2001).

Needless to say, the public was not enamoured of the practice of grave robbing. In a few notable instances, the public demands for the practice to stop bubbled over into civil unrest and could no longer be ignored by government.

The first of these cases was the New York Doctors Riot of 1788. A young boy, staring in through the window of the anatomy lab at the hospital society, was taunted by a student inside. The student waved a severed arm at the boy and told him that it was his mother’s. Coincidentally, the boy’s mother had recently died and upon visiting her grave, the boy’s father found that it had been robbed. In the ensuing riot, the lab was burned down, much of the hospital was destroyed and 7 rioters were killed (Roach 2003; Rosner 2002; Tward and Patterson 2002).

The second event was the notorious Burke and Hare scandal of Edinburgh, England in the 1820’s. Edinburgh was the centre of anatomy research and was a world-renowned facility for medical education. Unfortunately, Parliament only allowed one legal body per

year, and the demand was far greater than the supply (McDowell 2000). Meanwhile, William Hare, an owner of a local boarding house, was trying to decide how to recoup the money owed to him by a recently deceased tenant. He brought the body to local anatomist Dr. Robert Knox, and sold it for £7,10 shillings, which was an enormous profit at the time (Tward and Patterson 2002). Hare and his associate, William Burke conspired to lure people (indigents, prostitutes and others) to the boarding house, where they were intoxicated with alcohol and suffocated (Goddard 2003; McDowell 2000; Roach 2003; Rosner 2002; Tward and Patterson 2002). Burke and Hare were eventually caught in 1829 and charged with 16 murders (although some sources speculate that it could be as high as 30). Hare turned King's evidence, and Burke was sentenced to death by hanging. In an ironic twist, Burke's body was dissected and put on public display (Tward and Patterson 2002).

The third event in 1878 involved US Senator John Scott Harrison, son of President W.H. Harrison and father of President Benjamin Harrison. Three days after the Senator died, his son and nephew received word that the body of a family friend had been stolen from its' grave and taken to the Medical College of Ohio. They decided to visit the college, but were not able to find the body of their friend. However, as they were leaving they spotted the body of the Senator himself being hoisted into the room and about to be dissected (Tward and Patterson 2002). This prompted the passing of anatomy laws in Ohio and Indiana in the hopes of curtailing the illegal procurement of dissection specimens.

Laws and Legislation on the Use of Human Cadavers

Initially, the only legal source of cadavers was those of executed criminals. Britain's King Henry VIII endorsed such a policy in England (Rosner 2002). Unfortunately, this did little to discourage grave robbing and the illegal procurement of bodies. It wasn't until the New York Doctors Riot in 1788 that laws were passed in the US in 1789 forbidding grave robbing and allowing criminals to be used for dissection (Tward and Patterson 2002).

By the 1820's the medical community was lobbying parliament to pass the Anatomy Act, which would allow anatomists to use unclaimed pauper bodies in dissection (Rosner 2002). Of course, the poor weren't sold on the arrangement, and the Roman Catholic Church opposed dissection on moral grounds and not much progress was made. That is, until 1829, when Burke and Hare were tried for murdering 16 people and selling the corpses for dissection. This prompted legislation to finally be passed in Britain in 1832. The Warburton Anatomy Act, passed by Parliament via Royal Assent, allowed anatomists to dissect the unclaimed bodies of the poor from workhouses, hospitals, etc (Goddard 2003; Rosner 2002; Tward and Patterson 2002).

In the US, Massachusetts was the first state to pass an Anatomy Act in 1831 (Goddard 2003). In Canada the Act to Regulate and Facilitate the Study of Anatomy was passed in the Legislative assembly in 1843, and was later amended in 1883 (Francis 2001). The Canadian Medical and Surgical Journal reported in 1884 that grave robbing in Canada

had ceased (Francis 2001), although that was unlikely as grave robbing was reportedly practiced in Tennessee through the 1920's (Dyer and Thorndike 2000).

Unclaimed bodies comprised the source of almost all dissection specimens until 1968, when the Uniform Anatomy Gift Act was adopted in the all 50 US states (Tward and Patterson 2002). It ensured the right of a donor to bequeath his or her own body to medical science and education. Similar Canadian laws were passed. Currently Manitoba has The Human Tissue Act (1987) allowing adults over 18, or parents/legal guardians of minors to donate their body after death for therapeutic, educational or research purposes (Government of Manitoba 2003b). Manitoba also has an Anatomy Act (1988) that allows unclaimed bodies to be used for dissection and other research purposes (Government of Manitoba 2003a). In an ironic reflection of the method of historical procurement of bodies, the inspectors cited in the Act are to be paid \$10 per body delivered to the University of Manitoba, faculty of Medicine or Dentistry, and an extra \$2.50 when the body is delivered to an authorized source other than the University of Manitoba (Government of Manitoba 2003a).

The Future Role of Human Cadavers in Medical Education

In the last century, anatomic science has experienced a decline as research shifts from anatomy to other sciences, such as histology and immunology. Medical students spend increasingly less time in anatomy lab now compared to 100 ago (Dyer and Thorndike 2000; Gregory and Cole 2002). As well, the advancement of technology in medical science has resulted in an increasing and disturbing trend to reduce patients to their diseases (for example instead of referring to patients by name, they may be described by their disease "the fractured pelvis in bed one") (Dyer and Thorndike 2000; Gregory and Cole 2002). A response to this trend has been to include bioethics and medical humanities in medical education. Anatomy lab is thus experiencing a revitalization as a forum to facilitate teaching concepts of death and dying (Dyer and Thorndike 2000; Gregory and Cole 2002). The new role of anatomical study is to socialize medical students and provide them with an opportunity for personal growth—to "combine detached concern...with genuine empathy in a way that will best serve patients over a doctor's career"(Dyer and Thorndike 2000). In a way, this amendment of the way human cadavers are used in medical education has served to restore the humanity of the cadavers (Dyer and Thorndike 2000).

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THE FLEXNER REPORT: BEFORE AND AFTER

By

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ABSTRACT

The Flexner report in 1910 was a pivotal document for medical education in both Canada and the United States. Abraham Flexner traveled to all 155 schools in both Canada and the U.S. to scrutinize each medical school. This paper will tell the story of what medical education was like before the Flexner report, what it was like after the report and finally what concerns Flexner might have about medical education if he came back today.

Medical Education: Prior to the Flexner Report

Medical schools developed slowly in the first decades of the 19th century. But the extreme shortage of doctors and large profits possible from operating medical schools led to a rapid expansion: 26 new schools opened between 1810 and 1840, and 47 more between 1840 and 1875 (Orr 1960, 173:1429-1431). This rapid expansion degraded the quality of education. Opening a medical school required only a hall and a group of physicians willing to lecture. Because medical schools emphasized profit, not education, many schools had no admission requirements. Medical students were often described as unruly and undisciplined, and frequently illiterate (Orr 1960, 173:1429-1431). No clinical practice, aside from apprenticeships, was offered to augment lectures.

Many medical students earned their degrees through apprenticeship. Under this system, the student lived with a practicing physician for two to three years, going on call with him and studying his books. In exchange, the apprentice paid a fee and did chores around the house (Slawson 2002, 3:47-8, 57).

By the second half of the 19th century, almost anyone who saw fit to call himself a doctor could do so. Medical education was separate from the university system and those schools affiliated with universities were affiliated in name only (Orr 1960, 173:1429-1431). The field of medicine was wide open and free of governmental regulation, and malpractice suits were rare. Students who paid the tuition were often awarded a diploma regardless of their grades (Orr 1960, 173:1429-1431).

In 1908, Henry S. Pritchett of the Carnegie Foundation asked Abraham Flexner to lead a survey of the American and Canadian medical schools. Flexner began his survey of medical schools in December 1908. In less than a year Flexner visited all 155 schools in the United States and Canada (Bonner 1998, 73:160-166). In 1910, Flexner published his

report: "Medical Education in the United States and Canada, a report to the Carnegie Foundation for the Advancement of Teaching" (Flexner A 1910, Repr. 1972).

Who was Abraham Flexner?

Abraham Flexner, born in 1866, was the sixth of nine children that grew up in Louisville, Kentucky (Prutkin 1999, 72:269-279). He was the second of his family to finish high school and college (B.A. in Classics from John Hopkins University). After graduating from college, he went back to his home town and founded 'The Flexner School.' The school was based on individualized tutoring and teaching programs for each student. Innovative for the time, Flexner had great success and many of his students went on to enter elite universities in less time than some famous preparatory school. This brought Flexner many invitations to lecture and his fame spread (Bonner 1998, 73:160-166).

In 1898, Flexner married Anne Crawford who became a driving force in his life (Bonner 1998, 73:160-166). Flexner aspired for more education and in 1905; he left Louisville for Harvard University where he studied philosophy and psychology. After two years at Harvard, Flexner and his family traveled to Europe, where he studied different education systems in various European countries, particularly in Germany (Strauss 1960, 173:1413-1416). Upon his return to the U.S. Flexner wrote the book "The American College" which criticized the U.S. collegiate system, but offered innovative ideas for education reform (Flexner A 1908), (Prutkin 1999, 72:269-279).

Why Choose Abraham Flexner?

At the time, Flexner seemed an unlikely candidate for the evaluation of medical schools. Because he was neither a physician himself nor an expert in the health care field. It was thought he was hired for the job because he could write; he held the same views on education as Henry Pritchett (Prutkin 1999, 72:269-279) and he was well connected to medical the field through his brother Simon (who at the time was a well known pathologist at John Hopkins and the Director of the Rockefeller Institute for medical research) (Gardner 1960, 131:594-595).

Flexner researched the literature on medical education, conferred with the American Medical Association and went to John Hopkins University to discuss with the medical school faculty (Gardner 1960, 131:594-595). Flexner considered the medical school at Johns Hopkins to be an excellent model for medical education as it displayed some of the best features of the European schools in England, Germany, and France (Meites 1995, 41:627-632). He used this knowledge to develop specific guideline that he saw were necessary for a successful medical school. Flexner became respected and well-known for his innovative ideas (Strauss 1960, 173:1413-1416).

The Flexner Report

Flexner's report was published in 1910 and is now regarded as one of the most important documents in the history of medical education. Known as the Carnegie Foundation's "Bulletin Number Four," it was a complete synopsis of the North American medical

education system during the early 20th century. The Flexner report made six major recommendations regarding medical education reform. Flexner recommended:

1. Entrance requirements be established and adherent to them. Medical schools often admitted students with only a high school diploma. Many schools in the southern states didn't even require completion of high school. Other schools ranged from requiring their students to have a full four year college degree (John Hopkins University) to at least 1-2 years of college (Yale and Stanford University).

Flexner recommended at least 2 years of college prior to entrance into a medical school. During this time students were to be prepared in the sciences such as biology, physics and chemistry.

2. A decrease in the number of the medical schools and students. At the time, medical schools were consistently, increasing their enrollment to meet the demands of admission, not because of current population needs. For example, the University of Louisville in 1908 had increased their entering class to 600 new students and many had only a high school education or less. Out of the 155 medical schools in the US and Canada, Flexner suggested decreasing the number of schools to 34 with an average enrollment of 300 students and a graduating class of <70.
3. An increase in the amount of allocations of endowments and fees to support the institute. Of the 155 medical schools, 120 did not have subsidies from endowments or public funds. These schools relied solely on tuition from the students. Sadly, that money was usually given to the instructors or other personnel leaving little for laboratories, coursework, libraries and other resources. The report recommended that only 40% of the operating expenses be derived from tuition fees, with the rest coming from other sources.
4. Better quality laboratories and laboratory instructors. At the time most medical schools were privately owned, usually for profit. Flexner recommended that universities should exclusively run the medical school and a professor's rank in the medical school should be equal to any other university department professor with the same pay scale. Flexner felt should not be dependant on their private practice for funding but be permitted to serve as a consultant. Finally, professors should be chosen primarily for their training, experience and teaching skills not for their position of seniority or administrative clout.
5. A 4 year medical school programs and affiliation with teaching hospitals. At the time, many medical schools consisted of two years of schooling. A lecture series of four months was given twice, once each year. There was little if any patient contact. Most school had limited arrangements with neighboring hospitals which provided limited opportunities and student involvement. This led to an over abundance of ill prepared graduates who according to Flexner were 'a menace to society.'

Flexner recommended a four year program with the first 2 years emphasizing laboratory sciences: anatomy, physiology, pharmacology, pathology, bacteriology

and chemistry. In the second two years clinical practices such as surgery, obstetrics, diagnosis and treatment of disease would be covered. He also recommended that universities completely control medical training so that laboratories could be provided as well as proper staff and equipment. Finally, universities were urged to make strong affiliations with hospitals to make hospitals readily available to students.

6. Closure of most of the African American and all-female medical schools. Flexner recommended the closure of all 3 all-women's medical schools and five of the seven African American medical schools. Consequently, he recommended the immediate integration of women into other medical schools.

Flexner evaluated the African American schools with the same criteria as all the other schools. Just as Flexner advocated for "good schools rather than many schools" for white students, he likewise believed African Americans needed fewer great schools than many poor schools. (Flexner A 1910, Repr. 1972).

Aftermath of the Flexner Report

Medical education was changed forever with the release of the Flexner report in 1910. The outcry following this very controversial report resulted in the closing of 80 of the 121 schools recommended to be shut down within a decade of the report, and one by one, the state legislatures adopted minimum standards for licensure (Hiatt MD and Stockton CG 2003, 8; 2:37-40). Medical education was formalized, standardized and moved into the university environment. Medical professors were salaried by the universities and 'teaching hospitals' became an important part of medical education (Hiatt MD and Stockton CG 2003, 8; 2:37-40). Finally, funding such as subsidies from endowments or public funds for medical education increased (Strauss 1960, 173:1413-1416).

What Would Flexner Think of Medical Education Today?

Would he be pleased, amazed, excited and concerned? Yes. I think he would applaud the advancements in medical research, the continual support of both the university and external funding agencies, the recruitment of highly qualified students and tremendous improvement in medical education. He would be pleased with the gains made in medical education since the early 1900's, but concerned about how to address new issues that have arisen.

Since Flexner, many reports have been commissioned regarding medical education reform and its future (Christakis 1995, 274:706-711),(Rae 2001, 164:1860-1861). A review paper by Christakis N.A. (Christakis 1995, 274:706-711) describes four core themes repeatedly discussed throughout these reports.

1. Medical education should be accountable to society and community needs.
2. We need to address physician work force needs, in terms of numbers of physicians and their distribution.

3. We need to effectively manage the burgeoning medical knowledge.
4. We need to educate generalist physicians in balance with specialist physicians.

I think Flexner would be concerned that these problems were identified many years ago, yet still exist. I think he would question how we are tackling these issues, and advocate alternative reform methods. But how would Flexner address these issues in contemporary society? Trends in current culture leave decision making and reform to committees not to individuals. In the modern era where there is increased complexity, regulation, standards and knowledge, could an individual as dynamic and innovative as Flexner influence medical education reform as he did in the early 20th century?

Flexner was an iconoclast for his time; he was a novel academic who he broke down barriers, challenged existing ideas and fiercely pursued his goals. Reflecting on Flexner's accomplishments will help us address future medical education reform.

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MICHAEL BALINT AND THE ‘PATIENT-CENTERED CLINICAL METHOD’: LESSONS FOR YESTERDAY AND TODAY

By

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ABSTRACT

This paper looks at some key aspects of the work of Michael Balint.

It was Michael Balint, (1896-1970), a Hungarian psychoanalyst and GP, who is recognized as a forefather of the patient-centered clinical method. This model was introduced at a time when the field of medicine in Britain and elsewhere was failing to attract young doctors to general practice, due to the developing climate of frustration and low-morale in the profession. Young doctors were driven by the ‘diagnosis’ and struggled with the lack of time for the ‘difficult’ patient, while patients’ expectations were continually left unfulfilled. He was among the first to suggest that traditional medical training had not prepared doctors for the realities of practice. He also would identify that the most frequently used “drug” in general practice was the doctor himself, and that no pharmacology of this drug existed. He would research, build, and subsequently teach the ‘patient-centered’ model of medicine to doctors across the world. His model and its original construct, is worthy of a re-visitation, as Canadian Health Care is experiencing similar challenges in general practice in 2004, as well as frustrations in the patient-physician relationship. Pressure on doctor’s time has intensified, as doctors take on more roles, pressured to cram in more patients, procedures, and curriculum in to every waking moment. This pressure affects multiple aspects of medical practice, and it has particular implications for the physician-patient relationship. Practicing clinicians must perfect a ‘balancing act’, to develop a relationship based on trust, mutual understanding, and patient-centeredness, while meeting expectations of their practices. There is fear that there is an erosion of the patient-physician relationship in this day of medicine, due to competition of external influences for doctors’ already limited, time.

Introduction

Pressure on doctor’s time has intensified over the past two decades, as doctors take on more roles, pressured to cram in more patients, procedures, and curriculum in to every waking moment ((Balint JA, 1996), Lee VR, 2000). This pressure affects multiple aspects of medical practice, and it has particular implications for the physician-patient

relationship. In a recent study of general practitioners perceptions of patient care, *time* was identified as an essential component to effective health care, “Time influences everything. It influences getting a history correctly, engaging the patient if you don’t know them well, building up some sort of rapport, discussion treatment options, examining them properly” (Tomlin, 1999). Practicing clinicians must perfect a ‘balancing act’, to develop a relationship based on trust, mutual understanding, and patient-centeredness, while meeting expectations of their practices. The patients’ satisfaction and ‘feeling cared for’ is affected in both the quantity of doctor-time, and importantly its quality (Martin, 2001). There is fear that there is an erosion of the patient-physician relationship in this day of medicine, due to competition of external influences for doctors’ already limited, time (Balint JA, 1996).

