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Nezhat's History of Endoscopy

Let There Be Light: A Historical Analysis of Endoscopy's Ascension Since Antiquity

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PROLOGUE

Taking on the subject of the history of endoscopy can be a most confounding undertaking, for its development has been shaped by an often inscrutable entanglement of paradoxical forces, making the story one which nearly defies analysis. All manner of social, economic, and cultural influences have at one time or another been implicated in the endoscope's development. Still other theories abound to explain the "vicious cycles" between acceptance and resistance that so plagued the endoscope's history. Not simply a story of science then, the endoscope itself seems to have taken on meaning more closely achieving that of allegorical significance.

Cast in such symbolic undertones, pinning down an accurate interpretation of the endoscope's history is therefore a task fraught with complexity. From the outset then, I begin by acknowledging that this glimpse into the past is only one interpretation of the history of gynecologic endoscopy, one that may fall somewhat short of obtaining a perfected understanding. Of course too, no brief historical account could do justice to the countless individuals whose sometimes unrecognized efforts proved so crucial for endoscopy's progress. Despite such constraints, we have attempted to cast our net of analysis as broadly as possible, taking care to illuminate in particular contested histories that have been hitherto greatly misunderstood or altogether unexplored. Special attention has also been given to analyzing changes in surgical traditions, most especially the rise of

videolaparoscopy and the extent to which this departure from orthodoxy served to so radically redefine the entire field of surgery.

We have striven as well to provide the most accurate research as possible, taking care to extensively cross-reference all sources, seeking out archival documentation whenever possible, and investigating more fully secondary sources so often overlooked. Through this vigorous research we have indeed come across multiple discrepancies within the historical records. In such cases, we offered for the reader multiple perspectives into these contested histories so that a more balanced understanding could be achieved.

Despite these many difficulties complicating its history, exploring the endoscope's development has nevertheless been an extremely important undertaking; for the real story behind endoscopy is, above all, one that truly reflects the glory of the human spirit. It symbolizes our shared humanistic experience of struggling between the exhaustive extremes of dreaming and doubting. Just as importantly too, the story of endoscopy serves as a source of continued inspiration for all of us within the medical community, for it demonstrates that dreaming for a better way can pay off and that individual efforts can and do make a difference in driving forward profound transformations within science and society.

PART I) ENDOSCOPY AS A PHILOSOPHY: ANCIENT – EUROPEAN SCIENTIFIC REVOLUTION

CHAPTER 1

Endoscopy as a Philosophy

Perhaps the most unique aspect of the history of the endoscope lies in the issue of categorization. Just what is endoscopy anyway? Is it an instrument or technique? "Revolution or Evolution?" Many have come to understand the meaning of endoscopy as merely that of a technology or instrumentation. Because its roots as an almost exclusively diagnostic tool are so recent, this limited conceptualization has been somewhat difficult to escape. A more accurate definition however places endoscopy firmly in the realm of a new philosophy, one rooted in what is now referred to as *minimally invasive surgery*.

Interestingly, the idea of minimal intervention is not necessarily a modern phenomenon. Historical artifacts provide plausible evidence indicating many ancient societies had an interest in minimal intervention as far back as 4,600 years ago. In fact, prior to the mid-19th century, surgeons very rarely operated on the abdominal cavity. Rather, their efforts were confined to indirect methods such as dietary changes and purgatives.

One may also interpret much of the Hippocratic Corpus as predominantly advocating this minimalist approach, as can be inferred by the modern version of the Hippocratic ancient edict "First, do no harm." Hippocrates specifically instructed physicians to avoid as much as possible invasive methods, allowing instead allow for the body's own miraculous powers of healing to take effect. Of course, this approach was certainly influenced by the fact that invasive surgeries were almost unthinkable, as the mortality risk from infections was simply too great. Nevertheless, in reviewing the history of medicine, we can see that a philosophy of minimally invasive medicine has been an integral part of medicine for thousands of years.

"Big Surgeon = Big Incision"

Sometime between antiquity and the late 19th and early 20th century, the favored form of surgical intervention transformed into one dominated by big incisions. Exploratory laparotomies eventually came to be understood as integral to the treatment and diagnosis of many types of disease states that had defied other methods of diagnosis. Ironically, this growing preference for "classical" open surgery was most likely influenced significantly by the scientific advances in asepsis and anesthesia during the same time period, discoveries which finally ushered in the era of modern medicine.

With the advent of anesthesia and antiseptic however, this meant that for the first time in living patients the physician could now get right to the source of disease without having to rely on deductive reasoning or blind biopsies. Diseases of the abdomen could now be palpated, visualized, and treated surgically. Paradoxically then, while treatment options and recovery rates expanded, so too

did the circumference of incisions. Open approaches were soon codified as the gold standards of “classical surgery,” a point that later served to interfere substantially with endoscopy’s progress .

The Modern Era of Planx’s Quantum Physics and Einstein’s Relativity
The more we live by our intellect, the less we understand the meaning of life. -Leo Tolstoy

Taken collectively, these great strides in medicine, coupled with parallel advances in science and technology so characteristic of this late Industrial era, engendered a growing sense of scientific infallibility. By the 20th century, great thinkers such as Einstein, Hans Otto and Max Planx were revolutionizing classical understandings of science. Even Newtonian physics was called into question during this transformative time. In fact, after a nearly 200 year reign as supposedly irrefutable fact, many of Newton’s empirical observations of gravity were found to be significantly flawed, as demonstrated by Einstein’s brilliant theoretical work [1].

Traditional surgical conventions continued to undergo rapid change as well. The surgeon, once referred to as a mere butcher in Hippocrates’ time, was, by the 19th century, transformed into an idealized father-physician, whose unique position of authority over the human body was accepted in some sense as a reassuring presence amidst the uncertainties of life and death. Such changes in the surgeon’s status were reflected in the growth of new elite societies for surgeons only. Surgeons thusly began taking a place of prominence above internists and other disciplines. Many snappy aphorisms from our not too distant past supported this growing reverence for surgeons and by extension, for their surgical procedures too. Such sayings as “to cut is to cure, “the greater the surgeon, the bigger the incision,” and “wounds heal from side to side, not top to bottom,” were all common refrains which helped reinforce the prevailing attitude about the superiority of open surgical methods. Influenced by this entrenched dogma, the inherent morbidity associated with large incisions was de-emphasized, due mainly to the lack of surgical alternatives. Contrary to today’s standards, a large incision was seen as a necessary evil, unequivocally required to save the very life of the patient. In relation to certain death, the various morbidities and uncertainties associated with laparotomy were understandably viewed as acceptable risks given the medical limitations of the time.

Yet, just like Newtonian physics, these classical theories of surgery would ultimately be challenged by the conceptual breakthroughs driven in part by the burgeoning field of modern operative endoscopy. Of course, the sacrosanct system of scientific lore is often paradoxically unwelcoming of new-fangled notions, subjecting novel ideas to sometimes rancorous resistance. Our discipline clearly witnessed such a backlash to new ideas when we saw, for instance, operative videolaparoscopy so vehemently lambasted in its early ascendancy. Indeed, videolaparoscopy, by catalyzing such profound changes to the very

foundation of so-called “classical” surgery, came to symbolize an unwelcome threat to the entire order of things.

Facing such institutionalized beliefs about classical surgery, the aspect most remarkable about the endoscope’s story relates not so much to its ingenious technological progression, but rather to those individuals standing behind the progress whose courage and tenacity enabled them to boldly call into question orthodoxy, envisioning for the world a path of progress well beyond technical limitations, while facing simultaneously almost riotous ridicule for attempting to change established practices. The pioneers of endoscopy were therefore truly exceptional, for they were able to recognize the deeper humanistic significance of the endoscope, not as simply a “piece of technology,” but as something that instead signified a revolutionary advance for medicine and society.

Still, despite so much progress, despite so much unimaginable success, ambivalence and suspicion about operative endoscopy persists even today. As recently as 2003, editorials insinuate the worst, with rhetoric such as “just because we can [do endoscopy] doesn’t always mean that we should.” Another recent article implicates excesses of industry and the “glitz” of new technology as culprits with the following:

"Surgical technology in the area of endoscopy seems to be exploding, but at what cost? … Today, I ask the question: Who is driving the bus? Industry or physician? The focus on the basic principles of surgery is fast becoming blurred amongst the glitz of new technology."

These sources are not alternative reads either; they are mainstream publications with a wide and influential audience. For these reasons alone, taking a moment to review the endoscope’s developmental process will help us recognize just how dominant ideologies or cultural influences act as such profound forces in shaping the practice of medicine. In other words, medicine and science are not as *objective* as we so often assert. To review history then will keep alive this important exercise in critical introspection.