The ‘patient-centered’ model of medicine, as first introduced by Michael Balint (1957) and further developed by Stewart and colleagues (1995), aims to provide guidance in developing a therapeutic relationship between doctor and patient while balancing competing responsibilities of a practice. In her first lines of ‘Patient-Centered Medicine: Transforming the Clinical Method’, Dr. Moira Stewart writes ‘there are competing demands on the doctor for his or her time, availability and commitment. Confronted with the complex patient problems and shrinking resources, the physician can be easily overwhelmed by the responsibilities of practicing medicine’ (Stewart, 1995, p. xv). Stewart, like Balint, suggest that training has not prepared doctors for the realities of practice, and therefore patient interactions are often inefficient and lead to frustration on both sides of the therapeutic relationship. Although the patient-centred model of doctor consultation is widely advocated, recent research suggests that its use in practice is probably rather limited (Little, 2001; Barry, 2000; Britten, 2000; Law 1995). This is thought to be primarily due to the aspect of time, as patient centered visits are perceived to be more lengthy consultations (Little, 2001; Pimental, 2001; Mechanic D, 2001).

This paper will address the issue of ‘time’ in the patient-centered clinical method. A historical view will look at the development of the original patient-centered model of medical practice by Michael Balint (1957) and also the more recent Canadian model by Dr. M. Stewart of Western University (1995). This analysis will explore how time is considered in both clinical models. The second part of the paper will be a recent examination of barriers to employing the patient-centered method in clinical practice, as well as some of time’s qualitative changes since Balint’s model in 1957.

Time and Doctor-Patient Communication in Health Care

The doctor-patient relationship is the foundation of managing patient problems in general practice. In this setting, the doctor must rely on relatively simple means to arrive at the medical diagnosis and the therapeutic plan for their patients. This is based largely on the flow of information between doctor and patient, through a detailed history taking and a skilful physical exam. Surprisingly, there has been a lack of critical study focused on ‘basic clinical skills’ in general practice, despite their known crucial role (Ahmed, 2002, White, 1988; Bensing, 1991 p.3). The majority of patient complaints that are brought to general practice are managed in a non-technologically advanced manor, without referrals

to specialists or a battery of invasive tests (Bensing, 1991, p.2; Cassell, 1985, p.86). Ideally, their management is based upon the clinical judgment of the doctor, and a shared decision-making process with the patient (Stewart, 1995). Eric Cassell, in his book "Talking with patients", outlines four powerful and yet simple truths of clinical practice.

1. Doctors treat patients, not diseases
2. The body has the last word
3. All medical care flows through the relationship between physician and patient
4. The spoken language is the most important tool in medicine. (Cassell, 1985, p/4)

Cassell believes that without effective communication we are unable to acquire objective and subjective information in order to make decisions that are in the best interests of the patient, and, more importantly, we are unable to utilize the relationship between practitioner and patient for therapeutic ends.

It is also widely understood concept that problems without a strictly biological cause are abundant in general practice (Balint, 1957; Bensing, 1991). It is estimated that 60 - 70% of all cases presented to the GP today are 'non-biologic' in nature, or have a strong 'non-biologic' component (Peter, 1992). This situation is not a recent trend in general practice, although is it believed to be increasing (Peter, 1992; Stewart 1995), as the psycho-dynamic component of disease was noted in very early publications by physicians.

"I will venture to say that a critical examination of the patients seen by the average practitioner from day to day would reveal the fact that at least one-third of the cases demanded treatment by psychotherapeutic methods alone, whilst the remainder would be benefited by them." (Nobe S, 1916. Placebo: a protest and a plea. The Practitioner 97; 58. in Patient-Centered Medicine, Hopkins P, 1972, p.1)

General practitioners must often use skills in counseling and psychotherapy during routine office visits. In a study to mental health care practices of general practitioners, it was found that the majority of these patient needs are handled in their office; this is often due to patient discomfort with a psychiatric referral, long waiting lists, and inadequate community resources (Phongsavan, 1995).

Along with this, medical research has convincingly supported that many somatic problems have a strong psychological and sociological component (Chorot, 1994; Tennet, 2001; Homnick 2000,). There has been overwhelming evidence for this in relation to chronic diseases, such as coronary heart disease, cancer, respiratory illness, and diabetes (Chorot, 1994; Tennet, 2001; Homnick 2000). It is sadly ironic that clinical research has not spent more focus on areas such as help-seeking behaviours and the multifactorial nature of psychosomatic and emotional patient health problems. In the face of such understandings, the clinical value of biomedicine is over-estimated in clinical practice,

and the role of the therapeutic alliance remains poorly understood and under-recognized (Steward, 1995; Bensing, 1991).

Historical View of the Patient-centered Method

Much of the medical literature touts the importance of doctor-patient communication as a discovery of the 1960's, fueled by the work of Michael Balint in Britain. However, a deeper historical perspective proves this to be untrue. Bensing, a researcher on physician behaviour in general practice, notices that scientific attention to patient-doctor relations has taken a 'waxing and waning' historical pattern (Bensing, 1991). Attention to the topic arises in parallel to periods of interest in psychological and sociological components to people's health

The importance of doctor-patient communication was noted in ancient writings, by Plato, Aristotle, Hippocrates, and then again during the Scottish Enlightenment by such physician-writers as George Campbell (Downie, 2000 p.66; Bensing, 1991, p.2) Professional communication skills of the physician were referred to in these writing, as '*rhetoric*', and they emphasized education of a public or professional occupation (Downie, 2000, p.66). The modern day meaning of this terminology can best understood through the concept of 'explanation'. Professional skills in 'explaining' (or, skills of *rhetoric*) are a form of teaching concerned with creating an understanding. In the eloquent words of Campbell, the doctor's well-developed skill in communication should "enlighten the understanding, please the imagination, move the passions, and influence the will of the patient (Downie, 2000, p.67).

Interest in patient-doctor communication was next noted in writing of the respected physicians from pre-WWI such as Meyer (White, 1988) and Peabody (White, 1988); and then in the post-WWI work of Michael Balint (Balint, 1957, 1961, 1964),

More recent interest in the biopsychosocial nature of general practice and patient-doctor relationship has been demonstrated in the United States by White (1988), and in Canada by McWhinney (McWhinney, 1972) and later Stewart (Stewart, 1995). These North American works are undoubtedly Balint inspired, and have their foundations on the concepts developed in his patient-centered method.

Michael Balint: The 'Father' of Patient-centered Medicine

It is Dr. Michael Balint, a Hungarian psychoanalyst and doctor of general practice, who is credited with coining 'the patient-centered clinical method' (Hopkins, 1972). It was his work in Britain in the mid to late 1950's and beyond that would fuel the 'renaissance' of general practice into the 1960's, which would reach international levels. He would among be the first of his time to examine clinical practice in a scientific manner (Hopkins, 1972). His research would catalyze a new outlook on the doctor-patient relationship, with the notion of the 'doctor as medicine'. He is thought to be the first to scientifically explore the psychosomatic aspect of somatic illness – i.e. the link of emotional ill-health to physical ill-health (Hopkins, 1972). His two most famous works:

The Doctor, his Patient, and the Illness (1957) and *Psychotherapeutic Techniques in Medicine* (1961), are thought to be timeless pieces and ‘essentials’ for general practice (Samir, in *Patient-Centered Medicine*, Hopkins P, 1972, ch.3)

Balint also played an important role in introducing training on communication with patients into medical schools. Balint’s ideas and research have a continued presence in European Medical schools, which have integrated his ideas into core curriculum. Balint societies exist globally, for the purpose of education, training, and the further development of his ideas, for health professionals. Internationally, the Balint Societies congregate annually for conferences, and now publish a bi-monthly peer-reviewed publication: *The Journal of the Balint Society*.

Balint’s research was based on his personal long-standing curiosity of what was *really going on* in the doctor-patient interaction that had never been taught to him in medical school. For example, he sought to distinguish what was more important, the patient’s complaints or the act of complaining? And what were the consequences of doctor’s response to these complaints. His research would explore the nature of the patient-physician relationship, the meaning of this interaction, its therapeutic potential, and why it so often broke down with doctor and patient failing to understand each other. Balint studied the pharmacology of the doctor as a therapeutic agent himself: the doctor as a drug, exploring the correct dosage, maintenance and curative therapy, and side-effects. Balint was successful in changing the perspective of doctors in the practice of general medicine, and effectively boosted the interest, self-respect, and morale in the profession. At the same time, Balint indirectly presented a challenge to the widely-held paternalistic approaches to medical care, where the doctor as the ‘expert’ treated the disease and paid little attention to the ideas, feelings, and expectations of the patient.

The Doctor, His Patient and His Illness (1957)

Balint's work “The Doctor, His patient, and the Illness” (1957) came about during a time when general practice in Britain, and elsewhere, was failing to attract young doctors due to intense competition with other specialties (Rosenheim, 1972). A general feeling of frustration and low-morale had been steadily growing in the realm of general practice (Hopkins, p1; Sapir, p.13, 1972) Part of this frustration was attributed to feelings of being unable to ‘do something’ for patients who did not fit into traditional diagnostic categories (Hopkins, p1, 1972). Doctors training at the time had not adequately prepared them for the challenges in everyday practice. During the stressful transition from medical school to practice, doctors were faced with expectations and diagnostic dilemmas that were not anticipated. This was especially trying for the new doctor, primarily trained in the basic sciences, who had yet to develop experience and intuition in dealing with their patients (Hopkins, 1973, p5).

Despite the dismal climate of general practice that surrounded Balint at this time, Balint had a long-held curiosity on the subject of communication in general practice, and the potential in the therapeutic alliance (Balint, 1957). In the introduction of his first work, Balint identifies the catalyst of his research that occurred, based on discussions at a

routine research seminar at the Tavistock Clinic (Balint M, 1957). At one of these seminars, the topic was on drugs that practitioners often prescribe. Discussion soon led to the concept that the most frequently used drug in general practice was the doctor himself – it was not only the pills themselves that were involved in therapy for the patient, it was the ‘atmosphere’ (i.e. the way the doctor gave them to the patient) that was important (Balint, 1957). This led to his research, on the pharmacology of the doctor himself, as a therapy for the patient.

He began to research the intricacies of the doctor-patient relationship, through open discussions and research with a group of 14 other physicians. The chief aim of this group was to describe the processes in the doctor-patient relationship that often lead to frustration and its ineffectiveness. The second goal of the group was to describe the ‘diagnostic signs’ of these ‘pathological’ processes in the doctor-patient relationship, and thirdly, to devise a specific therapy (i.e. techniques) to remedy the situation. Essentially the group aimed to answer the question: what causes an unhappy therapeutic relationship, how can it be avoided and how can it be cured. The group met once-weekly, over a period of 3 years. The discussions were unstructured, and consisted of a sharing of recent experiences with patients. The continuity of the group enabled them to follow the development of patient problems over 3 years, to test theoretical approaches to patients, predict diagnosis, and to share how ideas and therapeutic attempts had worked (Balint, 1957).

The results of this work were published as a series of case reports with details of history, therapy, and successful approaches to the patient. Balint's work, *The Doctor, his Patient, and the Illness* (1957), described three previously unrecognized aspects of the patient-doctor interaction (John A Balint, 1996):

1. The first was the recognition of the physician as medicine. This concept emphasized the dynamic nature of the therapeutic relationship that could be benefited or harmed by the appropriate or inappropriate dosage of the physician, such as the frequency or duration of visit.
2. The second aspect was the ‘deeper diagnosis’, which was to include an understanding not only of the illness, but also of the personality of the patient, their interactions with family, and their social environment.
3. The third aspect of the relationship was what Balint calls the ‘apostolic’ function, in which the doctor encompasses the role of teacher. The doctor thus helps to enable the patient and enhance their beneficial outcome and self care by educating both patient and family.

The Doctor, His Patient, and the Illness, 2nd Edition (1964)

Balint and his team continued their research activity after the publication of the “*The Doctor, his Patient, and the Illness*” (1957), to expand, develop and refine their original of the doctor-patient relationship. Their efforts began to drift towards appropriate *therapy* for the patient, and the intricacies of the therapeutic process (Balint M, 1964). This led to the development of a revised 2nd edition of his original work, while the first

edition focused more on “listening” to the patient to achieve the deeper diagnosis, his second edition recognized two areas that are a continuation of the process. These two areas are “understanding” and “using the understanding so that it should have a therapeutic effect” (Balint, 1964, p ix). This would require the physician to predict the effect of the intervention, and therefore brought a treatment focus to the patient centered model of care.

The Canadian Model of Patient-centered Care

Research on patient-doctor communication first began in Canada at Western University in London, Ontario, in the late 1960’s (Stewart, p.xix). It was Dr. Ian McWhinney, who joined the faculty of family medicine at UWO in 1968, who would introduce the concepts of Michael Balint. McWhinney, having trained and worked in Britain, was familiar and fascinated by Balint’s teachings and concepts on patient-centered clinical methods. His first research explored the “real reason” the patient presented to the doctor (McWhinney, 1972), which set a foundation for further research in the breadth of patient problems (physical, social, or psychological) and their depth (meaning of presentation) (McWhinney, 1972). Dr. Moira Stewart, a colleague of McWhinney, would be guided by his research, and continue work with him in the area of patient-physician relationship (Stewart, McWhinney, & Buck, 1975, 1979).

Western University began to teach the “Patient-Centered Clinical Method” to medical students and residents, in 1983. Dr. Joseph Levenstein, a visiting professor of South African to the faculty of family medicine, who shared his patient-centered clinical technique with the school. Levenstein had attended seminars at the Tavistock Clinic in London, and received teachings from Michael Balint and his wife Enid. He was also a member of the newly formed Balint Society. He refined his understanding of his method while at Western University, and introduced it to faculty and the medical curriculum. The faculty at the university began to meet regularly to refine and elaborate the model, leading to the publication “Patient-Centred Medicine: Transforming the clinical method”, 1995, authored by Dr. Moira Stewart and her colleagues. This work hallmarked the formal introduction of the patient-centered clinical method to Canadian medical schools and health care professionals.

Stewart and her research team propose a model of medicine that integrates conventional understanding of disease with the patient’s experience of illness (Stewart, 1995, p. 23). Stewart’s model provides a conceptual framework to guide the practitioner when he or she is “in the trenches”, in contrast to Balint’s model, which looked at the doctor as medicine himself. Their model includes six interacting components which outline an ‘effective’ model of practice:

1. Exploring the disease and the illness experience
2. Understanding the whole person
3. Finding common ground
4. Incorporating prevention and health promotion
5. Enhancing the patient-doctor relationship

6. Being Realistic.

Patient empowerment is emphasized in this model, and unlike other similar models of patient-communication, it includes prevention, the doctor-patient relationship, and efficiency.

Doctor Time vs. Patient Time

Before beginning discussion on 'time' and its place in the patient-centered model, it is important to understand that time is experienced differently by the sick and the well, the health care system and the doctor, and the doctor and the patient. Thus, time by its definition, will always vary between both sides of the therapeutic relationship. This alone will challenge aspects of patient-centered clinical method, such as achieving common ground or renouncing control of the interaction (as outlined in Stewart's model), and complicates discussion around length of interaction in the patient-centered approach. An essay published for the International Balint Society in the early 1960's, separates time into 'Doctor time' and 'Patient time' (E. Nols in *Patient Centred Medicine*, Hopkins P, 1972). Doctor time can be broadly defined in three ways: 1) objective time: number of hours in a day – professional activities and for ordinary life of family, food, leisure; 2) subjective time: or time as it is experienced, which is the time that the doctor sees in varying ways, depends on his interest and his feelings around the doctor-patient relationship; 3) time considered from the angle of accountability – the necessary workload in a given time; financial considerations, which do not always correspond with the remunerative value accorded to them.

Patient is dynamic in definition, and may be experienced as: the duration of illness, time of onset of symptoms and his approach to the doctor, time spent waiting for appointment, and time he spends in direct contact with the doctor.

Thus, the duration of the interview is experienced as very different lengths and emotional intensity by doctor and patient. This will depend on their mutual feelings, and the circumstances (nature of symptoms, whether initial contact, follow-up, presence of observers, readiness to talk or to listen). The doctor must give up his own subjective sense of time with the objective time to devote to the patient. The patient virtually gives himself up to his own subjective sense of time.

Time in Balint's Model

Did Balint's original model of the patient-centered clinical method take into considerations of restraints of consultation length? Obviously a significant amount of time with a patient is needed to achieve the 'deeper diagnosis' for patients whose illnesses may be emotionally rooted, and to maintain an 'apostolic' role! In this work offers few suggestions of how to manage in a restricted time frame; he makes recommendations to invite difficult patients to come for a long interview outside surgery hours to talk about their lives (Balint, 1957).

In the both editions of “*The Doctor, the Patient, and the Illness*” (1957, 1964) Balint does indeed recognize the time challenge faced by physicians, but he offers it up to future contemplation, rather discussing it in definitive terms. In summary section of his 2nd edition, Balint writes: “...he (the doctor) must find time for his patient and then listen....” (p.286). On the following page he writes: “However favourable the Utopian economic and medical system might be, the commodity which is always and everywhere in short supply is the general practitioner’s time, especially during the winter months” (p.287). Still, just as time has to be found at present for a proper routine clinical examination, however hard-pressed the doctor or the specialist is, the time will have to be found in Utopia for a proper “long interview” whenever the doctor considers it necessary “to start” (p.287). This of course requires that the doctor is able to recognize those patients who need to come back to explore deeper associations of their illness.

Balint concedes that the challenge of time may be an ultimate barrier for physicians to take a patient-centered approach with their patients, but maintains that an investment of longer appointments presently will essentially save time later.

“Although the need for a better understanding of psychological problems and more therapeutic skill is keenly felt by many practitioners, they are reluctant to accept professional responsibility in this respect. The reason most frequently advanced is that they have too much to do as it is, and it is impossible for them to sit down and spend an hour with a single patient at a time, week after week. This argument, impressive as it sounds, is not in fact firmly based...it can lead in many cases to a considerable saving of time for the doctor and for his patient.” (p.108)

This again, reinforces the need for future study in the balance of time in the patient-centred model of care, and how to manage the challenges that are created for the physician who has an increased awareness of the multiple needs of his patient.

Balint's next work, *Psychotherapeutic Techniques in Medicine* (1961), would focus on special skills, psychotherapeutic techniques and approaches to patient interviews, in which to efficiently recognize emotional ill-health in patients. In this work, Balint and his researchers claimed that time, per se, was not a critical factor in the ability of the doctor and patient to engage in each other; what is needed, they proposed, is a re-education of the doctor (Balint, 1961). Over the next years, it would become increasingly apparent that the average general practitioner was struggling with accomplishing the ‘deeper diagnosis’, whilst trying to name the biological problem, and account for the environment of the patient, his internal world, his relationship to people around him, and the therapeutic development of the doctor-patient relationship (Balint E, 1973).

In Enid Balint’s publication *Six Minutes for the patient* (1973), the time-challenge faced by physicians was approached directly. It was increasingly apparent that Balint’s patient-centered techniques were...”far from being integrated into general practice, and had remained a ‘foreign body’” in the real world of clinical practice (Norrell, 1973, pXV). Balint states that one of the main reasons for this the perceived lengthy time of consultation that would be required to direct a patient-centered encounter (Balint, 1973,

ch.1). The psychoanalytical interview seems to need about 40 – 50 minutes, while the average consultation length in practice at this time was 5 – 10 minutes (Balint, 1973).

In the latter part of the 1960's, Balint and his team worked on the development of time-conscious therapeutic techniques that could be used in a 5 – 10 minute appointment, to fit day-to-day practice (Balint, 1973, p.32). Research was done by looking at successful interviews, in which GP's employed psychotherapeutic techniques in appointments that were 5 – 15 minutes. The alternative of formulating a shortened version of the long interview was quickly disregarded; Balint did not want to offer a "watered down psychoanalysis" or a "mini-long-interview" (Balint E, 1973).

The solution to the 'time-challenge' appeared to be the 'focal' diagnosis, a focusing on one particular aspect of the patient's illness (Clyne in 'Six Minutes for the Patient', Balint, 1973 ch. 6). However, Balint and his team were faced with a further practical dilemma: selection of the focal diagnosis, they felt, must be come from the patient (Clyne in 'Six Minutes for the Patient', Balint, 1973 ch. 6). This led the team to devise the "flash technique" in order to reach the patient quickly (Balint E, 1973, p.16). The 'flash' technique, describes the concurrent realization between doctor and patient of what the patient needs as a therapeutic intervention, based on a mutual understanding of the physical, psychosocial, and social difficulties of the patient. It is not time dependant, but intensity-dependant – intensity of observation, of identification, and of communication (Balint, 1973, p.19). The term 'flash' refers to the flash of understanding, which may be the tip of an iceberg or a larger issue that may be explored over weeks or months (Balint E, 1973, p. 21). This technique is based on the premise that the patient is in control of the pace and content of the therapy. It also requires a solid 'pre-flash' relationship, and it involves doctor picking up on verbal and non-verbal cues, and emotions shared by patients (Courtenay, in Patient-Centred Medicine, 1972, p.217). Enid Balint outlines the 3 principles for which the 'flash-technique' is based upon:

1. The doctor should let go of preconceived theories, so that his judgment will not be clouded and he will not miss obvious and simple aspects of the interview.
2. The doctor's observations: he/she must reflect on their meaning, and respond only when appropriate; there is an emphasis on using silences.
3. The doctors must respect the patient's privacy, in other words, he must give the patient the opportunity to communicate, rather than digging for untold secretes. (Balint E, 1973, p. 19-21)

Enid mentions that an advantage of this technique is the freedom it gives to the doctor: the freedom to be used by his patient, i.e. to give of himself without anxiety that his patients will abuse his time (Balint E. 1973, p. 24). In agreeing with her husband's words, Enid emphasis that the 'flash of understanding' must occur in a setting where ongoing therapy is possible, where patients are seen over the course of a series of ordinary consultations (Balint E, 1973, p.25).

The Canadian Patient-centered Model and its Handling of Time

Dr. Stewart, recognizes that time may be a perceived barrier to adopting her proposed model of the patient-centered clinical method. She acknowledges that the threatening nature of implementing new approaches to practice, and names fears such as “Will the office routine be slowed? Will the doctor be able to deal with all of the feelings expressed?” (Stewart, 1995, p.xxii). Like Balint, Stewart maintains that patient centered visits take no longer than ‘disease-centered’ visits. Stewart also reassures the reader that the benefits outweigh the potential risks, such as symptom reduction and improved physiologic status.

In the sixth component of this model, ‘Being Realistic’, Stewart addresses the issue of ‘time’ directly. Recognizing the competing demands for the doctors time, she states the need for skill development in ‘priority setting, resource allocation, and teamwork’ (Stewart, 1995, p.30). Stewart makes a direct link from knowledge of the whole person and the efficient use of time in the patient-centred method. Frequently patients take several visits to the doctor with non-specific complaints, before disclosing a personal matter. This may be due to the norms or values of the patient and/or his family, or due to a fear of reprisal or abandonment from their physician. It is important that the physician be attune to subtle clues from the patient, and create an atmosphere of trust and safety (Stewart, 1995, p.105). Similar to Balint, she suggests the use of several visits, overtime, to explore complex or deep personal patient issues. However, she does say that doctors must be able to recognize when a patient requires more time, even if it means disrupting their office schedules. “Such visits are likely to be the best use of resources over the long-term” (Stewart, 1995, p.103) potentially saving the patient from unnecessary tests, referrals, and from returning for a more accurate diagnosis.

Rather than offering precise clinical techniques to achieve therapeutic goals in a short consultation as Balint and his team attempted with the ‘Flash Technique’, Stewart offers broad recommendations. “Essential skills needed by the doctor are flexibility and a readiness to express both concern and a willingness to work with the patient in the future. Doctors need to work with patients to establish mutual agreement” (Stewart, 1995, p.104). She also mentions that the change must occur on both sides of the relationships, especially in terms of the patient expectations of their doctor. She writes: “Medicine is undergoing a radical transformation that demands fundamental changes in the way we conceptualize the role of the physician” (Stewart, 1995, p.xvii). Lacking in Stewart’s work are specific words of guidance and clinical technique to successfully integrate the patient-centered clinical method in modern-day medicine.

Part II: Time and the Patient-Centered Method: The Realities of Practice

Patient centered training may produce new clinical dilemmas for the practitioner as the doctor has increased professional skill and a new awareness of the enormous need opened up to him in his daily work. In Six Minutes for the patient, Philip Hopkins writes, “the question is: Is there any technique? Can we devise a technique that would be helpful to get one step further, and the next step will be done in two months time, or two weeks,

when the patient turns up again? (Hopkins, 1972). Practitioners at this time and in later years asked similar questions as they struggled with achieving for a deeper diagnosis and empowering both patient and family, yet keeping up with their practice and achieving desired clinical outcomes.

In an essay to the International Balint Society in 1984, Dr. Levenstein wrote of his feeling of “anti-climax” after reading Balint’s “Six Minutes” 10 years earlier (Levenstein, 1984). He expressed his sense of guilt, inadequacy, and anger as he was unable to “‘flash’ his patients into salvation”, unsure of a proper technique, and left without guidance. Ultimately he was left feeling “let-down” by the original pioneers of the patient-centered method, and felt unfairly compared as a GP to that of a psychoanalyst. “The problem of time in relation to consultations with a general practitioner is usually discussed in terms of the doctors’ workload...it is not sufficiently recognized that the general practitioner’s real point of reference for his comparison is the amount of time the psychoanalyst spends with his patients.” He poignantly differentiates himself from a psychoanalyst, questioning his professional ability to meet the needs of these patients in “six, sixteen, or even sixty minutes” upon achieving the Balint’s deeper-diagnosis (Levenstein, 1984).

In a recent study in the *BMJ*, general practitioners trained in the patient-centered clinical method, were interviewed about their perceptions of effective health care (Tomlin, 1999). *Time* was the most commonly cited external pressure which led to not practicing effectively, and that “the strength of this feeling was considerable” (Tomlin, 1999). *Time* was viewed by respondents, as a hindrance to effective practice across all aspects of care, and that constraints often led to giving in to inappropriate patient requests.

Time and the Patient-centered Method: A Perceived Notion?

Yet the question still remains as to whether or not there is enough time in a standard consultation to touch on all the domains that have been presented in the patient centered model. Proponents of the Balint-style and more recent ‘patient-centered’ approach to general practice emphasize that there is, in fact, a need for adequate time to be spent, in order to form a patient/physician alliance. However, the authors of both contend that patient-centered visits take no longer than the traditional ‘disease-centered’ visits (Balint, 1961; Stewart, 1995). Indeed, research has shown that visits in which the patients are active participants in telling about their illness and in asking questions are almost identical in length to other visits – visits were studied to be 9 minutes in Canadian family practices (Stewart, 1989). This view is bolstered by research which shows that approaches which contribute to the personal continuity of care and the building of trust in the doctor-patient relationship, in turn provide the opportunity for consultation time to be used more productively (Stewart, 1990; Little, 2001; Mechanic, 2001). To this end, the result of the initial investment of time can be seen to have dividends.

Perhaps most remarkable is the results of a large national study of American consultation frequency and lengths, which did not support the view that the length of visits to physicians has declined significantly in recent years --- in fact, both were found to be

increasing (Mechanic, 2001). Nationally representative data from the National Ambulatory Medical Care Survey (NAMCS) of the National Center for Health Statistics and the American Medical Association's Socioeconomic Monitoring System (SMS) was analyzed for the time period of 1989 through 1998. Consultation length and frequency for (prepaid visits) and non-prepaid visits for primary and specialty care were assessed for new and established patients, and for common and serious diagnoses. The average duration of office visits in 1989 was 16.3 minutes according to the NAMCS and 20.4 minutes according to the SMS survey. According to both sets of data, the average duration of visits increased between one and two minutes during 1989 and 1998. Between 1989 and 1998 the number of visits to physicians' offices increased significantly from 677 million to 797 million (Mechanic, 2001).

These results are surprising given the widespread impression that the length of office visits have been decreasing substantially, however, two other data sources present much the same picture. These included research which analyzed visits to primary care physicians between 1978 and 1994 (Stattford, 1999) and in reports that used data from the AMA (Luft, 1999). Unfortunately, similar data for Canadian consultation lengths is not available.

Data on Patient Satisfaction

Adding to the confusion of the 'conflict' between the perceptions and recent research findings of consultation lengths is American data which demonstrates patient satisfaction. A national survey in 1998 reported that most (87%) patients were satisfied with the length of their most recent consultation (Airey, 1999). However an interesting point brought up by Hart, is that satisfaction with any service will be high if expectations are met or exceeded, and such expectations are modified by previous experience (Hart, 1998). In this sense, it can be argued that the result is that primary care patients are likely to be satisfied with what they are used to. In essence, it is possible that patients are reporting 'satisfaction' even though service may be less than optimal.

Qualitative Changes of Time in Medicine

Certain 'external influences' on time in available in the every day practice in medicine that have shifted since Balint's time may include: complexity, patient access to health information and their expectations for their health care providers, and payment schedules for care, among many others. These factors, that remained unidentified at the time of Balint's work, may pose challenges in employing the patient-centered clinical method.

The Committee on Medical Care and Practice of the Ontario Medical Association (1992) has cataloged many of the societal changes that have occurred, and how they challenge the traditional practice of medicine (Table 1). All of these changes give patients the power to become more involved in their health care; however, some of these may create new challenges for doctors. Some of these challenges include the pressure of working in an increasingly litigious environment, operating under current payment schedules, and recent criticisms to the profession such as towards self-regulation.

Table 1: Medicine: The Changing Scene in Canada

Some of the Changes affecting the patient-doctor relationship

- Rise of consumerism in medicine
- Shift of care from hospital to community
- Increased attention to prevention and patient education
- Changing status of women in society
- Emphasis on patient autonomy
- Doctor's role as trustee regarding disability benefits
- Increased awareness of physician's sexual abuse of patients
- Increased hospital liability for doctor's care
- Administrative containment of medical care costs
- Increasingly litigious environment
- Increased use of technology
- Social acceptance of physician-assisted suicide
- Multiculturalism
- Social concerns about woman assault and violence
- Holistic and alternative health movement
- Increased emphasis on informed consent
- Change in status of all profession in society – decline of the role of medicine and expansion in the role of other professionals
- Attacks on professional self-regulation
- The rise of a disabled culture of affirmative action and pride

Source: unpublished report, "Strategic goals: Report on the doctor-patient relationship and doctor-patient communication", prepared by the Ontario Medical Association Committee on Medical Care and Practice, Toronto, Ontario, December 1992 (p.xvii in *Patient-Centered Medicine*, Stewart, 1995)

Although the increasing complexity of a patient-doctor interaction is multi-factorial in its nature, recent discussion has focused on the affect of public's increased accessibility to health information, rising patient' expectations, and the effect of payment models and delivery of health care.

Accessibility to Health Information

The general public's accessibility to health information has vastly improved over the 20th century. The media routinely covers health news, including the latest information published in *JAMA*, the *New England Journal of Medicine*, and other such journals. Major newspapers and television programs have special health sections, and cable television has channels dedicated to health news. The rising trend in CAM use has made consumers health literate, as well as skeptical of conventional approaches to care. The growth of the internet and its accessibility offers the public opportunities to acquire information. Although the internet offers only a small part of the array of health information available, it is shown to be increasingly important (Morrison, 2001). Patients have more questions and conceptions about their care than before, requiring doctors to

spend more time answering questions, comparing treatments, and dealing with misinformation.

Patient Expectations

Patients' expectations of doctors also continue to escalate. Doctors are not only expected to provide high quality medical care but also to deal with psychiatric disorder and substance misuse and to promote health with information on smoking cessation, exercise, nutrition, safe sexual behaviour, and so on. They are expected to have input in health planning in the community and to collaborate more with other professionals and other sectors of the community. Many doctors internalize these goals, attempting to do what they can. All these functions take time, and despite spending more time with patients doctors increasingly experience a conflict between the time needed and the realities of practice.

Payment: Fee for Service

Canadian doctors have been brought under increasing pressure as they try to provide better care and meet patient expectations, while working with system where remuneration is based on number of patients they service (Mass, 1999). The financial structure of fee-for-service medicine creates an incentive to maximize patients seen per unit of time, and decrease the time devoted to in-depth exploration of patients' concerns. It is felt that communication between patients and doctors that are tied to the financial underpinnings of that practice, and ultimately suffer as a consequence (Mass, 1999; Safran 2002). A former British study showed that encounters between primary care practitioners and patients tended to be hurried, and little time was spent communicating information under the fee-for-service model (Balint J, 1996). Interruptions and dominance gestures by physicians commonly cut off patients' concerns (Balint J, 1996). Further, exploration of issues in the social context of medical encounters, which patients experienced as important components of their lived experience of illness, tended to become marginalized in patient-doctor encounters in fee-for-service practices (Balint J, 1996). Patients' dissatisfaction with communication under the fee-for-service system nevertheless continued to rank among their most frequently voiced complaints about US medical practice (Stafford, 1999).

Conclusion

Undoubtedly time impacts every aspect of the physician-patient relationship. Its external influence and its limiting qualities on the therapeutic alliance have created an ultimate challenge in modern day medicine. Although the time-challenge existed in the day of Balint, it appears that the complexity in its usage has increased in more recent times. This calls for a retraining of the doctor; although the pressure of time may never subside, a deeper appreciation of human relationships and moral insight may make for more prepared physicians. I will end with a quote that reflects the importance of developing such an appreciation.

It happens so rarely in life that you have a person who understands what you are up to and openly faces it with you. That is what we can do for our patients, and it is an enormous thing. Michael Balint. 1964.

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EVIDENCE BASED MEDICINE: THE LATEST IN THE “EVOLUTION OF BUREAUCRATIC MEDICINE”

By

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ABSTRACT

While a prisoner himself, Archie Cochrane served as the sole physician to thousands. Ill fed and rampant with infection, Cochrane believed his limited supplies and equipment would result in the death of hundreds of captives. Amazingly, only 1 prisoner perished. Cochrane believed this to be a most telling tale emphasizing the relative unimportance of medical therapy as compared to the recuperative powers of the human body. In a surprising conclusion, he alleged that evidence from randomized controlled trials was essential to inform rational choices. In 1972, he became a pioneer of Evidence Based Medicine by publishing his thoughts.

This story will introduce the history of scientific thinking in medicine and highlight the role of Cochrane. I propose to critically appraise EBM, emphasizing the old and new aspects of the paradigm. Further, I will address how the methodology has attracted the medical community and how it has been misunderstood. The paper will prompt discussion on the future of Evidence Based Medicine.

“Science teaches us to doubt – and in ignorance, to refrain.” Claude Bernard.

Unfortunately, I fear I am not well learned! With this disclaimer, I pursue some thoughts.

Historically, clinical medicine was a science of anecdotal evidence, clinical impression, tradition, and expert opinion. The scientific revolution marked a drastic change in this perspective. While society sought to describe, document and test, previously accepted conclusions, the medical community was open to new ideas, wanted to evaluate information, and began new quests for learning in spite of traditional doctrine. It is not appropriate to outline the evolution of modern thinking at this time, yet it is vital to recognize that many great acts remained ignored for numerous centuries. With regards to the evolution of clinical studies, it is sufficient to note that the first randomized controlled trial (RCT) was not published until 1948 by the British Medical Research Council. Not surprisingly, this was an analysis of the treatment of tuberculosis (1). Subsequently, in ‘Clinical Judgment’, Feinstein called on health care providers to introduce scientific rigor to their own methods of practice (5). He called for clinical scholars to precisely define variables, refine clinical examinations and the taxonomy of signs, symptoms, and investigational findings. Clinical epidemiology derived by applying epidemiological

methodology to study the accuracy of diagnostic tests, and to relate disease prognosis and response of treatment to clinical presentation. Nevertheless, the term evidence-based medicine was not applicable until the 1970's when it was created in the mind of Archie Cochrane.