Note

1. Of course, Newton’s particle theory of light- which was half right at any rate- had also been overturned 100 years earlier.

CHAPTER 2

Ancient to Pre-Modern Period
~3000 BC through ~1000 AD

Introduction

The history of modern endoscopy is relatively young, dating back no more than approximately 130 years ago. However, the roots of endoscopy actually stretch back much farther. Investigating the endoscope's origins therefore naturally leads us far back in time, back beyond the reach of our clever radiocarbon-dating technologies no doubt.

To help us avoid getting lost entirely during our great leap backward in time, we propose for the reader four of endoscopy's most fundamental obstacles which will be used as reference points throughout this historical review. As we shall see, the great race to discover the internal workings of the human body was characterized in part by the incremental process of trying to overcome these four main hindrances which plagued endoscopy's pioneers well into even the twentieth century. In order for early endoscopy to truly achieve practical value, these obstacles had to be addressed:

Four Obstacles

1) Creating or expanding entrances to the interior body;
2) Safely delivering enough light into the interior space;
3) Transmitting a clear and magnified image back to the eye, and;
4) Expanding the field of vision [1].

As we review endoscopy's history then, it will be useful to keep in mind these four obstacles, for it allows us to keep perspective of the limitations the early pioneers were facing. And more than that, it is both entertaining as well as inspirational to marvel at the sheer tenacity and ingenuity involved in trying to outsmart this set of surprisingly persistent dilemmas.

Ancient Attempts to Overcome the Four Obstacles

Ancient Egypt

Indeed, some progress toward the first obstacle in particular was quite readily achieved by the ancients, proof of which has been provided by archaeologists, those dear individuals who, thankfully for humanity and history projects alike, are dedicated enough to sift softly through mounds of debris and decay, hoping to uncover vital clues to our human past. By this method, Egyptian history in particular has been meticulously reconstructed, allowing for remarkable discoveries in Egypt's history of medicine. From a manuscript discovered by the late American Egyptologist, Edwin Smith, we are able to trace some rudimentary outlines of endoscopic-like practices and precursors as far back as circa 2640 B.C., during which time the great pyramids were built. Smith's found manuscript, referred to as the *Edwin Smith Papyrus* [2], is one of the oldest known medical treatises in the world, written in approximately 1700-1600 BC, but referring back to another older text from circa 2640 BC. From these findings

we can see that Egyptian healing appeared to be an art form that was practiced on many levels, from embalming, to faith healing, to surgery. There are also clear indications that Egyptian physicians were treating some surgical conditions in ways remarkably modern in form. For example, a preference for non-intervention was described. Using an approach strikingly similar to modern-day triage, the ancient author divided medical conditions into three categories; treatable, treatable with difficulty; or “an ailment not to be treated," a category roughly analogous to our modern concept of “inoperable.” Establishing such limitations reflects a philosophy of minimal intervention, for it must have been understood that further surgical trauma could exacerbate a patient’s condition and suffering.

And long before our modern preoccupation for managing pain through minimal intervention, the unknown ancient author of the *Smith Papyrus* was deliberating on this same issue over 3500 years ago, a staggering head start to our own era of patient advocacy. Demonstrating great consideration for pain management, the author wrote "As for measuring things with a grain measure ... suffering is to be taken account of in the same way." In other words, this ancient physician conceived of pain- even just a grain’s worth- as something to be viewed with great care and sensitivity. Other disciplines of medicine were similarly progressive. Supplementing the *Smith Papyrus* was another found manuscript, dating back to 1650-1553 BC, which described such urological procedures as evacuating a blocked bladder. Even a manuscript specific to gynecology, called the *Kahun gynaecological papyrus*, has been discovered.

Recent research has also demonstrated that ancient Egyptian’s knowledge of plants with medicinal properties was so sophisticated, that today the same plants are still used for curing common ills. Just one example is acacia, which was used to treat coughs and eye complaints in ancient times and is still used for those ailments to this day. And anti-spasmodics, such as hyoscymus, cumin and coriander were used to treat colic just as they are today.

Despite such sophisticated medical sensibilities, religious practices, such as preserving the body in preparation for a presumed afterlife, appear to have inhibited the ancient Egyptian’s inspection of internal anatomy. We can especially deduce this by noting that hieroglyphics for various organs usually resembled those of animals, not humans, indicating that autopsies must not have been common practice. Thusly, though some of the surgical knowledge for solving the first task had indeed been invented, we would have to wait much longer before inspecting the human internal body became a commonly accepted practice.

Ancient China

China’s history of medicine is one of the most unique and extensive in all of world history, and, like Egyptian medical practices, it too can be said to reflect a long-standing preference for minimal intervention. An exquisite synthesis of philosophy and science, stretching back beyond 4500 years ago, much of ancient

Chinese medicine has indeed stood the test of time. Today it enthralls modern medical experts with much of its clinical efficacy, despite having been development in pre-modern eras without the benefit of (supposedly superior) modern medical knowledge. As well, western patients themselves have embraced the growing trend of so-called *alternative medicine*, a field deeply influenced by Chinese holistic and minimalist principles, such as maintaining harmony with nature, and more existential notions concerning our unity within the universal order of things. Like the ancient Egyptians, the ancient Chinese as well achieved an extraordinarily sophisticated understanding of medicinal plants, knowledge that is still relied on today. Some sources also cite Hua Tuo, the famous Chinese physician of the Three Kingdoms era, as one of the first documented physicians to have performed surgery with the use of anesthesia, achieved some 1600 years before western counterparts.

Precursors to technologies associated with endoscopy can be found in both broad and nuanced forms. Important Chinese contributions include early versions of catheters and understanding of the *camera obscura* phenomenon, knowledge of which would later of course influence the development of integral components of endoscopy. As for the catheter, it has a rich history at least 2000 years old as an integral part of medical practices throughout numerous ancient societies. China's version of a catheter was described as consisting of hollow leaves, referred to in Latin as *allium fistulosum*.

References to *camera obscura* principles have also been found in the literature of many societies throughout the ages, though Chinese discoveries in this field were among the earliest. Almost 2500 years ago, one of China's most famous philosopher's, Mo-tzu (470-391 BC) described what may have been the first accounts of camera obscura principles, which he termed "the locked treasure room" (also "the collecting place"). The ancient Chinese also contributed extensively to medical literature and compiled voluminous compendiums of knowledge. One such work, the *Nei-ching*, is considered one of the most important and extensive medical canon of all time and was said to have been written by one of China's most renowned philosopher-physicians, Huang-Ti [3], the third of the first five emperors viewed as China's Father of Medicine. Without question, the *Nei-ching* (*Huang-ti Nei-Ching su wen*) is China's single most influential work passed down from antiquity. Cited as written in approximately 2674 BC, the *Nei-ching* has stood throughout the ages as the primary foundation for traditional Chinese medicine, even as it is practiced today. Roughly translated as *The Yellow Emperor's Classic of Internal Medicine*(also *The Inner Classic of the Yellow Emperor*), this canonical masterpiece demonstrates an unprecedented degree of knowledge concerning physiology, pathology, surgery, and other disciplines [4]. For example, it outlines one of the earliest known references to the correct understanding of blood circulation, a discovery proposed over 4000 years before the famed British physician William Harvey's discovery of a similar kind.

Ancient India

Other civilizations as well were achieving progress toward overcoming the four obstacles that thwarted early efforts to visualize living viscera without harm. Rooted in such remarkable religio-philosophical works as the *Rig Veda* (circa 2000 BC), ancient Indians contributed to the world some of the most outstanding medical, mathematical and scientific discoveries. For example, one of the earliest known surgical and medical compendiums, with some parts compiled as early as circa 600 BC [5], was discovered in the present day city of Benares in northern India. Referred to as the '*Shushruta-Samahita*' [6] these extensive volumes were compiled in part by the famed practitioner named Shushruta, known today as one of the "fathers of surgery" for his exceptional skill and knowledge. Like the Egyptian *Smith's Papyrus* and the Chinese *Nei-Ching*, this Indian treatise also referred back to medical knowledge established as early as 2800 BC. These texts indicate that ancient Indian physicians were especially advanced in surgery, specifically in the areas of plastic surgery, removal of prostate gland, extraction of cataracts, crushing of bladder stones, and even dental surgery. In fact, some of the surgical methods Sushruta in particular advocated, such as his method of forehead flap reconstructive rhinoplasty, have been passed down almost unchanged today. And as for specific precursors to endoscopic-like methods, some of the first known descriptions of a tube speculum used for internal ear examinations are also found in these works; in other words, what we might today call otoscopy.