A charismatic individual, Archie was a brilliant scholar. Born in 1909 of a wealthy Scottish family, he inherited porphyria (8). Despite his riches, he was granted several scholarships early in his academic career. Even though he was interested in biology, he was bored with laboratory work. Fascinated by Freudian theory and plagued by sexual dysfunction, likely the consequence of his illness, he sought and studied psychoanalysis. Under Theodor Reik, a Jewish man, he moved to Vienna and then to Holland. Cochrane found no relief for his problem, but began medical studies and managed to learn German during this time. Disillusioned with Freud, he returned to London to continue his medical career. His studies were interrupted a second time when he volunteered to serve in the Spanish Civil War. Notwithstanding his initial fascination with Marxist ideals, he returned to clinical studies a political left wing, but not a communist. A critical man, he was astonished with the lack of supporting evidence for his clinical training. He was not satisfied to trust anecdotal ancestry. Throughout his life, this disparagement would persist. He was granted his medical degree and joined the Royal Army Medical Corps in 1939. He became a prisoner of war in 1941 and spent 4 years as such in Crete, Greece, and Germany. Because of his fluency in German, he was a perfect chief medical officer. In a Dulag in Salonika, there were over 20,000 prisoners. For a considerable amount of time, Cochrane was the sole medical provider. His equipment included mere aspirin, antacids, and skin antiseptics. The prisoners were fed only 600 calories/day and were left to their own devices to battle diarrhea and epidemics of typhoid, diphtheria, infectious jaundice, and sand-fly fever (14). More than 300 of the prisoners had pitting edema below the knee. Cochrane predicted hundreds to die of circumstance. He found himself frustrated with unmet demands for relief aid. Furious, he wrote the following:

*SuIperfluous Doctors – what a phrase to route
Dulled prison fires to flicker the muse
And build a brave new world. There would be
No famines, wars, or other acts of God
To break the Peace on Earth. No! Man would turn
From wanton killing of his cousins kin
To face his very foes, and Science, Art
With Labour in ally, would fight and kill
Want and its fears, disease, its very roots,
Squalor and filth and loneliness and pain;
And then let doctors quit the center stage
To usher in the prophylactic age.
But death was near and hunger and prisoners' dreams were rare.
The doctor in Salonika sat down and tore his hair (1).*

At the war's conclusion, only 4 prisoners died; 3 of whom had succumbed to gun shot wounds inflicted by the Germans. He was astounded by the human recuperative

capability and his critique for current therapies was reiterated. Later, Cochrane would wonder whether his captors were wise or cruel. His shocking conclusion was that they were certainly right! In his journals, Cochrane stated, "I would have willingly sacrificed all my medical freedom for some hard evidence telling me when to do a pneumothorax."(1).

During this time, Cochrane made an astounding leap in research. Suspecting the edema was a result of vitamin B deficiency, he tested his hypothesis by supplementing one ward with yeast, which he managed to smuggle in with his own money. He was right. After presenting the information to the Germans, he was rewarded with large amounts of yeast and the endemic dissipated. He later referred to it as his "first, worst, and most successful trial"(8). He then became involved with the care of prisoners with tuberculosis. He was again reminded of the lack of supportive evidence. He determined that randomized controlled clinical trials were essential for effective management of patients.

Cochrane was knighted for his services in the war and returned an epidemiologist. Receiving a Rockefeller fellowship in preventative medicine he was taught statistics by Bradford Hill and later studied the reliability and prognostic validity of chest x-rays in tuberculosis. Soon after, Cochrane's career as an epidemiological researcher was begun. Having been recruited to work with the Medical Research Council Pneumoconiosis Research Unit, he became fascinated with the progression of the disease. He sought to study two adjacent coal-mining valleys. The minors in both valleys were screened and treated. One town became the control while the whole population of the other town was screened, isolated and treated. This may have been the first study of a population in a controlled setting (8). The response rate was close to 100%, but the study was a flop. In 1969, he was asked to direct a new MRC Unit and was invited to write a book about evaluating the NHS (National Health Service).

In 1972 he published his thoughts, "Effectiveness and Efficiency; Random Reflections on Health Services". It was this book that would make him a leader in the development of evidence-based medicine. In his introduction we learn that after considerable deliberations, he wrote his slogan to be, "all effective treatment must be free." Even though he was cited by a friend as having 'Trotskyite tendencies', Cochrane persisted and hoped that his "sentimentality" had not clouded his judgment (1). It followed that to analyze the cost effectiveness of any prevention, treatment, or diagnosis, two components were necessary; that was, the efficacy, "to measure the effect of a particular medical action in altering the natural history of a particular disease for the better," (1), and the efficiency, "the benefit measurements at two levels of cost in the community...the optimum use of personnel and materials in achieving these results...the problems of treatment...of screening, diagnosis, place of treatment and length of stay, and, if necessary, rehabilitation." Further, Cochrane felt he needed another index to "add a little humanity to my approach...returning to my early enthusiasm for the idea...I soon discovered what I wanted: equality" (1). It is with these goals that Cochrane wrote the internationally cited reference.

While he suggested his passion derived from the social injustices he witnessed in the 1930's, he remained a critical social scientist at heart, concluding his introduction: "Such is my background. It is clearly one likely to breed bias when dealing with medical treatment and medical care...In particular, I believe that cure is rare while the need for care is widespread, and that the pursuit of cure at all costs may restrict the supply of care, but the bias has at least been declared." The remainder of his life was spent in the hopes of exposing his thoughts. He continued his research pursuits and traveled widely. In the end, "My colleagues, in their devotion to their patients, evoke my admiration, but also remind me of Agatha in Eliot's 'The Family Reunion', who wanted action not for the good that it will do but that nothing may be left undone on the margin of the impossible. I hope clinicians in the future will abandon the pursuit of the 'margin of the impossible' and settle for 'reasonable probability'. There is a whole rational service to gain"(1). He died in 1988 at the seasoned age of 79 but leaves us with a collaborative network, the Cochrane Library. He wrote his own obituary, "He was a man with severe porphyria who smoked too much and was without consolation of a wife, a religious belief, or a merit award – but he didn't do so badly." (3)

Cochrane's words would be a legacy and, true to his reputation, many parties would be required to ensure its survival (3). Three main tasks would be necessary. Primarily, the quality of studies must be high. Further, this evidence must be available and appropriately utilized by clinical care providers. Cochrane's stringent methodological concern and his theme of efficacy continued to grasp attention through David Sackett at McMaster University. Defining EBM, Sackett stated that it is the conscientious, explicit, and judicious use of current evidence in making decisions about the care of individual patients (13). He continued the pursuit by implementing a series of seminars to encourage the development of a means to evaluate health interventions, emphasizing the use of RCT's, to improve the effectiveness of the newly created national Medicare program in Canada. He felt that a good term must possess consistency, reality, and utility (12). Indeed, considerable effort was directed towards documenting these essentials, establishing internal and external validity. Also initiated by Sackett, with his colleague Brian Haynes, the emphasis was transferred to the implementation into physician training and practice, to encourage appropriate critical appraisal and application to clinical practice. Accordingly, it was crucial to ensure that this evidence be accessible. Iain Chalmers, who worked with Cochrane in the 1970's, assumed this task. In an essay published in 1979, Cochrane had cited obstetricians to be the least likely to implement randomized trials or to practice medicine based on evidence from those trials (2). Being an obstetrician, Chalmers was both challenged and taken by Cochrane's ideas. He became the first to develop a collaborative database when he created an electronic collection of RCT's in obstetrics and prenatal care (4). Recognizing the selection bias of non-randomized trials, he sought to include only those trials which were formally randomized or quasi-randomized (medical number, date of birth, or alternation). The only other exclusive principle was that the topic be relevant. His goals were to provide clinicians access to the best evidence available and to provide researchers with an accurate and current state of knowledge. Despite its limitations, his goal has remained noble. The Cochrane Collaboration was thus formed. Evidence-based medicine has had a parallel development. It continues to prepare, maintain, and disseminate up-to-date

reviews of RCT's of health care (8). Albeit a new paradigm, the methodology behind EBM has been long standing.

Louis undertook the first formal evaluation of medical treatment interventions using statistics (9). “The guiding model of his life was “*Ars medica tota in observationibus*”, that is, to carefully observe facts, carefully collate them, and carefully analyze them. To get accurate knowledge of any disease it is necessary to study a large series of cases and to go into all the particulars – the conditions under which it is met, the subjects specially liable, the various symptoms, the pathological changes, the effects of drugs. This method, so simple, so self-evident, we owe largely to Louis” (10). A pioneer in clinical epidemiology, his work was quickly drowned out by the achievements in biomedical science and did not gain notice until 200 years later. In the 17th century, a Flemish physician, Jean Baptiste Van Hellemond, refuted blood letting as a means of treatment and challenged his colleagues to “therapeutic competitions.” Chalmers suggests the methods applied were indicative of a “fair test of alternative therapy, generating comparable groups using lottery or alternation” (15). The winner would be the physician with the least funerals. Unfortunately, there is no data to suggest the confrontations ensued. In the mid 1800's, we see another example of randomization. Thomas Graham Balfour randomly allotted 150 boys to 2 groups. His only inclusion criteria was that he had tolerably satisfactory evidence that the boys did not have scarlet fever at the studies onset. He granted the treatment group belladonna (atropine), and the control group nothing. The disease affected 2 boys from each group. Balfour's amazing insight was that the study sample was too small to draw conclusions. A placebo was successfully used in a trial in 1918 by Adolph Bingle. He tested activated anti-diphtheria serum against non-activated serum. Despite these incredible feats in the evolution of evidence-based medicine, the advancement of medicine as a science had cast a shadow over the scientific study of clinical care itself (9). As with most professions, we seem to have masked our own progress.

Nonetheless, the practice and implementation of EBM continues to be controversial. In the *Lancet*, Peckham suggested that EBM is “an internal threat to the autonomy of the physician” (11). It is not surprising that it has been seen to be a science of politics, cost-effective management, and a denial of clinical expertise. Feinstein and Horwitz have suggested that it is a “new form of dogmatic authoritarianism” (6). Based on the cost-effective and equal application of efficacious treatment, this theorem of clinical practice is undoubtedly appropriate. In today's environment of fiscal restraint, it is understandable that administrators have taken hold of this evidence. It has become a means by which to establish practice guidelines in a growing public sector and to justify escalating costs. Following years of individualized training, physicians balk at the idea of algorithms. In an attempt to remove individual bias, researchers aim to demonstrate the most effective way to manage illness, alleviating both the fears of the patient and the individual judgment of the clinician (7). Still, the research environment differs significantly from the real world. Whilst patient compliance has been demonstrated to be extremely poor in reality, it is vital to the success of clinical trials. Perhaps, however, we can understand a treatments true efficacy on a societal level. “Compliant patients have a remarkable ability to sense what is wanted of them” Anonymous. The research

environment is also deemed to be “pure,” falsifying the realities of life. Additionally, peer reviews may be faulted in their own social biases. Chalmers has claimed that post-war Germany published negative trials in German and positive trials in English (15). Fairness in recruitment, informed, and voluntary consent are certainly philosophical ideals. Clinicians are concerned with the idea of quantifying the quality of life. There is little doubt that patient care differs from probability-based analysis and population-based data. The question remains, Will this person benefit? The problem lies in the uncertainty of probabilities. As Stephen Hawking so eloquently stated, "In effect, we have redefined the task of science to be the discovery of laws that will enable us to predict events up to the limits set by the principle of uncertainty." While physics and health care may seem diverse, they abide by the same laws. The art of medicine persists in the cultured ability to discern likely benefit for a patient.

EBM may be neither innovative nor perfect, but its goals are surely righteous. Its role in the future is expectant and defensible. But, how worrying is it that policy makers and management have taken hold of such a foreign language? Exclusive of the limitations of efficacy data, are there differences in the attitudes to medical diagnosis and clinical judgment by the patient, the physician, and the payer? If guidelines are indeed valid, are they justified? In the hope that the quest for knowledge prevails, I abide by academics and trust that guidelines are just that, guidelines and not rigid algorithms.

I leave the reader with this: If the placebo has been demonstrated to be both efficacious and efficient – why is it not being utilized? Does it satisfy Cochrane's principle of equality?

And a further disclaimer,

“This paper isn’t even good enough to be wrong!” Wolfgang Pauli

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PHYSICIANS AS ADVOCATES IN APARTHEID SOUTH AFRICA: COMPLACENCY OR CONSTRAINT

By

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ABSTRACT

From 1948 until free elections in 1994, non-white South Africans faced a legalized system of racism, oppression, exploitation, and deprivation known as apartheid. With separate areas for living, working, education and even receiving health care, the government policies and blatant signs proclaiming “WHITES ONLY” penetrated all facets of their lives. The basic determinants of health such as adequate shelter, sanitation, education, equality and political freedom were deprived from the portion of the population (83%) falling into the “black”, “coloured” or “Indian” labels assigned by the government.

There are a number of documented cases of physicians acting unethically, performing such tasks as certifying a prisoner fit for torture or overlooking gross human rights abuses. There are many more examples of doctors being complacent with the apartheid government, choosing not to be involved in these non-medical issues. There are also examples of physicians who stood up for their patient’s rights and suffered the consequences of an oppressive regime.

Many believe that individual physicians and medical institutions such as the Medical Association of South Africa and the South African Medical and Dental Council should have taken a stronger role in advocating for their patient’s basic human rights. Were physicians constrained by the threat of professional and societal backlash or should they have taken a bigger role in advocating for their patients? Should physicians be involved in these “political” or “subjective” issues or should they work only within their biomedical training? These questions are not only relevant to apartheid South Africa, but to many situations today in Canada and around the world.

“WHITES ONLY”. This message permeated the lives of non-white South African citizens during the period known as apartheid, not only on placards, but also in government policies that resulted in the oppression of a majority of South African society. This paper will explore how these policies affected the health of individuals not of European descent and will examine the response of physicians to the injustices and human rights abuses that occurred during this dark period of South African history. It

will also discuss the responsibility of physicians to work outside of the biomedical model, advocate for their patient's fundamental human rights and to improve all determinants of health.

Apartheid Policies

While non-Europeans did not have equal rights before apartheid policies were implemented, it was not until the election of D.F. Malan and the National Party in 1948 that this discrimination became so widespread and institutionalized (Deegan 2001, SADJ 1998). Soon after his appointment as Minister of Native Affairs in 1950, Dr. H.F. Verwoerd began to institute the policies that came to represent the National Party's ideology of *aparte ontwikkeling*, or separate development (Davenport and Saunders 2000).

On the surface, these policies claimed to allow the separate development of different races in their own geographical areas. Dr. Verwoerd expressed this idea in his first major speech in the senate: "South Africa is white man's country and he must remain the master here. In the reserves we are prepared to allow the Natives to be the masters, we are not masters there. But within the European areas, we, the white people in South Africa, are and shall remain the masters" (Harvey 2001). In practice, the nationalist government retained control over all facets of South African society exploiting non-white citizens for the gain of the minority white population.

Many laws were implemented to propagate the aims of apartheid. The Population Registration Act of 1950 lay the foundation for discrimination by race requiring all people to be classified as either "white," "coloured," "Indian" (Asian) or "black." The Group Areas Act allowed the government to declare certain geographical areas for the exclusive use by a particular race and to require citizens to live only in areas designated for their racial group. Many other acts under the guise of public safety, anti-communism and security enabled the government to arbitrarily detain people, ban organizations, prohibit public gatherings and protests, and require Africans to carry pass books outlining their employment, places of origin, tax payments and encounters with police (Deegan 2001, SADJ 1998).

***Table 1: Land, income and population distribution in South Africa, 1980
(WHO 1983)***

	White (%)	African, coloured and Asian
Population	17	83
Land	82	18
Personal Disposable Income	74	26

The apartheid policies resulted in the proliferation of existing inequalities giving the majority of resources to the minority white population as can be seen in

Table 1. With a minority ruling, the state had to use ruthless methods to suppress the protests and unrest that inevitably occurred. The laws discussed above gave authorities the legal right to act against individuals and organizations whose activities the government described as “furthering the aims of communism”, “terrorism”, “endangering the security of the State or the maintenance of order”, “endangering the public peace” or “threatening essential services”. The definitions of these terms were very open so that they could be used to suppress any opposition to the apartheid regime (IDAFSA 1983). The arbitrary detentions mentioned earlier were widespread with many reports of torture and even the death of detainees (SADJ 1998, IDAFSA 1983). Police violence also occurred “in the execution of their duties”, such as breaking up protests with batons, tear gas, whips, dogs and guns. A total of 946 African and coloured individuals were killed and 2558 injured between 1974 and 1979 alone during these “duties” (IDAFSA 1983).

Health Effects of Apartheid Policies

It has been recognized for many years that health is affected by many determinants including peace, shelter, education, food, income, social justice, equality, socio-economic status, social cohesion and others (WHO 1986, Marmot and Wilkinson 1999). The apartheid policies resulted in the majority of the South Africa population being deprived of many of these fundamental determinants of health (SADJ 1998, Davenport and Saunders 2000, IDAFSA 1983).

While few health statistics were gathered for the African population, those that were collected are indicative of the level of inequality that existed. Life expectancy for Africans was much less than that for whites with an average for whites of 68.4 and 52.4 for Africans in the late sixties. Infant mortality shows the same trend with 14.9 deaths per 1000 live white births compared to 100-110 deaths per 1000 live African births (Seedat 1984).

Over the course of the early twentieth century, many developed nations went through an epidemiological transition, with causes of mortality and morbidity changing from infectious to more chronic diseases (Phillips and Verhasselt 1994). In South Africa, the white population went through this transition while the African population did not, again highlighting the effects of apartheid policies on propagating health inequalities. In 1976 the primary cause of death for whites was ischemic heart and cerebrovascular diseases while for Africans, pneumonia, enteritis and other diarrhoeal diseases remained as the main causes of mortality (Seedat 1984).

Not only were the determinants of health withheld, but the provision of health care was also severely inadequate for the African population with much less being spent per capita on African health. The doctor to patient ratio for whites was 1:330 compared to an estimated 1:91,000 for Africans. It was also estimated that during the mid seventies only 7% of physicians were African due to severe restrictions on education and practice for non-whites (Seedat 1984).

All of the above factors compounded to adversely affect the health of non-white citizens. The vast differences in health statistics is no surprise when physical conditions such as overcrowding, inadequate sanitation, limited farming possibilities, occupational hazards and low pay are considered. Social conditions such as the lack of any political rights, gross societal inequalities, inadequate educational opportunities and worker migration resulting in the breakdown of social relationship also contributed to these disparities in health (de Beer 1984).

Physicians and Apartheid

The majority of medical schools in South Africa required physicians to take the Hippocratic Oath or the modern equivalent, the Declaration of Geneva, which gives physicians the responsibility of doing no harm and maintaining respect for human life (SADJ 1998). There were physicians practicing in South Africa during apartheid that both upheld and grossly neglected these fundamental medical responsibilities. While it is easy to lay blame on individuals acting unethically, the societal, political and organizational influences on these individuals must also be examined. As will be shown in the cases below, acting ethically and opposing the government often resulted in severe repercussions.