Ancient Greek and Roman Physicians- Hippocrates, Erasistratus, Celsus

As to diseases, make a habit of two things- to help, or at least to do no harm . -Hippocrates, in Epidemics, 1:11

It is to 5th century BC ancient Alexandria, Greece that many attribute as the era ushering in medical practices rooted more firmly in modern western concepts of the scientific method. Hippocrates (460?-377 BC) in particular must be given substantial credit for establishing an entirely new way of practicing medicine, one that emphasized close clinical observation and investigation into lifestyle and other environmental factors as contributors of disease. As well, Hippocrates insisted on finding a natural, rather than supernatural, understanding of disease. With his great skill in observation and analysis, Hippocrates was able to achieve an understanding of disease pathologies that were often previously attributed to supernatural inflictions. Most notably too, Hippocrates was one of the greatest advocates for minimally invasive medicine. Recognizing the value of a minimalist approach, he stressed that physicians, instead of trying to interfere with the body's own healing powers, should instead seek to restore harmony by prescribing diet, rest, exercise and even music as therapy.

The history concerning the origins of endoscopic precursors will always remain somewhat contested. In this case, Greek history is no exception. Though the other ancient surgical practices predating Hippocrates were thought to have informed Greek practitioners tremendously, generally Hippocrates is given credit as the first to have described an endoscopic technique applied to living patients.

The passage describing Hippocrates' endoscopic applications can be found in his great work *The Art of Medicine*, circa 400 BC. In excellent clinical detail, a clear method for examining the rectum using a speculum was found in*On Hemorrhoids, Section 5*, and is described as:

"But if the condyloma be higher up, you must examine it with the speculum, and you should take care not to be deceived by the speculum; for when expanded, it renders the condyloma level with the surrounding parts, but when contracted, it shows the tumor right again."

So while rudimentary endoscopic techniques had already existed, the more advanced nature of technologies found from this era do indicate that a shift toward incorporating internal inspections as part of normative medical practices was beginning to occur. One way to track this shift is through observing changes in instrumentation. Substantial improvements to the catheter for instance can be found during approximately the same time period as Hippocrates. The first known catheters with the correct anatomical curvature were described by Erasistratus (ca. 330-255 B.C.), a renowned ancient Greek physician and surgeon considered to be the first physiologist. Also of this era was the invention of the indwelling catheter, attributed to another well-known Grecian physician named Oreibasios, (b. circa 325 BC) who was also credited as an early contributor to endoscopic-like methods for examining inside the throat.

Antiquity with an Attitude
The scientific theory I like best is that the rings of Saturn are composed entirely of lost airline luggage.
-Mark Russell

In case you have nodded off as a result of this onslaught of historical anthologies, we would like to nudge you back into consciousness with a rather surprising fact: cutting or puncturing the peripheuneum on living patients is not in the least a new concept. Quasi-surgical techniques referenced by the Roman physician and author, Aulus Celsus (25 BC – 50 C.E.), have proved to be some of the earliest attempts to access the abdominal cavity, laying the groundwork for important understandings of the living anatomy. In addition to being the customary territory of lithotomists at the time, such medical innovations were likely influenced by the medico-philosophical doctrines promulgated throughout the Greco-Roman region, which emphasized maintaining balanced production and excretion of bodily waste, since imbalances were thought to trigger disease states. Therefore, preferred therapies aimed to restore normal balance through purgatives and cathartics. Alternatively, balance was said to be restored through a quasi-surgical technique (possibly similar in technique to acupuncture), by inserting a trocar-like instrument into the abdominal cavity in order to drain the disease-causing, bad humors. Of course, we have to issue a broad disclaimer here, for further clinical details have been difficult to procure. As such, just how common this method was, or to what depth the cuts were made is not at all clear. Indeed, the incisions made may only have been superficial and more

ritualistic in nature. Nevertheless, these early attempts to access the lower abdomen were important preliminary steps. Evidence to such procedures is given by Celsus whose written works left us with the following exquisitely detailed passage concerning this technique:

"Some perform it below the navel at the distance of about four digits to the left; some perforate the navel itself; some cauterize the integument and make their opening into the abdomen by incision..."

The instrument used was described as:

“A leaden or copper cannula with its lips curved outwards, or one that has a circular rim at its middle to prevent its slipping into the cavity, is then introduced through the aperture. When the latter is used, that part of the instrument that is introduced should be no longer than that which remains external to the aperture, in order that it may proceed beyond the peritoneum."

Even before Celsus, Erasistratus too had earned acclaim in Greece as a preeminent surgeon who performed abdominal surgeries rarely attempted (or successfully completed) by others in his day. Based on these records, along with discovered remnants of ancient trocar-like instruments and speculums, we can marvel in knowing that the history of endoscopy is a story which has been flowering and unfolding throughout the centuries, a fact which connects us therefore to a rich heritage filled with brilliant scholars and indomitable spirits.

Near and Middle East- Al-Qasim, Al-Haytham, Ibn Sina
Medical practitioners from the near and middle east were some of the first to come closest to solving the first two obstacles in one fell swoop, by using your everyday, run-of-the-mill mirrors, oil, candles, and sunlight.

A Turning Point- Abu-Qasim Establishes World’s Earliest Endoscopic Techniques
Hailing from Cordova, Spain and known as one of the world’s fathers of surgery, Abu-al-Qasim [7] was one of the greatest surgeons and philosopher-scientists of the pre-modern era, (936-1013 C.E.), whose innovations in surgery especially served as foundational principles throughout Europe and Eurasia for over 500 hundred years. Al-Qasim’s contributions to medical literature were also substantive, with his thirty-volume medical encyclopedia*Al-Tasrif* (*The Method*) among the most renowned. Most incredibly for the history of endoscopy, the descriptions of surgical practices found in the chapters dedicated to surgery demonstrate that al-Qasim was performing some of the earliest known procedures involving basic tenets of endoscopy. For these works alone, Al-Qasim is considered as one of the most important pre-modern founders of endoscopy. His pioneering spirit also led to a lengthy list of inventions as well. He is credited for inventing several of the surgical-cum-endoscopic instruments, including a device for internal examination of the ear, one for the internal inspection of the urethra, and a separate instrument for removing foreign bodies from the throat. Another instrument was described as an "exploring needle with a groove," which

had an attached handle, indication for a trocar or cannula-like instrument. While the records are unclear about the use of external light sources or the extent to which true visualization was achieved, these surgeries nevertheless demonstrate that early endoscopic techniques and instruments were in the process of being developed, even if only as a continuation of such well-established ancient practices as lithotomies.

Another Turning Point - Harnessing Reflected Light

Avicenna

In approximately the same time frame, the Persian physician-philosopher, Ibn Sînâv [8] from Buchara, commonly known to westerners as Avicenna (980-1037), stood as one of the greatest thinkers of his era. It is not surprising then to find that it was he who has been credited for one of the most crucial turning points in endoscopy's history; the use of reflected light. Avicenna's endoscopic techniques are generally considered to be the first documented instances of using reflected sunlight and polished glass mirrors to examine internal cavities. This method for examining the vulva and cervix consisted of laying a mirror in front of the affected vulva, expanded with a speculum, at which point the physician could then position himself standing behind the woman in order to view the reflected image. By these methods, Avicenna achieved a moderate degree of success in overcoming (at least partially) two of the four obstacles hindering endoscopic inspections. Other innovations introduced by Avicenna include a flexible catheter and a technique that suggested introducing a pipe into the larynx of a suffocating patient (an idea which also had been presented earlier by Hippocrates). Avicenna also reported on the use of diamond-tipped metal probes that were used to destroy bladder stones (something early Greeks wrote about too).

Al-Haytham

Innovations within other scientific fields proved crucial to endoscope's later development. In approximately 1000 AD, a mathematician and astrologer from Basra (now part of Iraq) named al-Hasan ibn al-Haytham [9], contributed substantially to the field of optics when he resolved the mystery of vision through experimentation, simple empirical observations and geometrical proofs. Al-Haytham determined that light originated from outside the eye and reflected back in, rather than the other way around as had been commonly believed. Through these observations, al-Haytham was able to overturn the prevailing classical theories proposed by Ptolemy and Euclid and discovered for his own era new insight into *camera obscura*. In fact, some in the field of optics today have referred to Al-Haytham as one of the fathers of modern optics.

Summary of Ancient Periods

How did our ancient friends do in resolving the four dilemmas? Struggles with operating within limited space still persist even today, but this initial task was one of the earliest hurdles that our ancient colleagues had to face before really being able to move on to the next levels. Such innovations as the trocar, sheath, speculum with screws, and the like, reflect the variety of methods used in trying

to solve the first dilemma of creating or expanding bodily cavities. As to the other tasks however– with the exception of Avicenna's modest efforts with reflected sunlight- we would have to wait until deep into the 19th century before these could be sufficiently addressed.

Notes

1. The author of *Highlights in the History of Endoscopy*, Litynski, suggested the first three tasks. We propose the addition of the fourth.
2. Not to be confused with a second medical manuscript known as the *Ebers Papyrus*.
3. There is some contestation about the true date in which the *Nei-ching* was written, and about whether Huang-ti actually wrote the text himself or even if he existed.
4. The *Huang-ti Nei-ching* is considered the original text, whose authorship is ascribed to Huang-ti himself. A similarly named text called the *Nan-ching* is a rendition written circa 150 CE.
5. 800 B.C. has also been cited.
6. Also called *Charaka-Samahita*
7. Full name Abu al-Qasim Khalaf ibn Abbas al-Zahrawi. Sometimes also referred to as al-Zahrawi. Known in the west by the Latin translation Abulcasis.
8. Full name is Abu Ali Al Husein Ibn Abdallah Ibn Sina.
9. Latinized as Alhacen or Alhazen.

CHAPTER 3

Renaissance, Scientific Revolution, Age of Enlightenment
1500s CE –1700s CE

Introduction

There is a single light of science, and to brighten it anywhere is to brighten it everywhere.
-Isaac Asimov

Clearly, the prohibitions concerning inspecting the human body were finally dissipating, allowing for a new era of discovery to steadily unfold. This turning point was crucial for another reason as well, for it was here that endoscopy was pushed toward the threshold of a new beginning, one characterized by a long, tedious battle to achieve a source of immaculate illumination– aka, the second obstacle. Leaving off from the 11th century, the story of endoscopy at this juncture centers on the journey toward solving the second problem of bringing sufficient light inside the body, a process that would take another 900 years of accumulated scientific knowledge to resolve. In fact, this second obstacle actually defied true decryption well into the 20th century, for it was not really adequately resolved until the introduction of electric technology and later, through fiber optics. However, during this pre-Edison era, the attempts were nevertheless clearly becoming more sophisticated. Innovators began experimenting with new sources of light, such as electrified platinum. Though these devices often proved impractical, such attempts to piece together the puzzle of illumination must be considered great acts of ingenuity for an age before Edison.

The European Scientific Revolution – 1500s–1700s

Leaving the 11th century, we make a fairly large leap forward, beginning with the year 1500, a year commonly cited as the starting point for the modern era of history. Despite our circumvention of a few centuries, it is important to remember that many minds contributed to the development of endoscopy, including those from the intervening years before 1500. For our purposes however, we turn now to the 16th century, an era when a brilliant rebirth of interest in the arts and sciences poured forth from the Eurasian continent in particular. Progress seemed to take shape especially after the world received perhaps one of this era's greatest contributions: the Guttenberg printing, perfected for use by 1440. While other rudimentary forms of mass print production had been in existence much earlier (most notably from 11th century China) the Guttenberg press stood out for its greater mechanical sophistication and for its ability to achieve production on a much larger scale. This breakthrough in technology was instrumental in launching a new era in communications, which naturally enhanced scientific understandings. Similar to the effects of today's Internet, access to knowledge soon became possible for a wider audience, not just for those within elite society. No doubt too, the

Guttenberg press helped further expand the scientific progress of this time period.

Until this point in time, the technologies associated with endoscopy had not developed much beyond their ancient forms conceived a thousand years before. But this seemingly plodding pace of progress was about to change with the onset of what is commonly referred to as Europe's Scientific Revolution [1]. With the great progression of scientific knowledge that ensued, countless medical traditions were boldly called into question; a great many physicians were knee-deep in this unfolding plot to overthrow all established but untenable theories held so dearly by their classical counterparts. Of course, even with the era's strident efforts to obtain more knowledge, a great many aspects of human biology remained woefully misunderstood. Misconceptions about female anatomy in particular were still circulating well beyond this 16th century time frame. Even the famed anatomist Vesalius (circa 1538) missed the mark considerably when he failed entirely to identify the ovaries in his classical works on anatomy published during this time frame.

A 2nd Turning Point- Capturing and Reflecting Artificial Light

Despite such lingering confusion over anatomy, a great many innovations during this era would prove crucial for endoscopy, particularly those relating to light and lenses. In the opening hours of this modern era, one of the first documented attempts to harness artificial light was achieved by the famed though somewhat controversial Italian mathematician-physician named Gerolamo Cardano (1501-1576) [2], whose life work exemplified the Renaissance era of rambunctious intellectualism. The ingénue behind many inventions and discoveries– and author of a notorious treatise on the secrets of successful gambling- Cardano clearly broke the mold for endoscopy at this time with his invention of a mechanical lamp for examining interior body cavities. Unfortunately, historical records reveal far too little about this particular innovation of Cardano's to hazard further interpretation. It is tempting however to view Cardano's work as a 270-year old ancestor to Bozzini's lichleiter.

Another Italian named Giulio Cesare Aranzio (1530-1589), a celebrated Venetian physician and anatomist in his day, is commonly cited as an important 16th century figure contributing to endoscopic-like techniques, though the bulk of his work related mostly to brilliant anatomical discoveries. However, he did devise a clever method for harnessing reflected light by utilizing the known principles of *camera obscura* to reflect natural sunlight off a glass balloon flask filled with water, which was then placed in front of the shutters of a darkened room and then directed into the nasal cavity of his patient.

Around the same time, important improvements to the simple specula were made by a French physician named Pierre Franco (1500-1560). A renowned lithotomist from Provence, Franco made substantial contributions on many levels, including the construction of an improved speculum to examine the female urethra, which ultimately helped to achieve some of the first instances of

extractions of urinary calculus in the female patient. With many other innovations, Franco is therefore credited by many with setting the foundation for urethroscopy.

Bombastic Blowing of Bellows- Paracelsus and Insufflation's Early History
Who does not know that most doctors today make terrible mistakes, greatly to the harm of their patients? Who does not know that this is because they cling too anxiously to the teachings of Hippocrates, Galen, Avicenna and others?.... In experiments, theories or arguments do not count. Therefore, we pray you not to oppose the method of experiment but to follow it without prejudice.
-Paracelsus, circa 1530

Experiments with an inseparable adjunct to today's laparoscopy– insufflation– were also just beginning to appear in the literature of this time, though early work in this area has also been attributed to Hippocrates. Born in Einsiedeln and later practicing in Basel, Switzerland, Theophrastus Philippus Aureolus Bombastus von Hohenheim– self-renamed *Paracelsus* (1493-1541)- was a physician credited with distending the lungs of his suffocating patient by devising a clever system using bellows to blow air into a tube that was placed in the mouth. Paracelsus also contributed to surgical literature with his well-regarded work entitled *Die grosse Wundartzney* (The Great Surgery Book). Despite these and other contributions, Paracelsus' unconventional methods were unfortunately not well received, attributable in part to his apparently arrogant demeanor (cited as the perhaps apocryphal origin of the word*bombastic*). He certainly made few friends when he tried to overturn many of the established medical tenets of the day, which in part still relied on Galen's grossly incorrect theories of the four humors. Or perhaps it was his uncanny talent for upsetting people with either his drinking or temper; he was reputed to have drunk "miners and teamsters under the table" and as well carried with him at all times a "huge sword." Dabbling too in other misunderstood and therefore controversial medical practices for the time, Paracelsus was taunted as "the Luther of medicine" and was forced by the mainstream medical establishment to leave his city altogether. As we shall see, this is just one of many figures in endoscopy's history who would be publicly disparaged for unorthodox innovations.

From Guttenberg to Newton- Late 16th through Early 18th Century
Nature and Nature's laws lay hid in Night. Then God said: "Let Newton be," and all was Light.
-Alexander Pope, giving praise to Newton

In short, the timing couldn't have been more perfect for the endoscope to take off at this stage in time. Divination had long since past as a popular means for treating illnesses. Fundamental changes in understanding about the physical world were unfolding, elegantly illuminated by such brilliant minds as Newton. And though remnants of erroneous Aristotlian-based medicine, with its central belief in bodily humors, were still part of commonly held convictions, these views were indeed crumbling before an ever-widening audience of educated

thinkers ready to scientifically challenge unverified assertions. Perhaps most importantly for surgery, the long-standing unease about inspecting the interior human body- living or otherwise– had finally abated to the point where research actually could be conducted for the most part in full view of academic bystanders. In short, it seemed at last the world was now ready- socially and religiously- for great and profound leaps forward in science and medicine.