Complacent Physicians

While there are few examples of physicians actively participating in gross human rights violations, there are many examples of complacency and inadequate care. Many of these ethical breaches came from district surgeons, whose responsibility it was to provide medical care for prisoners and detainees, to keep records on their physical and mental health and to ensure that basic sanitation, food and general health care was adequate. Unfortunately, these responsibilities were often in conflict with the pressure they felt from security officials to support the police and prison officials for “national security” reasons (SADJ 1998).

The most widely known case of negligence was the death of Stephen Biko while in detainment. After a short time as a medical student at the University of Natal, Biko turned to anti-apartheid political action forming the South African Student's Organization, becoming honorary president of the Black People's Convention and a leader of South Africa's Black Consciousness movement. As a result of these activities, he was “banned” by the government. This order, among other things, prevented an individual from being in the presence of more than two people at one time, prohibits the publication or dissemination of anything the individual writes or says and limits them to a particular geographic area (Arnold 1978).

The events surrounding Mr. Biko's death were revealed during the official inquest of his death in 1977 and much later during the Truth and Reconciliation Commission (TRC) hearings in the mid nineties (SADJ 1998, Arnold 1978). Biko was arrested for the last time on August 18, 1977 for breaking the terms of his banning order by leaving his hometown. The security police alleged at the time that he was travelling to disseminate

“inflammatory pamphlets...inciting blacks to cause riots.” On the day following his arrest, he was moved to Port Elizabeth where he remained until September 11, the day before he died.

He was apparently in good health before his arrest and remained so until September 5. Police later testified that during interrogation on September 7, a violent outbreak occurred and with a “wild expression in his eyes,” Biko assaulted the officers. They stated that in restraining him, he might have hit his head.

Two hours later, the district surgeon, Dr. Lang, arrived and examined Biko after being told that he was unresponsive. Dr. Lang and two other physicians that subsequently examined him initially ignored obvious signs of neurological injury. They also failed to advocate for more humanitarian conditions than his current state of lying naked on a mat manacled to a metal grille. After his condition deteriorated, another physician was consulted and a lumbar puncture was performed. The puncture revealed blood in the cerebrospinal fluid, indicating a possible brain injury, but was reported as being normal and Biko was sent back to his cell.

The final omission by physicians was when they allowed police officials to transport Biko 1200 km to Pretoria on September 11. Despite the obvious signs of injury and fragile state, Biko was shipped naked in the back of a land rover without a physician or his medical records and died the next day on the floor of a Pretoria prison cell. The autopsy, performed by a series of highly qualified pathologists, found brain damage and necrosis, extensive head trauma, disseminated intravascular coagulation, renal failure and various external injuries.

After the official inquiry into Biko’s death, the matter of professional misconduct on the part of the physicians was passed on to the South African Medical and Dental Council (SAMDC). The preliminary inquiry, two and half years later, found no misconduct by the physicians and despite outcries both locally and internationally, the Medical Association of South Africa (MASA) supported this decision.

As mentioned above, during these inquiries, there was outrage and disagreement with the SAMDC and MASA. There was, however, a concerted effort by the executive of MASA to suppress many of the letters and comments submitted to the South African Medical Journal (SAMJ). An anonymous editorial was even written in the SAMJ in 1980 implying that those objecting to MASA and SAMDC action on the case were being emotional and that their professional objectivity was being “clouded to some extent by subjective or political issues” (Anonymous 1980). It was only in 1997 after the end of apartheid, that many unpublished letters regarding Mr. Biko were published by the SAMJ. The multitude of letters of condemnation showed the full scope of backlash against MASA by physicians around the country (Ncaylyana 1997).

It took the dedication of six physicians over many years to finally have the SAMDC decision overturned by the Supreme Court. In 1985, eight years after Stephen Biko’s death, two of the physicians involved in his care were found guilty of improper conduct

with one of the doctor's name being struck off the role of medical practitioners and another being suspended for three months (SADJ 1998).

The Biko case serves as a useful prototype for the action of physicians in South Africa during apartheid. There were a number of individuals who supported the government policies and for whom the interests of the state took precedence over their patient's health. As will be shown later, there were also physicians who vehemently resisted the unethical conduct of their peers and actively opposed the policies of the apartheid regime.

During the TRC hearings, other incidents of negligence by district surgeons were reported. Many involved the inadequate care of obvious injuries such as declining to refer a detainee to hospital who had three gunshot injuries in his groin because the physician believed it was more important for the detainee to be questioned by police. A district surgeon was even allegedly asked by police if a detainee was fit to undergo further electric shock torture (SADJ 1998).

A final illustration of negligence is the case of Ms. Elda Bani, an insulin-dependent diabetic who died while in custody. Ms. Bani initially treated herself with insulin she had brought to the prison. However, when her supply ran out, she received no treatment from the district surgeon and was made to eat meals at inappropriate times. At one point her cellmates noticed that she had become incontinent. She was taken from her cell, her cellmates assumed to hospital. However, when she returned she reported to them that she had instead been beaten by police, a claim supported by the blood on her clothes. Ms. Bani's condition inevitably deteriorated and she soon fell into a hypoglycaemic coma and subsequently died from her entirely treatable condition.

The above cases indicate the vastly unethical conduct of a small number of South African physicians. Perhaps the bigger injustice came from the multitudes who did not commit human rights violations, but furthered the aims of apartheid by remaining silent while their patients were oppressed and their health threatened.

Physicians Who Resisted

While the above highlights physicians who were complacent or negligent, there were many South African physicians who resisted the apartheid regime, often at a risk to their careers, relationships and personal safety.

Dr. Raymond Hoffenberg was a well-respected lecturer and researcher at the University of Cape Town in the fifties and sixties. He was an outspoken critic of apartheid and became the chairman of the National Union of South African Students, a multi-racial and vocal anti-government organization. As a result of these activities, he was banned in 1967 preventing him from teaching or publishing anything, medical or otherwise. He received little support from the university administration, subsequently left the country and became the president of the Royal College of Physicians of London (ANC n.d.).

Dr. Wendy Orr, after recording 286 cases where detainees had complained of assault during police interrogations, launched an application with the Port Elizabeth Supreme Court to issue an interdict restraining police from assaulting detainees. This action was granted by the court, but only at a cost to Dr. Orr. She was banned from seeing further detainees, her telephone calls were monitored, and her duties as a district surgeon became virtually nonexistent (SADJ 1998). Both Dr. Orr's case and that of Dr. Hoffenberg demonstrate the danger of resisting the apartheid regime and what might have prevented other physicians from taking a stand.

There was also opposition to and action against the apartheid regime from physicians on a larger level. During and following the inquiry into Stephen Biko's death, as mentioned earlier, many physicians were unhappy with MASA's handling of the case. For this reason, because of the "devastating effects of apartheid on health and human rights" and because of "the failure of existing medical organizations to respond cogently to these issues," a group of progressive physicians formed an alternative medical association, the National Medical and Dental Association (NAMDA). This organization sought to attain the highest level of health for all South Africans and its members were often harassed for opposing apartheid policies (SADJ 1998, SADJ 1997).

Complacency or Constraint

The examples given above demonstrate physicians who advocated for their patient's human rights, sometimes at a severe risk. They also highlight the complacency and sometimes gross human rights abuses perpetrated by other health professionals. One of the arguments presented at the time for not becoming involved in anti-apartheid activities was that physicians should avoid "subjective" and political issues and work within the biomedical model for which they were trained.

As de Beer (1984) points out, "The barriers that have been erected between health and politics are artificial. They must be broken down before we can even begin to think what a healthy society might look like." Since the recognized determinants of health are affected directly by government policies, change in those policies is required to improve the health of the population.

While the oppression and brutality of the apartheid regime likely prevented many anti-apartheid advocates from speaking out, the results of this complacency highlight the importance of advocating for our patients in all areas of society.

While the injustices of apartheid are in the past, the lessons that emerged, primarily after South African free elections in 1994, are just as relevant today. In Canada and around the world, there are many populations whose health is adversely affected by government policies or other determinants not usually falling into the biomedical sphere.

Many issues affect the health of Canadians such as the marginalization of First Nations and the growing gap between rich and poor. Also in our society, political and corporate institutions influence health practitioners, our environment is deteriorating, and sexual

abuse by physicians still occurs. All of these problems greatly affect the health of Canadians, though the majority are not addressed by physicians.

Internationally, there exist many issues that adversely affect the health of large portions of the world's population. International conflicts and injustices such as those in Iraq, Cuba, the Democratic Republic of the Congo, Kashmir and Chechnya are widespread. The gap between western countries and the global south is increasing and populations such as Kurds, Israeli/Palestinian, Maori and others are being marginalized. Threats such as these affected the determinants of health of the South African population during apartheid and now jeopardize the health of billions of people throughout the world.

As physicians we pledge to do no harm, but if we are to significantly improve the health of populations in Canada and around the world, we must examine all of the determinants of health. The lessons of apartheid South Africa demonstrate the vast effects that government policy can have on health. The health model that currently exists in the majority of the world gives the medical profession the responsibility of understanding and addressing health and illness. If physicians are not able to engage political issues in order to advocate for their patient's health, who is?

“The only thing necessary for evil to flourish is for good men [sic] to do nothing”
- Sir Edmund Burke

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ERECTILE DYSFUNCTION: A HISTORICAL REVIEW

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ABSTRACT

Sex for pleasure is a feature of copulation that has evolved, perhaps exclusively, in humans. For this reason, we have spent centuries developing novel ways to maintain an erection for prolonged periods of time. Erectile dysfunction (ED), traditionally referred to as impotence, describes the inability of a male to attain and maintain an erection adequate for sexual intercourse. Many folklores and myths have been used historically to explain this condition, and throughout time, we have developed a plethora of potions, ointments and procedures to treat it.

It seems to have all started in 8th century BCE with Samhita Sushruta, an ancient Indian healer, who's many oral and topical remedies for ED claim to enable any man to 'visit a hundred women.' Hippocrates also dedicated some time to this condition and described impotence as an imbalance between the four humours of the body. During the Middle Ages, witchcraft was blamed and methods of violence were implemented to restore male potency. The Victorian Era believed that ED was the result of insufficient self-control and sexual overindulgence. Anti-masturbatory devices were thus used to inhibit such forms of sexual misconduct.

The dawn of science and use of empirical knowledge has contributed greatly to our understanding of the pathophysiology of ED. In 1489, Leonardo da Vinci was the first to explain erections as an increased flow of blood to the penis, rather than air as Hippocrates believed. Since then, many unique methods of treating ED have been investigated. For example, in 1918, Serge Voronoff transplanted ape testicles into a male scrotum, claiming to have observed a physical and mental rejuvenation in his patients, and in their pants. Currently, those suffering from ED have both medical and surgical treatment options. Perhaps with the recent discovery of Viagra, mankind's quest for eternal erections has ended.

Introduction

Many people believe that erectile dysfunction is a modern curse to man. However, man's preoccupation with potency or lack thereof, has been passed down from generation to generation for centuries. Erectile dysfunction, traditionally referred to as impotence, describes the inability of a male to obtain and maintain an erection adequate for sexual

intercourse (NIH Consensus Conference, 1993). This review will use the term impotence because historically it is the term found in the literature.

Sex for pleasure is a feature of copulation that has evolved, perhaps exclusively, in humans. For this reason, we have spent centuries developing novel ways to maintain an erection for prolonged periods of time. Historically, ancient folklores and myths have been used to explain and treat impotence with only recent contributions from modern day science and technology. It is therefore not surprising that we have developed a plethora of treatment options throughout time; ranging from potions and ointments to medicinal and surgical interventions.

Impotence in Ancient Times

It seems to have all started in 8th century BCE with the Samhita of Sushruta. This ancient Hindu text is the oldest reference to impotence and suggests at least four causes of this condition: voluntary, congenital, praecox and diseases of the genital organs. Many interesting remedies were recommended within the Samhita:

“Powders of sesame, Masha pulse, and S’ail rice should be mixed with Saindhava salt and pasted with a copious quantity of the expressed juice of the sugar cane. It should then be mixed with hog’s lard and cooked with clarified butter. By using this Utkarika a man would be able to visit a hundred women” (Bhishagratna, 1963).

Traditional Chinese medicine is strongly based on the concepts of Yin (negative, dark and feminine) and Yang (positive, bright and masculine). An imbalance between these two opposing but complementary sides of nature is thought to be the cause of disease among the ancient Chinese. It is believed that the life providing power of Yin declines significantly with age, and therefore, a 60 year old man was expected to be impotent (Ebrey, 1993). The Huang-Ti Nei-Ching (The Yellow Emperor’s Classic of Internal Medicine) discusses the philosophy of impotence during the Yellow Emperor’s (Huang-Ti) rule from 2697 to 2595 BCE. This text also describes a potion with 22 ingredients that the emperor drank himself, allowing him to ‘mount 1200 women and achieve immortality’ (Shah, 2002).

Hippocrates devoted a considerable amount of time to the topic of impotence. In his readings, impotence can result from an imbalance between the four humours of the body (i.e. blood, phlegm, yellow bile and black bile) and the four elements (i.e. earth, water, wind and fire). Hippocrates believed that sexual excess could lead to such an imbalance and ultimately to a loss of potency; a theme that has been considered many times over the last 2000 years. He also believed that an erection was caused by an increased flow of air to the penis, facilitated by fine erectile cords connecting the testes to the penis (Carson et al., 1999).

By the Middle Ages, and for many years thereafter, witchery was thought to be the cause of impotence. Known as a magic ligature, a witch could cast this spell on a groom by

tying a knot into a ring with a cord of leather. The witch would then hide the magic knot and the impotence would last until the knot was found. More interestingly, it was believed that the groom could counter the curse by urinating through the wedding ring the night before the wedding (Robbins, 1960).

New theorems regarding the cause of impotence continued to pop up throughout the centuries. Authorities during the Victorian Era claimed that impotence was a male disorder due to insufficient self-control and sexual misconduct. The high incidence of impotence at this time was attributed to the voluntary loss of semen through the abuse and over-indulgence of masturbation. Pamphlets were thus distributed telling parents to warn their sons not to practice this evil act. Several unique treatments were subsequently practiced during this era, including quinine, opium, digitalis, and sponging the genitals with cold salt water at 5 o'clock in the morning (Milton, 1854). Prevention, it seems, was the primary form of treatment during this era.

Until knowledge of the anatomy, physiology and pathology of impotence were discovered the general attitude of the public and the medical profession was eloquently summarized by Nicholas Vennette. He stated that, "If a woman's hand, which is the best of all remedies, is not good enough to cure the flabbiness of a man's penis, the other remedies will do little" (Vennette, 1984).

Aphrodisiacs

The word aphrodisiac is derived from Aphrodite, the Greek goddess of love, and these foods have been consumed for thousands of years in an attempt to increase libido. There are many explanations as to why some foods have evolved as aphrodisiacs, while others have not. In some cultures, mis-translations and linguistic origins resulted in the belief that some foods had aphrodisiac properties. For example, vanilla is the diminutive of the Latin term vagina and is considered to be a very powerful aphrodisiac. On the other hand, chilies and spicy foods evoke the similar physical response to sexual intercourse (i.e. sweating, burning and distraction), and have therefore been adopted as aphrodisiacs (Ratsch, 1997). Others believe that some foods hold aphrodisiac properties because of their physical resemblance to the genital organs. For example, seeds, oysters and rhinoceros horns have all been consumed as aphrodisiacs because of their similar resemblance to semen, the vagina and the penis, respectively. Interestingly, the Doctrine of Signatures during the time of the Saxons states that 'every plant that is of use to man has been marked by God in a way that reveals its intended use' (Taberner, 1985).

The aphrodisiacs consumed in the past stems from the belief that organotherapy was a reasonable cure for impotence. Thus, the Romans consumed the sexual organs of virile animals, such as rabbit or dried tiger penises. They also consumed the hormonal secretions of animals: 'The semen of virile young men should be mixed with the excrement of hawks or eagles and taken in pellet form'. Likewise, the ancient Chinese consumed the blood and penises of deer, a delicacy even today (Taberner, 1985).

Scientific Contributions to Impotence

Much of our understanding about impotence today spawns from the scientific and medical discoveries made during the last few centuries. During the Renaissance, Leonardo da Vinci challenged Hippocrates' work and proposed that erections were generated from an increased flow of blood to the penis, not air. He validated this claim by cutting the penises off of men executed by hanging who developed reflex erections (Van Driel et al, 1994). Later, in 1668, Reiner de Graaf demonstrated that an erection could be produce by injecting saline into the hypogastric artery of a cadaver (Belt, 1965). Furthermore, in 1863, Eckhard elicited an erection in a canine model by applying electrical stimulation to the pelvic nerves (nervi erigentes). This finding led him to believe that erections were in fact a neurovascular phenomenon, and speculated that the autonomic nerve fibres stimulated in the pelvis supplied vasodilator fibres to the penis (Eckhard, 1863).

During the 19th century, many people believed that endocrinology held a crucial role in the development of impotence. The relationship between the testes, male behaviour and potency had already been considered by the Sushruta of Samhita, which advocated the ingestion of testicular tissue as a possible treatment for impotence (Bhishagratna, 1963). In 1889, the French neurologist Charles Edouard Brown-Séquard went one step further. At the age of 72, he injected himself with an extract from the testicles of dogs and guinea pigs, and reported a rejuvenation of his physical and mental abilities, a better stream of urine and the relief of constipation (Brown-Séquard, 1889). This elixir of life was subsequently administered by over 12 000 physicians by the end of 1889 and introduced the idea of androgen therapy to modern medicine. The most alarming procedure that considered endocrinology as a possible cause of impotence came from the Russian, Serge Voronoff. In 1918, he performed transplantations of testicular grafts from apes directly into human testes in an attempt to restore youth to aging men. However, despite the initial claims of success, these testicular transplantations did not cure impotence nor did it serve as a 'fountain of youth' (Voronoff, 1925). Several other physicians, including Victor Lespinasse and Leo Stanley, also performed this organotherapy procedure and reported positive but transient improvements in impotence (Shah, 2002).