Electricity Unleashed- The Second Obstacle Begins to See Its Slow Demise

Within this vibrant era of scientific discovery, crucial new research about electricity was being conducted, which naturally directly catalyzed great advancements in medicine. Of course, theoretical knowledge of electricity's existence was known since ancient times. The word *electra* was a Greek word for amber, a mineral rock found to be capable of lifting light materials after being rubbed. This era however was characterized by efforts to actually capture this mysterious electrical energy, as well as to understand its effects on animal tissue. Physicians were especially influential in this critical new field and were some of the first to find ways to harness the powers of electricity for the benefit of humankind. One such pioneer was William Gilbert, the personal physician to Queen Elizabeth I and founder of the so-called 'magnetic philosophy.' In 1600, Gilbert introduced the term 'electrica' and described what would later be known as 'static electricity,' a term used to distinguish his discovery from earlier terms associated with the prevailing but erroneous Aristotlean views on matter that had for centuries misguided scientists concerning the physics of electricity. Without question, these innovations proved to be crucial for the transformation of endoscopic technologies, though another 200 years or so of tinkering would be required before these discoveries could yield an endoscope of practical use.

Peripheral Developments - Lens Technology

Great strides were being made in other fields during this period of rapid scientific transformation. In particular, progress in lens technology was advancing quite nicely. Many of the necessary components for modern endoscopy were being conjured up right here. Credit is given to the Frenchman Pierre Borel of Castres (1620-1689), the personal physician to King Louis XIV, for inventing the concave mirror that reflects light more intensely and precisely. Borel is also considered among the first to apply the microscope to medicine. Of course, the invention of the microscope itself (in the late 16th century) catalyzed tremendous advancements in biology and medicine. In 1683, Antony van Leeuwenhoek, a renowned Dutch scientist, became the first in history to actually visualize living bacteria when he used a microscope to examine his Petri dish filled with water. Other crucial innovations in optics during this era include Galileo's improved telescope, while Newton advanced theoretical knowledge of light and optics with the publication in 1704 of his other brilliant work entitled *Opticks*.

As can be said of today's surgical practices, it is frustrating to note how long it took for many of these technologies to find their way into the fold of endoscopic usage. As the next chapter and others will reveal, so many of the world's most

important discoveries were actually initially the subject of scathing ridicule, dismissed as irrelevant- or irreverent– or, at other times simply blithely overlooked, only to be re-discovered years later.

Notes

1. Of course Europeans were not the only ones contributing extensively to the advancement of the sciences at this time. In fact, during this early 16th century time frame, Europeans were actually much less advanced than other societies in many important ways. China's Ming Dynasty and the Middle East's Ottoman Empire, with several centuries' head start, continued to reign as two of the most sophisticated societies of their time, with highly developed centers of culture and science. Thus, it is more accurate to state that endoscopy's further advancement during this era resulted from the continued exchange of scientific knowledge from multiple societies.

2. Known also by his latinized name Jerome Cardan.

CHAPTER 4

Hovering on the Brink of Modernity
1700 – 1806 CE

The Lost History of 1710

Man will occasionally stumble over the truth, but most of the time he will pick himself up and continue on.
-Winston Churchill

The development of endoscopy needed several stages before lifting off to become a clinically successful technology. But to the dissatisfaction of our logic-seeking minds, this multi-staged affair did not necessarily happen in a straightforward, linear fashion. Leaps forward were sometimes abruptly followed by staggering digressions backward. This brief story about the lost history of 1710 provides for an excellent example of just such an uncoordinated unfolding of history.

In 1710, the German Johann Michael Conradi, compiled a textbook on the evolution of optics, cleverly entitled *The First Optical Instruments as Allegorical Depiction*, which also included remarks about endoscopy's history. Remarkably, Conradi's work provides for an unexpected revelation, for it reveals that almost all elements necessary to make the endoscope viable existed at this very early juncture in time. Using the framework of optical technologies, Conradi outlined the roots of endoscopy and summarized the development of endoscopic technologies from the previous centuries. A number of optical instruments were depicted in fine detail. What is most striking is that, based on these diagrams, one can see that every single part necessary for Bozzini's endoscope was in fact already available. Even many of the parts necessary for Nitze's work were pictured. The full list of items included a prism similar to the one utilized by Trouve and Nitze, magnifying glasses, microscopes, lenses, a lamp case, and a conical mirror (both flat and curved) used for distorting, a feature necessary for future otoscopes and periscopes. Just missing from the list were galvanized wires and electricity, which naturally were not available during this 1710 time frame.

Perhaps merely a reflex of our modern minds, accustomed to rapid-fire change, but it seems nevertheless exasperating to note that nearly a century went by before a synthesis of these existing ideas could be achieved.

The 1700s – Coming Closer to Fully Resolving the Second Obstacle

Despite what appears to modern viewers as a dreadfully slow and leisurely progression of progress, a long continuum of unabashed curiosity luckily persisted well after Conradi's work. All over the globe still many pioneers were pioneering away with tubes, probes, and pipes- whatever they could get their hands on really- to discover the secret energies and enigmas housed within the human form. Indeed, as early as 1706, the term "trocar" was apparently first coined, a word thought to have derived from trochartor troise-quarts, which describes a

three-faced instrument consisting of a perforator enclosed in a metal cannula. Later in 1762, William Smellie of London, considered one of the most preeminent obstetricians of his day, treated asphyxia in newborns by inserting catheters inside the upper respiratory track, a procedure that necessarily followed endoscopic-like principles.

Turning Point - The Use of Lenses to Reflect Light
Remarkably, the use of biconvex lenses to redirect light was documented as early as 1729. In 1729, another British physician, Archibald Cleland, described a nasal illumination device that consisted of biconvex lenses placed in front of a wax candle in order to magnify and redirect the light. Though little more is known of the circumstances surrounding Cleland's innovation, including whether he was in fact the first to use lenses in this manner, we do know for certain that his work represents an important turning point in the history of endoscopy, certainly a big step up from the early days of using drinking glasses filled with water! Though this milestone is rarely mentioned in other histories of endoscopy, it is a significant first that brought the field closer than ever to modern-day techniques.

Milestone Achieved – Endoscopic Visualization of the Eardrum
Using similar techniques as Smellie and Cleland, the German physician, Samuel Vogel, circa 1780s, is credited as the first ever to view the eardrum in a living patient, by using a small plane mirror to reflect sunlight into the auditory canal. This marks a defining moment in endoscopy's history, for this represented a synthesis of medical knowledge which finally led to visualization of a more difficult to reach internal cavity.

Precursors to Laparoscopy
Precursors to laparoscopy were slower in developing than other endoscopic specialties. Even so, like the ancient physicians before, surgeons continued their efforts to treat kidney, bladder and gallbladder stones with the use of an abdominally placed trocar. The trocar itself was designed to not only help guide the probes placed inside the urethra into the correct bladder location, but also were used to keep the bladder empty. However, this approach often led to complications because the trocar would get clogged. To overcome this problem Domenico Masotti of Florence designed a new trocar in 1756, which came equipped with drainage canals. Amazingly, these same design principles were alive and kicking some 200 years later when Reuter "reinvented" the technique using the low pressure "TURP" trocar lithotripsy.

The Chapter of Unsung Milestones – A Few Cases of Overlooked Innovations
Modena, Italy, 1780: – Early attempt at Gastroscopy!
L. Spallanzani was apparently the first documented to insert what he described as a metal tube into the stomach of a living animal in order to observe its viscera.

Paris, France - 1743
While many countries contributed to scientific progress during this era, France in

particular was considered one of the most important centers within Europe for science and medicine. The work of another Frenchman, one of the most intriguing innovators of his time, has been actually almost lost in historical obscurity. Appointed to the French Royal Society for both surgery and obstetrics, the obstetrician-surgeon Andre Levret (1703-1780) was an esteemed practitioner and innovator whose imaginative energies led to the invention of numerous surgical techniques and instruments. In 1743, Levret described a novel specula used to facilitate the ligature of uterine polyps and which combined the dual features of reflection and illumination, a similar concept to the one so famously introduced 50 years later by Bozzini. Though this discovery has not been given great coverage in many histories of endoscopy, this development actually was an extraordinary milestone, for it marks one of the earliest documented cases- perhaps the first– of a *therapeutic*endoscopic procedure using reflected light other than sunlight. Levret was also one of the earliest known pioneers to have invented an instrument with the correct angles for viewing the larynx indirectly.