These most recent experiments illustrated the benefits of organotherapy and, to no surprise, the pharmaceutical industry was quick in trying to isolate the active agent responsible for these effects. In 1931, Butenandt analyzed over 25 000 litres of policeman's urine and successfully isolated 15mg of androsterone. This important medical advance was quickly followed by the artificial synthesis of testosterone from cholesterol by Ruzicka in 1935 (Shah, 2002). In 1939, both men were awarded the Nobel Prize in chemistry for their work, spawning a new era in the development and consumption of anabolic-steroids.

Surgical Therapies for Impotence

Surgical treatments for impotence have been available since the beginning of the 20th century. In 1908, Frank Lydston performed over 100 dorsal vein ligation procedures with

a 53% cure rate in treating impotence. The success of this procedure was attributed to the mechanical obstruction of venous outflow from the penis (Lydston, 1908).

Since then many other surgical procedures have been formulated and practiced, but of greatest importance was the first penile implant performed by Nicholai Bogoras. In 1936, he used rib cartilage to restore penile rigidity adequate for micturition and sexual intercourse in patients who had suffered penile amputations. Unfortunately, the implant was reabsorbed several months post-operatively, and the search for an appropriate synthetic material began (Jonas, 2001). Currently, many patients with organic impotence are offered prosthetic implants for treatment, with two main types available. The first type is a malleable implant, which originally consisted of two silicone rod prostheses designed by Small and Carrion in 1973 (Wilson and Delk, 2000). The mechanical rigidity of this device meant that the patient had a permanent erection. To avoid this problem, most recently designed malleable implants allow the patient to bring the penis into an erect position and bend it back into the flaccid position. The second form of implantable prostheses is inflatable implants. These devices are preferred by most patients because of their improved cosmetic appearance. With two silicone cylinders implanted into the corpora cavernosa, the patient can voluntarily fill the cylinders with fluid stored in a reservoir, located behind the rectus, with a pump implanted in the scrotum (Jonas, 2001).

Other Therapies

Vacuum devices are commonly used to treat impotence, and have been since the first prototype was made in the mid 1970's. These devices use negative pressure to increase corporeal blood flow to the penis. A constriction ring is then worn at the base of the penis to restrict venous drainage, resulting in a prolonged erection. Unfortunately, due to the decreased blood flow to the penis, it may become cold, numb and cyanotic (Oakley and Moore, 1998).

Vascular surgery is also an option and includes arterial revascularization and venous ligation. However, careful patient selection is necessary for these procedures and long-term improvement is inconsistent. Some patients can be treated with intracavernosal therapies, which are accomplished by injecting alprostadil, a naturally occurring prostaglandin E1, into the corpora cavernosa. This causes the penile smooth muscles to relax and induces an erection. Alprostadil can also be administered intraurethraly in a pellet form (Jonas, 2001).

Oral Therapies

The first oral agent marketed for impotence was discovered accidentally in 1994 during a clinical trial investigating the use of sildenafil for the treatment of angina. While this drug was unsuccessful in treating angina, study patients experienced better erectile function. In 1998, the FDA approved sildenafil (Viagra) as the first oral anti-impotence drug (Stief and Krane, 2001). Due to the success of sildenafil, the race is now on for pharmaceutical companies to develop a new oral therapy for impotence with a faster

onset of erection and fewer adverse effects which can be made available to all patients. To date, three other agents have been developed for this purpose: apomorphine, vardenafil and tadalafil. Oral pharmacotherapy is now well established for the treatment of impotence and is currently recommended as a first-line therapy (Valiquette, 2003).

Conclusion

Until only recently impotence was believed to be of psychological or supernatural origin, and those suffering from this condition were left with only a few unproven and questionable treatment options. Today, both patient and physician have a choice of several medicinal and surgical interventions to manage this condition. At the present time it is reasonable to say that things are looking up for men suffering from a condition now known as erectile dysfunction.

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FROM PIETY TO MALADY: THE EVOLUTION OF ANOREXIA AND ITS IMPLICATIONS

By

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ABSTRACT

Anorexia nervosa is not a new illness. Women who were once canonized into sainthood for their behaviors of self denial are now introduced to hospital wards. The number of people inflicted with the illness waxes and wanes throughout history as cultural and familial values change. Eras in which anorexia is increased in prevalence share commonalities with each other, as do historical periods in which anorexia is virtually not seen at all.

After some curious incidences of self starvation reported by the *Lancet* during the 1860's, the Industrial Revolution in the 1870's brought with it the emergence of anorexia as it is seen today. The culture was one in which females were respected for their aesthetic value, as a frail woman proved she was not required to work. Parent-child relationships were intensified as a woman's choices were thought to reflect upon the family.

At this time anorexia was described by two physicians as a coherent disease distinct from starvation among the insane and unrelated to organic disease. Dr. Charles Laségue used the term l'anorexie hystérique to describe the psychological influences surrounding self-starvation and focused on the patient's relations with the family. Dr. William Gull took an organic approach in his published descriptions of the lack of appetite as nervous in origin, anorexia nervosa. Both physicians stressed the importance of removing the patient from home, or "parentectomy" as part of a successful treatment plan.

By regarding the historical similarities of periods when anorexia is seen in light of modern research, a cohesive model can give insight into the nature of the illness. Anorexia continues to mystify the public and experts alike. With understanding perhaps the mystery may one day be solved and unsuccessful treatment of anorexia another curiosity of the past.

Anorexia nervosa is not a new illness. Women who were once canonized into sainthood for their behaviors of self denial, are now introduced to hospital wards. As cultural and familial values change, the number of people suffering from the illness waxes and wanes

throughout history. Eras in which anorexia is increased in prevalence share commonalities with each other, as do historical periods in which the disease is virtually not seen at all. By regarding historical similarities in light of current genetic and familial influences, one can gain a more comprehensive understanding into the origins of the illness and insight into therapeutic interventions.

The first recorded incidence of mortality from self-imposed starvation occurred in the Roman Era. In 383 AD St. Jerome became the Gnostic spiritual advisor to a group of noble Roman women in which he taught spiritual asceticism. His teachings required suppression of bodily desires such as hunger and sexual impulses as the body was thought to be relatively “evil”. Overcoming the material world in this way was seen as virtuous for the soul. One woman followed St. Jerome’s teachings so closely that she starved herself to death, resulting in his return to Bethlehem. (Ranke-Heinemann 1990)

The fall of the Roman Empire and ensuing Dark Ages (400-1060 AD) followed with no recorded incidences of self-starvation. As war, diseases, and famine were rampant during this time, reproductive capabilities and physical stamina became highly regarded in societal attempts of self preservation. Culture and sophistication were lost as whole cities collapsed. (Manchester University)

The Renaissance (1200-1500 AD) brought prosperity and safety to middle and upper class society. In this environment self-starvation began to flourish as young women became preoccupied with eating and non-eating as a basic way to express religious ideals. Some devoted their lives to aiding the sick and poor at the expense of their own health and appearance. Self-starvers became glorified and emulated as the ability to survive on God’s grace through prayer and eucharist portrayed evidence of a miracle. These behaviors of anorexia mirabilis (miraculously inspired loss of appetite) contributed to some women becoming canonized into sainthood. St. Catherine of Sienna (1347-1380) reportedly existed on a spoon of herbs a day, freely gave away food to those in need, and attested to the ability to communicate with Christ. Through control of appetite, the medieval woman strove for perfection before her God. (Bell 1989)

The Catholic Reformation in 1545 AD brought religious change as well as a dramatic decline in the incidence of anorexia. The Catholic Church announced that only an ordained male priest was capable of communicating with Christ. Subsequently, any woman claiming to do so was thought to be either possessed or fraudulent. Male clergy were very cynical of women who displayed acts of “radical holiness” such as prolonged fasting and “good works” were instead encouraged. Simultaneously, the environment was one of unrest as Protestant versus Catholic disputes were fought. (Bell 1989)

By the 17th century only a few cases of self-starvation were reported. These “miraculous maids” were young women from humble rural backgrounds where old Catholic traditions remained strong. The claim of not eating was rare enough to generate debate among clergy, physicians, dukes, bishops and kings. These young, humble women generated much attention as stories of anorexia mirabilis became available through Europe’s new printing press. Investigations did nothing to ease the debate as different examiners

reached conflicting conclusions. In 1600 French physician Jacob Viverius was sent by the king (most likely Henry IV) to observe the behavior of Miss Jane Balan, a fourteen year old who claimed to have not eaten for almost three years. Dr. Viverius reported, “The inferior part of her belly is in such manner grown lean, and dried up in her, as down from her sides, and so along her navel, there remaineth nothing on the belly she had before.” (Brumberg 2000) The French physician failed to find any feces or urine in his examination of the girl which led him to conclude that Miss Jane Balan was in fact a “miraculous maid” whose life was sustained on nourishment from God.

The 19th century became a time of transition in which self starvation was no longer considered a miracle by most medical personnel, yet the term “anorexia mirabilis” continued to exist in medical dictionaries. Sarah Jacob was the “Welsh Fasting Girl” who became martyred to put the issue to rest. Miss Jacob, a thirteen year old farm girl in rural Wales, quickly became famous across Britain and the United States in 1869 after it was attested by the local Anglican vicar she did not eat. Reverend Evan Jones challenged the medical communities interpretation of her behavior as he stated that Sarah Jacob has not “partaken of a single grain of any kind of food whatever for over sixteen months.” (Brumberg 2000) Hundreds of people visited Miss Jacob’s bedside to catch a glimpse of the “Fasting Girl”. London physician Dr. Robert Fowler paid a visit to Miss Jacob in the summer of 1869. After an examination of the girl where subcutaneous fat and verification of digestive activity via stomach sounds was found, he diagnosed Sarah Jacob as hysteric. Dr. Fowler published his findings in the March 27, 1869 Lancet where he stated, “no sensible medical man, unless guaranteed perfect control and means, would undertake the treatment of such a case in the cottage in which the girl lives.” He suggested the girl be treated in hospital, away from those who believed in her. Unable to dissuade the family from their belief in the miraculous, the London medical establishment sent nurses to the home in an attempt to empirically determine the accuracy of Sarah Jacob’s claim. Unfortunately after ten days of close scrutiny, Miss Sarah Jacob died of starvation December 17, 1869. The Lancet responded December 25, 1869:

From the first moment that we heard of this so-called miracle, we did not hesitate to characterize it as a gross imposition. Every scientific man knew that it was a palpable absurdity, and in contravention of all known laws and experience, to suppose that the temperature and the development of tissue could have been maintained without any waste or change of substance. The only medical aspect of the case of any interest ought to have been mainly induced by moral means easily accomplished in the wards of an hospital, whither she ought to have been removed long ago. So deluded were those who ought to have known better, that our opinions were, of course, rejected by many as the arrogant expressions of professional prejudice. (Lancet 1869)

Industrial progress in the late 1800’s began the emergence of anorexia as it is seen today. The cultural environment was one in which the appetite was closely linked to femininity and sexuality. Slimness in a woman replaced the ideal that girth signaled social status. A thin body displayed that it was unfit for productive work. As reproduction was not a primary concern in this prosperous time, female worries of body image replaced those of

body function. Curiously, psychologist William James noted young women were easily influenced by traditions of religious asceticism in 1902. Many strove for saintliness by overcoming bodily desires and gaining pleasure through sacrifice. (James 1997)

English physician Dr. William Gull and Paris neurologist Dr. Charles Lasègue were the first to simultaneously describe anorexia as a coherent disease distinct from starvation among the insane and unrelated to organic disease. Dr. Gull described the lack of appetite as nervous in origin and coined the term anorexia nervosa. His approach to the illness was primarily medical through reports of objective findings:

Miss K. R-, aged fourteen, ... she was extremely emaciated, and persisted in walking through the streets to my house, though an object of remark to the passers-by. Extremities blue and cold. Examination showed no organic disease. Respiration 12 to 14; pulse 46; temperature 97°. Urine normal. Weight 4 st. 7 lb (63 lb); height 5 ft. 4 in. Patient expressed herself as quite well. A nurse was obtained from Guy's and light food ordered every few hours. In six weeks Dr. Leachman reported her condition to be fairly good. ... This story, in fine, is an illustration of most of these cases, perversions of the "ego" being the cause and determining the course of the malady. As part of the pathological history, it is curious to note, as I did in my first paper, the persistent wish to be on the move, though the emaciation was so great and the nutritive functions at an extreme ebb.
(Gull 1888)

Dr. Charles Lasègue's description of what he termed l'anorexie hystérique was more psychological in its focus. The pressurized family environment and emotional stresses the patient may "avow or conceal" were emphasized in the development and maintenance of the disorder. Dr. Lasègue repeatedly heard in the initial weeks of the disease, "I cannot eat because I suffer." While after a period of food refusal the patient would say, "I do not suffer, and must then be well." He also noted, "The abstinence tends to increase the aptitude for movement. The patient... is able to pursue a fatiguing life in the world." (Brumberg 2000) Both Dr. Gull and Dr. Lasègue agreed on the importance of removing the girl from the home, "parentectomy", as part of a successful treatment program. (Brumberg 2000)

The World Wars and Depression of the early 20th century interrupted the thriving society of the Industrial Revolution, which also halted the incidence of anorexia. Mara Selvini Palazzoli, Italian pioneer in the psychiatric study of anorexia reports, "During the whole period of World War II in Italy, there were dire food restrictions, and no patients at all were hospitalized at the Clinic for anorexia. (After the war) concurrent with the explosion of the Italian economic miracle and advent of affluent society, hospitalizations for anorexia were seen." (Brumberg 2000) Interestingly, the current epidemic of anorexia seen today did not begin until a few decades post World War II, specifically the late 1960's- 1970's.

An overview of anorexia throughout the ages shows that the incidence of the disorder increases when the cultural environment is calm and reproduction generally assured.

Women are highly regarded for their aesthetics or spiritual natures rather than their ability to reproduce. In contrast, the incidence of anorexia decreases when society is under strife, whether due to war, famine, or disease. Perhaps under these circumstances women become cherished simply for their ability to reproduce as survival is less assured.

Family life and interactions may also depend on the state of society. In turbulent times families are more likely to come together, help each other, validate each other and voice their love for each other. Conversely, it is easy to forget about the importance of these things when other pursuits may take priority. This becomes important in the etiology of anorexia as psychotherapist Steven Levenkron attests, "Various family dysfunctions can sabotage the development of the emotional trust and dependency necessary to maintain security and stability for a predisposed anorexic." These familial dysfunctions range from a mismatch of temperament between the anorexic and her parents, parental expectations not shared by the anorexic, to parental death, abuse, or incest. The anorexic becomes emotionally closer to her disease than she is to her family. (Levenkron 2000) Psychiatrist Dr. Hilde Bruch described the anorexic as feeling ineffective and powerless, exasperated by a parenting style in which decisions are made regarding the child without concern for their needs or wishes. Anorexia may be used as a tool to gain a feeling of control and effectiveness in her life. (Bruch 1980) Dr. Salvador Minuchin proposes that the anorexic's family characteristics include overprotectiveness, rigidity, lack of conflict resolution, and enmeshment in which parents speak for their children believing they know how the child feels. (Minuchin et al. 1975)

Current evidence suggests genetic influences increase the risk of developing of anorexia. Family studies show that first degree relatives of young woman with anorexia are about four times more likely to develop the disorder. (Davison and Neale 2001) Evolutionary psychologist Shan Guisinger has presented animal, human, and biochemical evidence to support the hypothesis that anorexia nervosa is the remnant of an adaptive response in periods of famine. (Guisinger 2003) The symptomatology of food restriction, denial of starvation, optimism and hyperactivity seen in anorexia is in contrast to the "normal" pattern of starvation which leads to fatigue and hunger. Dr. Guisinger suggests, "When resources were depleted and the tribe despaired, the anorexic's energy, optimism and grandiosity would mobilize the other members to heroic marches... When a starving tribe reached a new hunting/ gathering ground, social pressure exerted by family and friends would in turn have helped the anorexic member(s) to begin eating again." (Strauss 2004) Starvation in anorexia may increase the levels of endogenous opioids, resulting in a positively reinforcing euphoric state. (Marrazzi and Luby 1986) In present day anorexia the woman resists the social pressure to eat, preferring instead the optimism and energy her genetics create in response to not eating.

Biological differences in woman with anorexia have been investigated, although it is difficult to separate these variations from the physiological effects of starvation. Connan et al. propose that chronic stress in those predisposed to anorexia leads to a deviant hypothalamus-pituitary-adrenal axis response resulting in decreased vasopressin up-regulation, and chronically elevated corticotrophin releasing hormone activity. (2003) Excessive corticotrophin releasing hormone activity is associated with loss of appetite

due to its influence on anabolic and catabolic pathways of the hypothalamus. Serotonergic dysfunction is also implicated as a cause or effect of this aberrant response. (Connan et al. 2003)

By regarding the historical similarities of periods when anorexia is prevalent in light of modern research, a cohesive model can give insight into the nature of the illness. During historical periods of conflict when survival is not guaranteed, self preservation becomes rewarding in itself. Women in society become treasured just by virtue of being female with reproductive capabilities. The community may come together and become more altruistic, and the family more validating and caring. In this environment it would be easy for a young woman to feel effective and cared for, just by being herself.

In contrast, during periods of prosperity, basic biological survival is assured for most. It is no longer fulfilling just to survive. Other avenues of interest may be pursued such as spiritual practices. The culture may become one which glorifies female aesthetics over reproductive capabilities. Parents may become busy with career in pursuit of fulfillment. These situations combined with a temperament of perfectionism and desire to please others may cause a woman to feel ineffective in her abilities. Any stressors or anxiety may compound this feeling. In an attempt to extinguish these emotions, she may look to culture to find what is valued and become overly socialized to the feminine role. Some may begin the behaviors of self-starvation in a struggle to feel accepted. At this time addictive changes occur in those with a genetic predisposition as endorphins are released. Neuroendocrinological changes occur in the brain, resulting in decreased hunger and hyperactivity. Physiological adaptations occur to lower the basal metabolic rate such as bradycardia, amenorrhea, decreased peripheral circulation, and lowered body temperature. The woman begins to gain attention and nurturance from others due to her emaciated state. Perhaps this emotional concern from others is what the woman was searching for all along. Anorexia becomes an identity that is more difficult to change the longer the woman stays in its grips.