Levret's many other innovations, including improved forceps and cesarean techniques, enjoyed tremendous prestige during his life and today he remains honored as one of ob-gyn's greatest figures, considered second only to Smellie. Yet Levret's reflecting-illuminating device apparently failed to capture the attention of the world in the same way as Bozzini's similar invention did just a few decades later. Of course, it may be an unfair comparison to view these two different developments using the same yardstick. Even so, the fact that Levret's work is almost entirely overlooked in many accounts of endoscopy's history is an unusual point that calls for a moment of reflection. This brings us to the next chapter, which attempts to provide insight into such disparities within endoscopy's history.

CHAPTER 5

The Anatomy of a Pioneer

If you have an important point to make, don't try to be subtle or clever. Use a pile driver. Hit the point once. Then come back and hit it again. Then hit it a third time- a tremendous whack.
-Winston Churchill

Unfortunately, the world would indeed have to wait another half century to see further progress, for Levret's devise, overall, appears to have gained only minimal attraction from the medical community. In hindsight, this seems surprising considering that Bozzini's device just 50 years later was able to garner such a greater degree of interest. Curiously too, the amazing fact that Levret was possibly the first ever to have performed a *therapeutic* endoscopic procedure using reflected light other than sunlight also seems to have slipped past the world's notice. While the causes for such disparity in acclaim can never be known for certain, the inattention given to this particular invention of Levret's may have resulted simply because his several other innovations, including his contested but still acclaimed improvements to obstetric forceps, were perceived to be more important achievements at that moment in time.

Such instances of the *so close, yet so far away* syndrome seem to have been rampant across the landscape of medical history. So often it appears that an earlier invention had everything required to make it just as much of a hit as a later version. Yet, some essential ingredient proved to still be utterly absent. Many of the factors associated with the success of an idea can be attributed to conditions outside the control of the innovator, such as time frame and presence of other technologies. Yet, the efforts of the individual do have a great deal of influence as well, for part of the genius of any innovation is having the inventor recognize the significance of his own discovery. And even that aspect is not sufficient to launch an idea, for the inventor must be able to explain to the world, in simple and easily understood terms, why the invention is worthy of consideration.

The history of endoscopy is therefore ultimately a story inextricably bound by the human energies of character and charisma, persistence and insistence. As Dan Goleman, today's expert on social intelligence would agree, these 'people skills' are absolutely crucial for pushing ideas forward and to the fore, past the pessimists lurking at the door, past dogma and doctrine and even decorum at times. This is the real story behind the endoscope, the one that reveals the irrepressible human spirit as the true driving force behind all of humankind's greatest achievements. And within a few years the world would indeed see just such a pioneer burst onto the scene whose work would finally advance endoscopy firmly and definitively into the realm of reality.

PART II) 1800-1877: BOZZINI, DESORMEAUX, CRUISE

CHAPTER 6

BOZZINI: The Beginning of Early Modern Endoscopy
1806

Introduction
One man with courage makes a majority.
-Anonymous

Naming a specific moment when the modern endoscopic era began is an imprecise art, one that is also subject to biases in perspective. For urologists, the beginning may rightly be attributed to Desormeaux, while for laryngoscopists, Kussmaul's incident with the sword-swallower could be cited. General surgeons of course, as the story goes, seem to mark 1987 as the year it all began! However, amongst various disciplines, it seems the Italian-German Philip Bozzini was the physician most believe achieved the first significant attempt to visualize the interior body in a novel way, earning him the title of*the* father of endoscopy.

How Bozzini Gave Endoscopy Its Groove
So one may rightly wonder; why all the fuss over Bozzini? After all, were there not others who developed similar instruments for similar purposes? Such issues may never be completely resolved to the full satisfaction of everyone. Part of the answer, however, predictably relates back to our constant companions, the formidable four obstacles. Bozzini's essential achievement was that for the first time in history, three of the four central constraints hindering endoscopy's development for thousands of years were finally all cured in a single moment in time by Bozzini's singular instrument.

Some aspects of Bozzini's invention cannot be considered innovations at all. For instance, reflecting light using mirrors was not at all a new concept. As previously mentioned, al-Qasim experimented with similar concepts nine hundred years earlier. Moreover, as was already noted, the technology required to make a functional endoscope had been available since at least 1710, if not earlier. This includes the lens system that Bozzini utilized, which had been derived from 17th century telescopes. Still, Bozzini's creative genius went beyond the work of earlier innovators, for he was the first ever to efficiently solve endoscopy's third flaw; reflecting images back to the eye.

Perhaps most crucially (though this part of the history is contested), Bozzini's lichleiter was in fact somewhat successfully used [1] in several diagnostic procedures on actual, living, breathing patients, making the device not just one languishing in theoretical hinterland, but one which indeed achieved immediate, practicable value. While such solutions may appear outrageously obvious to us today, in fact no one before Bozzini had been able to successfully combine the necessary technological elements into one unified, usable source. In short, it was

a breathtaking coup, one that sets Bozzini apart as the indisputable founder of modern day endoscopy. As the saying goes, Bozzini was indeed “the right man, at the right time, with the right stuff.”

Despite Bozzini’s novel achievements, there are in fact disputed and somewhat disturbing aspects to this story. Therefore, to better understand the significance of this turning point in endoscopy’s history, let’s review not only details of the instrument’s best features, but some biographical aspects of the man behind the machine as well.

Technical Details

Throughout the history of endoscopy, many have denounced Bozzini’s device as rather simplistic in form, not the stuff turning points are made of. However, engineers at Mercedes Benz, who were recently commissioned to reconstruct the lichleiter using only Bozzini’s drawings, were in fact “very impressed” by the technical skill required to make the instrument.

Besides the complexities in the instrument’s design, being first counts as well. Bozzini was indeed the first to adopt existing lens technology in order to solve the third problem of reflecting images back to the eye (our modern understanding may not include Bozzini’s system of mirrors as an actual “lens system,” but it was for his time just about the latest that technology had to offer). He did this by devising a system of double aluminum tubes equipped with strategically angled mirrors (flat, concave and convex) that were positioned in such a way as to bring the image back to his eye while simultaneously conveying the distally-placed candlelight into the interior body. Though the double tubes ultimately proved unnecessary to reach this end (a singular tube is able to convey light in both directions at once), such knowledge of optical physics was not well known at the time, rendering this “mistake” a forgivable lapse in design. One could also interpret this differently and say instead that Bozzini was simply two hundred years ahead of his time on this point, for fiber optic technology in fact utilizes two “tubes” for conducting light and image separately.

Originally, the lichleiter was designed mostly with obstetric and gynecologic inspections in mind, since Bozzini’s initial training was in this field. And it appears that the most success with the lichleiter was in examining female patients. In this field, Bozzini became especially frustrated that only blind palpation was available as a means of examination. In fact, a common saying during his time was that “the eye of the obstetrician should be located in his fingertips.” Yet, this was a view Bozzini did not share in the least. Bozzini is quoted as stating that such inspections relied “merely on good luck and chance.“ He firmly believed that such games of chance could finally be ended by using his device.

Bozzini was especially hopeful that his lichleiter would render exact diagnoses of pathological lesions of the uterine orifice. True to his vision, he did construct a metal catheter for the female urethra, with lateral slits on the sides through which instruments for “swabbing painting and cauterization” could be

introduced. Specific therapies for cervical carcinoma were also described as early as 1805.

One of the contested aspects of Bozzini's history concerns whether or not his device was used on living patients. Based on the latest research by Dr. Peter Figdor, a German physician, documents were uncovered which indisputably confirm that the lichleiter was successfully used on living female patients. These test trials were conducted at the private maternity ward of the Institute of Professor Ludwig Friedwich von Froriep, in June of 1806. One specific report, referred to as the "ninth experiment," described a case in which the lichleiter was used to visualize a high fistula within the rectum, a condition that was later operated on.

The next report, named the "tenth experiment," described using the lichleiter on living, female patients, in which an exact diagnosis of pathological lesions of the uterine orifice was obtained. Specifically, the lichleiter was used to examine the vaginal canal of a woman who was believed to have a tumor, which had been palpable upon digital examination. Using the light conductor, the physician was able to definitively confirm the presence of a polyp. As a result of this observation, the patient subsequently underwent an operation and was healed seven weeks later. The positive report of these results stated that 'This preoperative colposcopy conducted by Dr. Beinl is the first published clinically indicated endoscopy.'