What does all this mean in terms of treatment of the disorder? The root of the illness must be attacked, the core problem which set in motion the behaviors of self denial: her feelings of ineffectiveness. Since genetics and culture cannot easily be changed, family therapy would be the best way to battle the emotional comfort anorexia provides. Parents should fight the illness with a united front, being caring yet firm, while creating an environment of unconditional love for their child. This may persuade the young woman to take the frightening step of relinquishing the emotional bond to the illness in the trust that her emotions will be respected by others. In this way the balance of alliance is changed so that the victim can fight her disease along with those who care for her. (Levenkron 2000)

Unfortunately anorexia continues to mystify the public and experts alike. With increased understanding perhaps the mystery may one day be solved and the unsuccessful treatment of anorexia nervosa another curiosity of the past.

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APPROACHES TO INFERTILITY THROUGH THE AGES: YOU'VE COME A LONG WAY BABY!

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ABSTRACT

Infertility exacts enormous consequences on couples both financially and emotionally. Historically a societies the approach to infertility has closely mirrored that respective societies approach to women. In ancient Egypt a society in which women could hold leadership positions, infertility was viewed as both a male and female issue. In contrast by the middle ages the status of women had declined significantly and women were held as far inferior beings. Corresponding to this view in 17th century Britain, infertility was believed to be solely a female issue and the consequences of a “barren womb” were extreme and could include death.

Treatments for infertility have evolved immensely since ancient Egyptian times and in the last century have transformed the natural outcome for couples who have difficulty conceiving. In ancient times treatment revolved around being exposed to “helpful” fumes and drinking fertility potions. In the mid 1800's the role of the sperm and ovum were correctly elucidated and the first successful artificial inseminations took place. Since that time great advances have been made in the area of artificial reproductive technology. Though the chances of a successful pregnancy following treatment has improved, the cost and the controversies that have arisen from some of these far reaching technologies have ushered us into a new era of ethical dilemmas.

Introduction

The costs of infertility are enormous both financially, and socially. From the beginning of time the ability to procreate has been considered not only a necessity but also a statement of ones worth as a human being. If one considers the most pure of Darwinian theory, the inability to procreate is the equivalent of being worthless. In less philosophical views on the purpose of life the outcome is not so hedonistic but still suggests that some part of ones worth is still not being achieved. In contrast strongly feminist theory would suggest that the value of a female and her ability or desire to have children are not related at all.

In ancient societies where morbidity and mortality levels were high, considerable emphasis was placed on fertility and consequently there were often several deities devoted to good fortune in this area. In royal circles children, specifically boys were a

means of maintaining the family line and keeping the crown in the family. Amongst the poor, children were a source of labor and ensured someone to look after you in old age. As the political and economical atmospheres changed so did some of the importance and purpose to procreation. Initially with the deplorable conditions and high mortality rates in the industrial revolution the need for a child's income to supplement the family income was critical. However by the 1920's changes in manufacturing as well as child labor laws made this irrelevant and the view of children and their purpose changed. As we continued moving forward the political climate and status of women continued to advance and with these changes an era of controlled reproduction was ushered in. No longer was reproduction a "chance" happening but a planned event and women no longer had a passive role in this event.

The approach to fertility had changed as had the mobility of women in society. But some would question whether the general view of the infertile woman had changed since ancient times. Despite now having the control to decide when to get pregnant there is still an underlying expectation that a woman should want to get pregnant and if she can't there is something "wrong" with her. The scientific advances that had led to the development of various forms of birth control also led to the development of various forms of assisted reproduction. The impossible became possible with the birth of the first "test tube" baby in 1978. However this "miracle" ushered us into an era of new controversy as the ethics and morality of such research and treatment became a publicly debated topic. And for the first time though a viable option was available to women who had lost hope, the new stigma arising from such options forced some couples to face decisions far beyond simply whether or not to have children.

Ancient Egypt

Ancient Egyptian societies held women in higher esteem than most of the societies that followed until the nineteenth century and in some cases more than some societies in existence today. While legally the freedoms afforded women were generalized across the classes there is some evidence that the women in the upper classes were actually the only ones to enjoy the full spectrum of freedoms. In this hierarchical society, women as well as men were ranked according to the class in which they existed. On one extreme this would have meant they lived purely as subordinates to the laws of the kingdom on the other extreme they could have potentially influenced the development of those laws if the men they were associated with, were in bureaucratic positions. Although for the most part the laws were made by men for men and so despite the view of women as equals the laws were generally more favorable to men than women. For example complete fidelity was expected of women but the same was not true for men (Robins, 1993).

Regardless of their role in society, Egyptians in general were very religious having multiple gods and goddesses to guide their lives. For example Bes was a god thought to protect women during childbirth and the infant after birth. Hathor was the goddess of female sexuality, love, music, dance and inebriation, in addition she was believed to bring fertility and protect women during childbirth. She was a goddess with a dual nature, although she could bring good fortune she could also bring about destruction when she

was not pleased (Sullivan 1997). She was also the wife of the highest power, the sun god, and so she was the image with which women were evaluated in Egyptian society. Thus women were also believed to incorporate both good and bad into them selves. Some of the laws such as those surrounding infidelity were made to control the dual nature of women (Robins 1993).

That being said Egyptian women still had enviable economic and legal positions compared to women in most other societies. For example as early as the third dynasty, women as well as men could own land, which they may have inherited, from a parent or husband and which they could bequeath as they saw fit. In the upper classes only men could hold bureaucratic positions and thus receive income directly from government. Women were however, able to conduct business transactions on their own for example selling clothing or food (Janssen, 1973). According to the Wilbour Papyrus women could also own and rent land on their own.

In the eyes of the law both men and women were considered, in theory, to be equal. Women could be brought to court as plaintiffs, defendants or witnesses and could even file lawsuits. In any of these activities they did not require the guardianship of a man, they were responsible and held accountable for their own actions. In the event they were found guilty of a crime they were given the same punishment a man might for the same crime. While there was nothing barring women from these legal activities, accounts seem to place men in these positions more often than women and rarely were women in a position to determine judgments in cases (Robins 1993).

While all these factors seem to imply the role of the female in Egyptian society was relatively equivalent to those of a male there are some indications that in practicality this was not always the case. Since women were not able to hold bureaucratic positions they were often not taught to read or write so accounts of their experiences are rare. In Egyptian art women are often depicted in a less honorific position than their husbands or sons. In terms of fertility this discrimination is also evident while it was generally accepted that infertility was both male and female issue women were held responsible more often than men (Robins 1993).

In ancient Egypt the purpose of marriage was first and foremost to produce offspring. The Egyptian physicians understanding of female health is documented in the oldest Papyrus known, the Kahun papyrus. This “textbook” details not only how they treated infertility but also other female gynecological issues such as contraception. While Egyptian physicians recognized the link between intercourse, semen and pregnancy, they reasoned that semen held the seed which the womb was to nurture until birth. They did not acknowledge a female gamete. All organs including the reproductive organs were described as interconnected channels which opened up into a central cavity. Infertility was thus seen as an obstruction in the reproductive channel and as such the primary way to diagnose infertility was to place an onion bulb into the vagina if, the odor of the onion was detected found in her nose the next day she was deemed to be fertile, since the odor could not have traveled through a blocked channel. (O’Dowd, 2001)

Based on this understanding of female fertility the primary treatment involved unblocking the relevant channel. It was believed that the channel could be opened if a mixture of hot oil, frankincense, dates and beer was squatted over so that the fumes could enter the body. In the event that this did not work women would pray and leave offerings for Hathor hoping she would grant them a child. If all this failed to produce a child, adoption was common and with the high mortality rate across all ages groups orphans were fairly common. Unlike in many of the societies that followed divorce due to infertility was frowned upon (Nunn, 1996)

Medieval Europe

Life in medieval Europe was strongly influenced by the church and the most vocal of men on a woman's role in society were those who had chosen a life without them. Using the biblical story of Adam and Eve they espoused the idea that women were created inferior to men. "the male body created first was considered superior to the female's created subsequently from the male body; woman was God's gift to man, a providential instrument to help him reproduce" (Klapisch-Zuber, 1992).

Nearly all the legal codes of the time limited women's right within the family and in society. Women were considered the legal ward of the men in their life, be it their father or husband. Women were not permitted to engage in business transactions or public affairs. They could not appear in court but rather were represented by their "guardian" if their presence was required there. A woman's guardian was able to use and sell all of her property, punish her wrongs, with penalties as severe as death, arrange her marriage and in some cases sell her. (Klapisch-Zuber, 1992).

In the eyes of the Church a good marriage required a man that ruled, and a woman that obeyed always. Women were often married off at a very young age: "the female body was declared mature at age twelve, But the female mind though fully developed was weak. Past the age of twelve a girl had nothing more to learn, but she could still lose what was most precious" her virginity. Once married it was expected at least in the upper classes that all of a woman's needs that had been met by her father would now be met by her husband she was expected to do nothing but reproduce. Women in the lower classes fared somewhat better, as the family financial situation often dictated that they be involved in the family business and in taking a role in the family affairs was able to secure herself some dignity and respect. (Klapisch-Zuber, 1992)

Infertility in this era was ascribed completely to the female unless a husband could be proven impotent. If a wife was unable to bear children after a few years of marriage it was okay to "send her back". In some instances if a husband were not willing to return his bride due to barrenness, his family would intervene and do it for him. Given such grave consequences to infertility it is not surprising that women, especially those in the upper classes where marriage was a means to maintaining your status, sought out therapies for their barren wombs. The church had an overpowering influence at this time and infertility was felt to be the result of being judged by God as unfit for such a gift. Consequently women were unlikely to openly seek treatment, as it would imply they

were trying to change the will of God. Instead much treatment involved home remedies of herbal teas and special diets (O'Dowd, 2001). Interestingly a woman could be accused of witchcraft and burned at the stake if she was successful.

Modern Times

As the middle ages ended and the modern era began there was still a very strong belief in the church and the will of God. The prevailing view that women were the property of or at the very least dependent upon men, left them subordinate to the men in their lives. A woman was the legal responsibility of her father until she reached the marrying age at which time she was given to a man who expected to be compensated for taking her on (Davis and Farge, 1993), thereafter he was legally responsible for her and provided for her needs. This sequence of events only truly actually occurred in the middle and upper classes where women were not expected to work. The reality for the lower classes was that as soon as a female could work she would have begun contributing to the family finances and to her dowry.

In 1677, Anton von Leeuwenhoek had “discovered” sperm and hypothesized that sperm contained the entire human form, which the female nurtured until birth. The ova was not discovered for another 150 years so those suggesting greater role for the female in procreation had no proof to support their claims (Speert, 1994). The role of the female was limited to nourishing and supporting the developing sperm and this believe gave rise to the idea that female good humor was evidenced by an orgasm was essential for a pregnancy. Mauriceau wrote in 1697 that it was the “insensibility of some Women, who take no pleasure in the venereal act,” as the “most frequent reason why this orifice opens not in this act to receive the Man’s Seed” This led to plethora of advice on sexual techniques to ensure female arousal and orgasm was achieved. It was also indicated that for maximal fertility, sex should not occur too frequently, after all it was pointed out that prostitutes have very few, if any children. The reasoning behind this was eloquently described in a popular book on the subject, *Aristotle’s Master Piece* “...for the Grass seldom grows in a Path that is commonly trodden in.” (Marsh and Ronner, 1996)

By the end of the eighteenth century a transformation was taking place in how infertility was viewed. Rather than being seen as the will of God it was slowly being considered a condition that may be altered with the right remedy. However it should be kept in mind that at this time infertility was still seen as a female issue unless it could be demonstrated publicly that a husband could not maintain an erection. The view that only impotent men were infertile meant that it was primarily women seeking out remedies for barrenness. There also still remained a strong believe in the church and the view that infertility was God’s will or a test a couple must endure remained popular and so seeking treatment was still viewed by many as tampering with God’s will. Thus treatment still usually involved the self-administration of potions often offered by traveling salesman or “witches”. One of these “never-failing-prescriptions” for infertility offered by James Graham (1745-1794) a self proclaimed expert in the field included:

one handful of red virgin sage leaves; steep them in a bottle of old red port; then drink a glassful every morning; repeat it in two or three months;...with regular hours and moderate exercise,... with plain and simple drink; bathing is also necessary.

If this remedy failed the “doctor” suggested a night in his vibrating celestial bed, which was an option only open to the wealthy. (Marsh and Ronner, 1996)

Throughout the eighteenth century infertility was never a societal concern and very little public attention was paid to it. However by the middle of the nineteenth century, in America, fertility began to be viewed as an important medical issue when the birth rate began to fall. The government suggested it was a woman’s patriotic duty to populate the land with “true” Americans before immigrants took over. With government support, physicians began looking into physiologic bases for infertility. In 1844 American practitioners had access to a treatise written in France by Vincent Mondat. In this work he dispelled all myths regarding the minimal role of the female in procreation. By this time the ovum had been discovered and he presented very convincing arguments in favor of women contributing equally to the next generation. He also reposed the earlier theories regarding the blockage of the female reproductive organs as a major component of infertility. With this work Mondat introduced a new era in infertility treatment where prescriptions of diet and self-treatment were discarded and surgical intervention became the treatment of choice. (Marsh and Ronner, 1996)

With the increase in pressure to identify and treat the true reasons for infertility J. Marion Sims, considered by some to be the father of gynecology, opened up a women’s hospital and began performing surgeries aimed at curing infertility. His methods were so erratic and unfounded that he has been considered a reckless experimenter by some and as a savior by others (McGregor, 1989). Based on the reasoning that obstructions were the cause of infertility, he began removing what he felt were intrusive portions of the cervix, in many cases from women with physiologically normal cervixes. This was most certainly not an example of evidenced based medicine as it was stated by his assistant, Thomas Emmet that he was impossible to learn from because he performed the surgeries so quickly, never explained anything and never performed the same surgery twice (Marsh and Ronner, 1996). Interestingly, he declared a woman cured if on subsequent exam he determined her organs to be unobstructed and she was free of infection that the surgery might have caused, there was never any mention of a subsequent pregnancy and interestingly many women were “cured” more than once.

In true testament to the fact that although treatments had changed drastically attitudes were slower to change, women were often subjected to surgical procedures at great risk without their husbands ever being examined. This is particularly interesting in light of the fact that Sims was a staunch believer that a man could be sterile even if he wasn’t impotent. Sims, however does deserve some credit because it was quite likely that some of the women he did perform surgery on did have an obstructed cervix. It has been suggested that much of the female infertility during that period was caused by a scarred cervix as the result of a gonorrheal infections passed from asymptomatic husbands. In

addition his surgery did help many women suffering from pelvic pain and dysmenorrhea produced from the scarring effects of this disease. (Marsh and Ronner, 1996)

As the eighteenth century approached a close the women's movement was gaining momentum. Women were beginning to step away from their traditional roles and as a result were falling under heavy criticism from some more conservative members of society; fertility was used in an attempt to keep them at home maintaining the status quo. It was declared by some prominent men in society, such as a well known gynecologist Horace Bigelow that attending college and obtaining a higher education were "inappropriate behavior" and a cause of infertility and thus women and their selfish desires were at the root of the drop in birth rates. Although women technically had more freedoms it was still implied that women and the "freedoms they were allowed, should be used correctly by choosing to have children". It was a women's biological mandate to have children regardless of the cost and so radical and unfounded surgeries such as those performed by Sims continued (Marsh and Ronner, 1993)

Further advancements in contraceptive therapy meant that women could put off childbirth in order to pursue an education (often without a subsequent career as it was still a scandalous choice to have a career) However in many circles, including the still male dominated medical field a woman's desire to postpone childbearing was still viewed negatively. The idea that infertility was brought on by bad behavior dominated this period (Sandelowski, 1990). This link between behavior and sexuality worked both ways and the most common surgery of the time became ovariectomies. Ovaries were removed for all sorts of reasons not just tumors, leading to an entirely new, iatrogenic, cause for infertility (Marsh and Ronner, 1993)

By the end of the eighteenth century two significant events had taken place. First oral contraceptives were readily available as were abortions thus creating options for women. This led to the development of the field now known as gynecological medicine. With the introduction of female reproductive medicine as a specialty physicians could now become experts in the field. This led to improvements in the understanding of the physiology of female fertility and increased the positive role that men played in treating infertility. In addition female voices on the issue began to be heard for the first time, initially from women in infertile marriages who refused to be accused of "race suicide" and then from the first female physicians who were beginning to graduate set up practices and becoming advocates for women in the health arena. By 1890 it had been quietly acknowledged that 20-30% of infertility could be attributed to sperm. At the same time gynecological surgeries were becoming more sophisticated and for the first time successful.

As female social influence rose, their behavior and attitude changes were implicated as a direct threat to the attempt to populate America with white Anglo-Saxons. Childless women were accused of race suicide. In 1903, President Ted E. Roosevelt declared that "voluntary childlessness was a shameful desire...of ease and self indulgence". It was also around this time that the idea that every form of contraception could cause sterility took hold making its way into the popular press. If a woman arrived in a doctors office

with concerns on infertility and she had ever used the contraceptive pill she ran the risk of being treated poorly if at all and blamed openly for her problems. At the same time with some trepidation male infertility was coming under increasing scrutiny (Marsh and Ronner, 1993).

The shape of the American family began to change around 1920, the economy had changed enough that children were no longer a financial necessity creating more opportunity for voluntary childlessness or delayed childbearing. The field of endocrinology was launched with the discovery of estrogen and the first steps towards understanding the female cycle were taken. At the end of World War I, science took another giant step forward and the documentation of experimental treatments and surgeries began. No longer were women being used arbitrarily in attempts to “cure” infertility. New diagnostic procedures were developed including the Rubin test, based very much on the same principles as the Egyptian onion bulb test. In the Rubin test the patency of the fallopian tubes was determined by inflating them with carbon dioxide. If the tubes were free of occlusion the gas would pass through them and into the abdomen where it would be felt as a pain in the shoulder (Heaney, 1923). For the first time infertility could be diagnosed accurately without major surgery. In addition the infertility work up involved both men and women and included the assessment of several endocrine factors. (Marsh and Ronner, 1993)

Just prior to the outbreak of the World War II a concept that had been tried as early as 1780 with limited success began to show promise, artificial insemination (Speert, 1994). The first successful embryo transfer with an egg fertilized *in vitro* took place in a research lab in 1943. The following year the first human egg was fertilized *in vitro* (Rock and Menkin, 1944). This development ushered in an entirely new era in reproductive medicine and the debate that began with the first rounds of successful artificial insemination raged on. In spite of these early successes it would take several more years before the two technologies would meet culminating in the first term pregnancy from *in vitro* fertilization in 1978.