It is also of great importance to mention that Bozzini did in fact understand the significance of the endoscope's operative potential. He described his hopes in the following passage:

"Surgery will gain not only from the new operations that could not easily be performed until now, but also all other uncertain operations, which depended on mere luck and chance, will now be relieved of uncertainty by the influence of sight…But extirpation of carcinoma of the uterus, many of the unfortunate women who otherwise could not escape certain death will be returned to the enjoyment of life and health. Deformations of the uterine orifice, the vagina, polyps and ulcera of the same, and of the rectum and the bladder stone can be operated by sight" – Bozzini, 1805

Indeed, such designs truly establish the lichleiter as one of the most significant precursors to operative endoscopy, a vision Bozzini embarked upon almost one hundred years before others would even attempt to extend the endoscope into such realms.

Versatility

What is also striking about Bozzini's work is the wide range of use he had envisioned. Possessing a naturally expansive imagination, Bozzini declared that his device would be applicable for "practically all cavities." Since it was an accepted custom for physicians to work in multiple disciplines during this time period, Bozzini did indeed conduct research in many fields. The attachments he

designed for his lichleiter were intended for inspections of the vagina, urethra, the female bladder, the rectum, and the upper air passages. Other auxiliary attachments were constructed which could be used for parts of the body inaccessible to direct viewing, such as was necessary for the esophagus, larynx, and posterior nasal and throat cavities. Called a "*winkelleitung*," or angle conductor, these specially designed lenses enabled him to achieve some visualization to these areas for the first time in documented history. Many laryngoscopists in fact credit Bozzini as being the first to conceive of the laryngoscope. An early pioneer of laryngoscopy by the name of Morell Mackenzie (1837- 1892) referenced Bozzini in an 1867 publication, noting that the lichleiter was the first laryngoscope to have achieved success in clinical uses.

In the field of urology, the record is unclear concerning the lichleiter's success. Bozzini had crafted a smaller tube specifically for urethroscopy which allowed for ulcers in the male urethra to be visualized. However, the record is not clear as to whether bladder stones were in fact removed from living patients. Research on this topic was conducted by one of endoscopy's later pioneers, Professor of Urology, Otto Ringleb. After extensive investigations, Ringleb concluded that he didn't believe Bozzini was actually able to access bladder stones in living patients. Instead, Ringleb found that Bozzini's reports were more consistent with experiments using cadavers, in which case such access could easily be achieved. Nonetheless, Bozzini does appear to have had some success with the female urinary tract.

Concerning other fields, there is again some dispute concerning the lichleiter's efficacy, particularly for the esophagus. Historical records also do not make clear whether the investigations of the upper G.I. were successful in living patients.

Bozzini conceived of other uses that remained only in his imagination. For instance, he had intended to eventually modify the lichleiter to make it capable of inspecting the abdomen; in other words, laparoscopy. Of course, prior to the advent of asepsis and antisepsis, such operations would most likely have been lethal. Nevertheless, these historical notes attest to Bozzini's genius, for his visions were truly far ahead of his time. Through the originality of his work, the stage was set for subsequent trailblazers who would come to acknowledge and rely on many of his foundational principles.

Some Setbacks

Despite these great strides, Bozzini nevertheless came up against a great many difficulties. This next section explores the hindrances affecting Bozzini and the acceptance of his Light Conductor.

In reviewing the history, it seems Bozzini faced at least three main types of obstacles: 1) technical difficulties, 2) time constraints, and 3) resistance and rivalry from colleagues.

As for the technical side, the light source of candlelight has been cited as the weakest aspect of Bozzini's invention. Of course this is a consequence stemming

from the limited range of light sources available during his time. In fact, the problem of inadequate illumination would not truly be solved until almost 200 years later, with the advent of fiber optics. We certainly cannot bother Bozzini too much then, on this point. It does seem that Bozzini made the best of what was available. His meager little candle in fact was not so measly, for he devised a way to stabilize it with a system of springs so that it remained securely in place in order to deliver a consistent ray of light as reflected off the concave mirror placed adjacent to the wick. Another technical concern was the small field of vision, which was limited to the circumference of the scope itself. In fact, this drawback was the main one cited by Bozzini's most vigorous critic: Dr. Andreas Josef von Stifft, head of the opposing Viennese medical center and also personal physician to the Kaiser himself. Despite his prestigious ranking, Stifft was hardly a visionary; he dismissed the lichleiter, claiming that even if improvements in the optics were made, "the judgment of a reasonable doctor and the finger of an experienced examiner will still remain, as in the past, the sole means from which the patient …can expect…fitting treatment." Within just a few short decades of course, Stifft did stand corrected.

In any case, again, one cannot really fault Bozzini's inability to overcome the field of vision aspect, for this obstacle remained insurmountable for quite some time and was not actually solved satisfactorily until Nitze's innovations, some 70 years later. More importantly, Bozzini had the ability to use his powers of imagination to see past such nominal constraints, a talent which set him apart from everyone else of his day.

The other immediately observable setback relates to the untimely and unfortunate demise of Bozzini himself, who succumbed to typhoid fever on April 4, 1809, just about a month shy of his 36th birthday. This fact underscores that Bozzini actually achieved a great deal within his short life. Within only three short years from its first round of testing at the Josephinian academy in 1806, and until his passing in 1809, Bozzini's lichleiter was able to garner the attention of some of the most important medical centers of the world. To put this in proper context, consider that even in the 20th century, the remarkable discover of penicillin by Alexander Fleming actually took over ten years to be recognized as valuable by the scientist community.

Other issues related to the resistance and rivalries of fellow colleagues, a persistent problem that has affected quite a few pioneers within endoscopy's history. Some of Bozzini's contemporaries reacted with resistance for having to undergo special training (a similar problem to that encountered hundreds of years later when videolaparoscopy emerged). Because the lichleiter was new and had so many sets of attachments, carefully reading the instructions was mandatory. Bozzini believed that those physicians who rejected his devise had done so prematurely as a result of failing to follow his precise instructions. To be fair, Bozzini's invention was not exactly "user-friendly," with its perhaps unruly array of attachments and such. In other words, just like today, the lack of training, technical inexpertise and 'user-error' (or lack of user-friendliness)

figured into some of the reported failures. To the end, Bozzini made many special efforts to point out these errors and attempted somewhat in vain to rectify the situation.

Finally, it was the myopic views of a handful of Bozzini's contemporaries that stood as one of the most difficult setbacks of all. Many could not see past the lichleiter's technical flaws. Bozzini was so far ahead of the curve that he envisioned his instrument as an operative force almost 200 years before advanced operative laparoendoscopy made it to the mainstream. Yet, invariably it seems, being too far ahead of the curve has its consequences, making pioneers susceptible to reactionary criticism.

Latest Research on Bozzini

Despite such a long list of hindrances, Bozzini did gain the respect of the majority of his colleagues, contrary to today's commonly held beliefs about the matter. Helping us set the record straight again is the research by Dr. Figdor, whose keen eye has been responsible for clearing up a great many inconsistencies in Bozzini's story. Dr. Figdor's extensive research uncovered for the first time documents archived in Frankfurt and Vienna. Among the best of Figdor's new findings was that Bozzini's lichtleiter was not so thoroughly rejected as has been commonly claimed. Other reports also erroneously describe Bozzini as a man whose "reputation was ruined" and whose career was destroyed after receiving widespread criticism. Fidgor's research however, uncovers a substantially different picture. Though Bozzini had his critics, he also had his staunch supporters and friends in very high places, including the Kaiser Wilhelm's brother, the Archduke. Bozzini also could not have been chosen as the Frankfurt city doctor– an appointed position– without having the support of the elected officials of Frankfurt. And though there eventually was an official *Imperial Resolution* that forced use of the lichtleiter to cease, Figdor points out that, off the books, unofficial clinical use continued. In fact, a modified version of the lichleiter, called the Viennese-model, enjoyed fairly wide usage, even by Bozzini's archrival, Dr. Stifft himself! As well, Bozzini's invention remained the subject of lively discussion and marvel throughout the world's most important medical centers at that time.

Based on Figdor's analysis, this Imperial Resolution is also somewhat misleading because it was apparently influenced by Bozzini's most powerful critic and rival, Dr. Stifft, who again we should be reminded was the Kaiser's (i.e., the signator of that very Imperial Resolution) personal physician. So, influence may have had more to do with this decree than the actual shortcomings of the device.