In the 1970's societies enthusiasm for science and research was dwindling. Scientists and the work they were doing came under increasing moral and ethical scrutiny. Just as the concern over artificial insemination was fading, the side effects of some infertility drugs were being noted. In particular a synthetic estrogen, DES, which had been used to prevent miscarriage was being linked to a rare vaginal cancer in the daughters of women who had used it. The public became more cautious about utilizing new technologies and skeptical that science was really making things better, Assisted reproduction techniques were seen as an attack on the biological family and by the 1980's even feminists had taken a stand against *in vitro* fertilization (Marsh and Ronner 1993).

Each new round of development in the area of assisted reproduction has stirred up the controversies ignited by Rock's work in 1944. Today women over 60 can get pregnant, deformed sperm can fertilize an egg, embryo's can be frozen for later use, and healthy embryos can be selected and genetically screened for specific features such as the absence of disease. These advances while beneficial in some respect also opened the

doors to potential abuse. Infertile couples who choose assisted reproduction must now wade through an increasing amount of material and options to find the solution that is right for them not only in terms of success but also in terms of their personal beliefs.

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QUEER HISTORY: OUR EVOLVING UNDERSTANDING OF HOMOSEXUALITY

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ABSTRACT

Few topics are more controversial today than homosexuality. Whatever your opinion, one fact is undeniable: it is pervasive and widespread, affecting millions of people, from all races, religions and walks of life. As one expert in the field noted, “Clearly, same-sex behavior of some type or other seems to be found in all but the tiniest cultures, and therefore may legitimately lay claim to the status of a universal component of the human behavioral repertoire.”

Civilizations around the world have struggled with this issue for millennia, coming to interesting and often varied conclusions. To the ancient Greeks, homosexuality was the noblest form of love, something that transcended ordinary heterosexual intercourse. The native peoples of North and South America considered it a gift from the gods worthy of reverence. During the Middle Ages, homosexuality was banned by the Church as one of many sinful acts of lust, along with oral sex and penile withdrawal. The 19th century saw the dawn of the ‘scientific’ age and the first analyses from the behavioural perspective, firmly entrenching homosexuality in the sphere of mental disease. By the mid-20th century, pure scientists began to examine homosexuality more objectively, and they found it to be more prevalent than previously imagined. With the arrival of the information age and modern biological research tools, investigators are now beginning to unravel the processes of brain development that determine one’s sexual orientation.

Our current understanding of homosexuality is complicated. As Francis Mondimore wrote, “homosexuality is a human condition that develops as do most other complex behavioral phenomena, through a complicated and quite distinctly human intermingling of many factors – biological, psychological, and social...any understanding based too much on only one of these factors is simply incomplete.”

Introduction

Few topics are more controversial than homosexuality. It has been called variously a sin, an illness, a heinous crime, a normal variant of human sexuality and a gift from the gods (Mondimore, p. 2).

In the debate on homosexuality, the fundamental question has always been one of origin. Is homosexuality an inborn characteristic, a position espoused by the *essentialists*, or is it a trait formed by the pressures, attitudes and customs of society, as the *constructionists* would have us believe (Turner, p. 69)?

As we shall see, societies around the world have struggled with this issue for some time, coming to numerous and oftentimes quite opposite conclusions.

“The Unspeakable Vice of the Greeks”

To say that homosexuality was common among the ancient Greeks is perhaps a bit of an understatement. Indeed, no other culture has ever idealized the notion of homosexual love to the same extent. To them, it was the only form of love that could transcend sex and be pure and everlasting; the Attic ruler Solon even went so far as to ban it among the slaves and lower classes (Boswell, p. 27).

Greek culture had an understanding of human sexuality that was fundamentally different from ours. While our dichotomy is based primarily on gender, theirs centred on domination – who was doing what to whom. As the noted classicist David Halperin wrote (1986:39), “in classical Athens, sexual objects came in two kinds – not male and female but active and passive, aggressive and submissive.”

As a result, the notion of the “homosexual” was completely foreign to them; indeed, neither the Greeks nor the later Romans had a term for such a person (Mondimore, p. 3). It was expected that men, especially older men, would marry and have a procreative relationship with their wives, but would also carry on a romantic relationship with a younger man, the *eromenos*.

Even among the Greeks, however, it was acknowledged that some males, including the philosophers Bion and Zeno, and the famous Macedonian king Alexander the Great, had a strong preference for other males. Plato rationalizes this in his major exploration of love, the *Symposium*. As the character of Aristophanes explains, early man was a double-being composed of two heads, four arms, four legs and two sets of genitals. When these proto-humans tried to attack the gods, Zeus split them in half to make them less of a threat. Forever after, the two halves were destined to seek their counterpart. While most of these double-beings were originally male-female, some were male-male and female-female and so they naturally sought their complement among members of the same sex (Bullough, p. 3).

The *Berdache* and Homosexuality Among Native Americans

When the early French missionaries arrived in North America, they encountered among the native tribes males who took the dress and cultural role of females and vice-versa. They called these people *berdache*, the French term for homosexual (Boswell, p. 2). This institutionalized homosexuality was widespread, being found from the Iroquois of the Northeast to the Alaskan Inuit to certain South American tribes (hence the term “Amazon”, coined by the Portuguese explorer Pedro de Magalhães de Guandavo to describe a group of female warriors he discovered in 1576 in northwest Brazil (Mondimore, p. 12)).

To the native peoples, sexuality was a gift from the spirit world, meant for both procreation and pleasure. The *berdache* was thought to be a special person, someone of a third sex sent by the gods with a special role neither man nor woman could fulfill. In the creation myths, First Man and First Woman live in misery until Turquoise Boy and White Shell Girl, the first *berdaches*, arrive to teach them farming, pottery, and other skills.

Because of their special connection to the spirit world, the *berdaches* were highly respected in the tribe and served as the medicine men or shamans. They were thought to be prophets who could interpret dreams and, like Turquoise Boy and White Shell Girl, were usually renowned as master craftspeople.

When the Spanish *conquistadors* arrived, they systematically burned the *berdaches* at the stake for sodomy. They used this sin as justification for their conquest and blamed it for the diseases that annihilated almost 90% of the native population. As Mondimore writes: “In a chilling foreshadowing of attitudes seen at the beginning of the AIDS epidemic, the deaths of millions of Native Americans from measles, influenza, and smallpox, diseases spread by Europeans, were attributed to divine retribution for the sin of sodomy” (p. 15).

Medieval Times: Stoicism Reborn

Around 320 A.D., Constantine declared Christianity the official state religion of the Roman Empire. Over the course of the next 1300 years, the Roman Catholic Church would extend its influence across most of Europe and beyond, dramatically influencing popular opinion on sexuality and behavioural mores.

A striking change occurred in thinking between the time of the late Empire and the early Middle Ages (Boswell, p. 21). While the Romans, like the Greeks, had been fairly permissive of various forms of sexuality, the new dogma condemned them almost universally. At the root of this paradigm shift was the rediscovery of Stoicism.

The Stoics belonged to a school of Greek philosophy that flourished in the 3rd century B.C. It taught that all forms of excessive emotion were to be avoided; this included pleasure and, in particular, sexual pleasure. Only procreative sex was natural; other sexual acts such as masturbation, homosexuality, oral and anal sex, bestiality, *coitus interruptus*, in fact anything other than male superior intercourse, were by definition lustful and sinful (Boswell, p. 98).

Church figures such as St. Albertus Magnus and St. Thomas Aquinas adapted the Stoic philosophy for Medieval Europe. As justification they used Scripture, including the old Jewish prohibition on depositing semen anywhere but the vagina and the destruction of the city of Sodom in response to the homosexual rape of the God's emissary angels (Bullough, p. 17). The term *sodomy* was derived from this latter event; the term later came to refer to any prohibited sexual act.

By the 14th century, the church had enough influence over Europe to make sodomy a punishable offence. A bureaucracy was established to enforce the prohibition and eliminate any who opposed the church, including sodomites, Jews, and Muslims; this developed into the Office of the Inquisition.

The coming of the Renaissance saw the end of most Medieval sexual mores due to opposition from the public. Homosexuality, however, continued to be a crime well into the 20th century. Mondimore argues (p. 27) that because this issue affected only a small minority of the population, opposition was never widespread enough to force the ban on homosexuality to be lifted.

The 19th Century: A 'Scientific' Approach

The 19th century was the dawn of the scientific age. People of the time believed that research and study would eventually lead to a cure for all of society's problems. It was in this context that medicine began to take an interest in homosexuality.

Among the earliest to study the phenomenon was the French neurologist Jean-Martin Charcot, the director of the Salpêtrière asylum. He tried to cure homosexuality with hypnosis and, when he failed, declared that the sexual "inversion" was due to a hereditary degeneration of the nervous system.

His contemporary, Paul Moreau, extended this theory by postulating the existence of a sixth "genital" sense that was congenitally weak in homosexuals; when further damaged by environmental factors such as poverty, age, and climate, the disorder manifested itself (Bullough, p. 8). This introduced the notion of *degeneracy*, which implied that homosexuality was a defect of heredity, a throwback to a more primitive stage of evolution.

Perhaps the most influential figure of this time was Richard von Krafft-Eding, who in 1886 published *Psychopathia Sexualis*, a collection of more than 200 bizarre sexual and psychopathic cases. He described degeneracy as the basis for mental retardation, crime, and homosexuality, and supported the view of St. Thomas Aquinas that only procreative heterosexual intercourse was "natural". His book, full of gruesome and lurid detail, quickly became a best seller. It is credited with linking homosexuality to mental disease, and was the gold standard of scientific thinking on the topic for nearly eighty years (Mondimore, p. 36).

The 20th Century: Psychoanalysis and Surveys

In early- to mid-twentieth century work on homosexuality, two figures stand out – a Viennese physician and an entomologist from Bloomington, Indiana.

Sigmund Freud was the father of psychoanalysis and creator of a new theory of the mind. He placed great emphasis on events of early childhood and believed that every child had to achieve certain milestones in their psychosexual development; failure to do so arrested maturational development (Mondimore, p. 68).

He further postulated the so-called Oedipus complex wherein a child temporarily falls in love with the parent of the opposite sex and develops a hatred for the parent of the same sex. He used this model to explain the case of the homosexual, who in infatuated with a woman he cannot have (the mother) and represses this desire by eliminating sexual feelings for all females (Bullough, p. 13).

Freud himself did not believe homosexuality to be bad; he is often quoted as saying, “it cannot be classified as an illness; we consider it to be a variation of the sexual function produced by a certain arrest in development” (quoted in Mondimore, p. 76). The Freudians who rose to prominence following his death, however, believed homosexuality to be an environmentally induced disorder and thus treatable with extensive psychoanalysis. This remained the prevailing view in psychiatry until the 1970’s, when homosexuality was finally removed from the Diagnostic and Statistical Manual (Bullough, p. 151).

One of the most influential figures in sexual orientation research of the last sixty years was Alfred Kinsey, an entomologist from Indiana University at Bloomington, who in 1948 published a landmark study entitled “Sexual Behaviour in the Human Male”. This was the first large-scale study of sexual behaviour in the population. From the nearly 12,000 in-depth interviews Kinsey conducted he derived estimates of the prevalence of various sexual activities in the “normal” population. These included masturbation, oral and anal sex, and of course homosexuality. The results of his study created a frenzy when they were released – 13% of males and 7% of females admitted to being exclusively homosexual, and more than 40% of men had experienced a homosexual event bringing them to orgasm at some point in their lifetime (Kinsey, 1948).

Although his methods and analyses were severely criticized by some, Kinsey’s work was the first scientifically valid analysis of human sexual behaviour and the results of recent studies are consistent with his data (Laumann, 1994). He is also credited with creating and validating a spectrum model of behavioural norms, ranging from heterosexuality through bisexuality to homosexuality (LeVay, p. 47).

Genes, Hormones, and Nuclei: The Modern Perspective

Over the last twenty years, research into the origin of homosexuality has taken an increasingly scientific tack. Advances in physiological and molecular biological

techniques have allowed researchers to explore the brain itself to determine what differences, if any, exist between gay and non-gay people.

Early work with sex hormone disorders has led to some interesting findings. Androgen insensitivity syndrome is a condition in which there is a defect in the testosterone receptor. A biologically male fetus, effectively immune to testosterone, grows into a physically female adult and develops an attraction to other males. In congenital adrenal hyperplasia, the fetal adrenal glands produce excessive amounts of testosterone, which results in the effective masculinizing of the female fetus. Even with surgical and medical treatments that restore normal ovarian function soon after birth, there is an increased rate of lesbianism among the subjects. In 5- α -reductase deficiency syndrome, there is a defect in the enzyme that converts testosterone into the form active in the genitalia, resulting in a neonate that is female anatomically, but whose brain has been exposed to normal amounts of testosterone. At puberty, these 'girls' suddenly and unexpectedly develop into normal straight males, even though they have been raised as females. All of these observations suggest that the brain undergoes a 'masculinizing' process in the presence of testosterone (Mondimore, p. 107).

Increased levels of testosterone are known to increase lateralization within the brain and cause early maturation of the right hemisphere; this mechanism is generally used to explain the greater visual-spatial abilities and left-handedness among men versus women. Interestingly, these trends are also seen in lesbians, who were reported to be 69% left-handed versus 35% of non-gay women (Mondimore, p. 127). Gay men have been shown (like women) to have larger anterior commissures and corpora callosa than non-gay men, supporting the concept of increased bilateralization in the male homosexual brain (Scamyougeras, 1994). Recently, oto-acoustic emissions have also been compared to sexual orientation and results "were most often consistent with the hypothesis that male homosexuals were undermasculinized and female homosexuals overmasculinized" (Loehlin, 2003).

Much has been made of the differences in hypothalamic structure between men and women and between gay and non-gay men. In 1991, LeVay *et al.* discovered four new anterior hypothalamic nuclei, one of which, INAH₃, was found to be sexually dimorphic (differing in size between men and women). What made this study revolutionary was that it was the first to find a difference between the brains of gay and non-gay men, gay men having an INAH₃ nucleus similar in size to that of a woman (LeVay, 1991). This work has come under criticism, however, as the autopsy specimens for the gay set seem to have come in large part from AIDS patients.

Much work has also been done in the realm of genetics. Twin studies in particular have yielded some interesting results. Monozygotic twins (with identical genetic complements) show a 50% concordance of homosexuality, greater than more distantly related dizygotic twins or adopted siblings. This suggests that, although genetics plays a role in determination of sexual orientation, environmental factors (especially differences in the environment) are also highly influential (Rosario, p. 230-4). Gay men and women are also known to have more gay siblings of the same sex (Bailey, 1991).

In 1993, Hamer showed that there was a link between homosexuality in males and markers at the Xq28 region on the tip of the long arm of the X chromosome. Although called the “gay gene”, it correlates only partially with the homosexual trait and many gay men do not have the markers in question. At this time, the function of the gene is still unknown, although it is thought to have some role in brain development (Hamer, 1993). This discovery, and the widespread furor that ensued, were among the most important scientific debates of the late 20th century.

Conclusion

Being from a small town in southern Ontario, I grew up with American television and culture and their somewhat right-wing views on the world. Homosexuality was something only talked about in a mocking or derogatory manner; in high school this is the case with most things that are different I suppose.

When I went away to university, I discovered that homosexuality was not just a phenomenon found in San Francisco and New York. There were gay people everywhere – in my classes, at the bar, in my residence. I began to see that there were other ways of looking at homosexuality beyond simply a sinful abomination, and this paper has given me the opportunity to explore these perspectives.

To the Greeks, homosexuality was the noblest form of love, something that transcended ordinary sex. The native peoples of North and South America considered it a gift from the gods and worthy of reverence. During the Middle Ages, homosexuality was banned by Church as one of many sinful acts of lust, although at the time no worse than oral sex or penile withdrawal. The 19th century saw the dawn of the ‘scientific’ age and the first analyses of homosexuality from the behavioural perspective, which firmly entrenched it in the realm of mental disease. By the mid-20th century, pure scientists were beginning to examine homosexuality from a more impartial perspective, finding it far more prevalent than ever imagined. Finally, with the arrival of the information age and modern biological research tools, investigators are beginning to unravel the mysterious processes of brain development that determine one’s sexual orientation.

Our current understanding of homosexuality is complicated. As Mondimore writes (p. xii):

“homosexuality is a human condition that develops as do most other complex behavioral phenomena, through a complicated and quite distinctly human intermingling of many factors – biological, psychological, and social...any understanding based too much on only one of these factors is simply incomplete.”

Whatever your views on homosexuality, one fact is undeniable: it is a pervasive and widespread occurrence, affecting hundreds of millions of people around the world, from all races, religions and walks of life. As one expert in the field noted, “Clearly, same-sex behavior of some type or other seems to be found in all but the tiniest cultures, and

therefore may legitimately lay claim to the status of a universal component of the human behavioral repertoire (Dynes, p. xv).”

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NOTES

The following students presented a paper at the conference but did not submit a formal manuscript for publication.

From Psychiatrist to Enemy-of-the-State to Prophet: Karl Jaspers Trudy Adam
And the Phenomenology of Psychosis..... University of Calgary

When Elevators were for Pianos: An Oral History Account of the Audrey C. Campbell
Civilian Experience of using Wheelchairs in Canadian Society - McMaster University
The First Twenty Five Years (1945-1970)

Scurvy: The Scourge of the Naval Surgeon..... Paul D. Chapman
..... University of Manitoba

The History of Cardiac Pacing..... Kelly L. Craig
..... University of Calgary

“Dammit Jim, I’m A Doctor Not George Clooney!” Mark Gatha
..... University of Calgary

A Brief History of Wound Closure..... Vithya Gnanakumar
..... University of Calgary

Women’s Morbidity and Mortality in the Pursuit of Kerri Johansson
Physical Attractiveness University of Calgary

The Edwin Smith Papyrus: Ancient Egyptian Surgical Practices Curtis Myden
..... University of Calgary