Summary of Bozzini

It is always wise to look ahead, but difficult to look further than you can see. -Winston Churchill

It has been said that Bozzini "stood at an historical turning-point between old and new medicine." By wishing to avoid needless patient injuries and to gain knowledge about disease pathologies, Bozzini evolved beyond the ways of old

medicine, which had relied on blind palpation and diagnosis through deduction. By so fearlessly forging ahead, Bozzini helped to herald in the new medicine, rooted in what we know today as the scientific method.

The combination of all of Bozzini's strength of vision and character signaled a significant advance for the endoscope's development, one that captured the interest of the world's most established medical centers of the time. It is equally important to note that, like a good pioneer, Bozzini recognized the value of his discovery and spent significant energy trying to bring to the world's attention the implications of his innovation. By solving the endoscope's first three shortcomings with one instrument, with clinically useful applicability on living patients, Bozzini presented a conceptual breakthrough. His invention allowed for an entirely new way to diagnose and treat diseases that had been otherwise difficult to learn about since the interior body could not be systematically and conveniently explored.

Though all of this may seem effortless to us now, such concepts had in fact defied the best and brightest for centuries before Bozzini. Later, the likes of such world-renowned pioneers as Desormeaux, Segalas, and Cruise, all would follow the principles of Bozzini's light conductor. Perhaps if Bozzini had not succumbed to typhoid at such an early age of 35, he most certainly would have remained a tireless advocate for not only endoscopy, but for the many other innovations that were tumbling around in his head, such as flying machines, aeronautical studies, mathematics, and art as well.

While no consensus has ever been reached as to whether Bozzini's work was truly abandoned by the medical establishment, it seems quite apparent that overall Bozzini's contemporaries fell short of understanding the potential value of his invention, and ultimately it was not fully recognized until many years later. Therefore, as Churchill's quote expressed, the tradition-bound medical community found it difficult to look further than they could see.

Note

1. From our modern perspective, claiming that the lichleiter achieved clinical success may seem a stretch. However, for the times, obtaining that tiny, blurred speck of visualization of living internal organs was an achievement that had never been achieved before.

CHAPTER 7

Post-Bozzini
1809

Introduction
The Road to Success is always under construction.
-Unknown

After Bozzini, a curious thing happens. The history books get a bit sparse from the time period after the lichleiter's 1806 debut and up until approximately the 1820s. It is difficult to interpret this apparent silence within the endoscopic pioneer community. Perhaps the Napoleonic Wars during this time period served as a disruptive force, for, coincidentally, after the decisive debacle at Waterloo in 1815, within a few short years endoscopic development reemerged, this time with a decidedly quickened pace.

Pierre Segalas
One of the most notable physicians to kick off this post-Bozzini decade was Pierre Salomon Segalas of Paris (1792-1875), the famous French urologist some have cited as one of the "co-inventors" of endoscopy. Other sources however have referred to Segalas' work as merely a revival of Bozzini's work rather than an original contribution. Though ultimately it is difficult to tell just how usable Segalas' scope was, such accusations were in fact typical assaults against these early pioneers and therefore such claims should not be construed as reflecting the entire truth. In any case, Segalas' innovations were in fact mentioned in the prestigious British Journal, *The Lancet*. And Segalas' instrument achieved something that the lichleiter apparently did not; it was easier to use.

Details
Developing these improvements actually took several years of experimentation. Segalas consulted with a highly acclaimed optical physicist in order to understand how best to optimize illumination. Finally, in 1826 he introduced his new and improved endoscopy [1], dubbed "speculum urethra-cystique," which was designed mainly for inspecting the urethra and interior of the bladder.

Segalas' instrument consisted of several important innovations. Not surprisingly, most of the change was to the lighting system, an aspect that remained the weakest feature of the endoscope well into the mid-20th century. To address this issue, five new features were incorporated. Firstly and most simply, two candles were included instead of one. While perhaps seemingly obvious to us today, nevertheless no one else apparently had thought to make this simple change. Secondly, a new double lens system, including the addition of an oblique lens was constructed in order to help concentrate and magnify the light from the candle. To this system Segalas added a large, conical mirror that helped to capture more light and redirect it toward the point of interest. Finally, the viewing tubes were painted black to prevent scattering of the light particles, a feature that was indeed well ahead of his time. Together, these changes did

apparently improve visibility. Segalas himself claimed that one could read the finest print from a distance of 15 inches.

To achieve greater ease of use, Segalas departed from Bozzini's principles in a few key ways. Firstly, a newly designed cannula-catheter was constructed in order to drain the contents of the bladder so that the inspection could commence without that difficulty. Segalas also chose to construct this component out of gum elastic material instead of metal in an effort to add greater safety and comfort [2]. As a result of these elegant innovations, Segalas became one of the few to perform simple therapeutic procedures with his cystoscope, specifically cauterization of the urethra.

Some Drawbacks

One of the most troublesome drawbacks related to the uncovered candles, which presented some danger of burning. This feature however was also the aspect that made Segalas' device easier to use, for without the large metal lampshade of the lichleiter, the weight of Segalas' cystoscope was significantly lighter and consequently more maneuverable. Other complaints on the record relate back to the limited number of clinical trials Segalas was actually able to conduct. For instance, during the time period from 1826-1828, he reported only three clinical cases. There is no record to indicate the reasons for such a limited number of clinical cases. In the worst case, it could suggest that perhaps a greater failure rate occurred than was officially reported. Another discrepancy in the record has to do with the claim that Segalas' device enabled him to *visualize* and therefore accurately diagnose a bladder stone in a three-year-old girl [3] who subsequently underwent an operation for its removal. This is a difficult claim to support since most pioneers who emerged after Segalas reported having significant difficulty in obtaining clear visualization of bladder stones in living patients, even with more advanced lenses and lighting systems available. In fact, even decades after Segalas, few others were able to replicate his results.

Other Works

Segalas also invented other devices and techniques. He is cited as one of the first to replace the hammer required for crushing bladder stones during his era with a much more patient and user-friendly screw mechanism.

Summary

Even with the limited technologies available in the 1820s, Segalas was still able to achieve significant progress for the endoscope. His technical innovations were almost unrivaled for his day. In fact, even decade's later, later practitioners were still relying on many of his original design principles. As well, the clinical success he achieved on living patients, though limited in number and shrouded in some uncertainty, was still a unique accomplishment for his time.

In 1828, Segalas also became one of the earliest to publish a textbook which included some chapters highlighting endoscopic techniques [4]. And perhaps just as importantly, after an almost twenty year absence, it was Segalas who became the main force in helping to revitalize interest in the subject of endoscopy.

Other 19th Century Pioneers from France – Civiale and Bonnafont
Other pioneers contemporaneous with Segalas were continuing France's long tradition of leading the world in medical innovation.

Endo-Urological Surgery
French established the foundations for endsocopic procedures with their blind treatment of ureter, prostate, and bladder stones. Among others were Pare, Frere Come, Dionis, Mercier, Leroy D'Etiolles, and Maisonneuve. Cornay De Rochefort developed the first aspirator (1844).

Jean Civiale (1792-1867)
Jean Civiale, a surgeon and urologist from Paris, was one such pioneer considered to be among the foremost genito-urologists of his day. With his 1823 substantial improvement to the lithtrite invention of a lithotrite, or modification of the same, Civiale was able to achieve one of the first successful, endoscopic transurethral lithotripsies (though his technique was still actually performed 'blindly'). For this, Civiale is considered as the founder of early modern lithotripsy.

The method itself was apparently invented for the most part by Leroy D'etiolles, also of Paris, in approximately 1822. D'etiolles also received a prize from the Academy for this work. Other aspects of the instrument were said to be derived from Heurteloup's device. Civiale incorporated D'etiolles main design principles of a wire loop basket with rotating milling cutter, a concept that harked back to the principles set by Fournier and Gruithausen. One of the most important of Civiale's innovations was the inclusion of two irrigation channels that helped evacuate the contents of the bladder. Civiale's device, which he dubbed a *Litholabe* or *Trilabe* also crushed the stones rather than attempting to extract them (extracting was always more risky). During this time it was also common to use a hammer to assist in the breaking of the stones. It seems part of Civiale's innovation was that the use of a hammer was no longer necessary. Civiale was also apparently able to treat bladder tumors with his device as well.

Civiale wrote extensively on his findings as well, including articles on pathological lesions of the urethra, prostate pathologies, and bladder conditions. Civiale's innovation marked a clear and crucial turning point for endoscopy, one distinguished for moving surgical practices more decisively toward minimally invasive methods, a shift which spelled near extinction for the abdominal lithotomies of the past. Indeed, by 1833, just ten short years after Civiale's invention, endoscopic lithotripsy had swept through the medical world, effectively supplanting the old-fashioned – and more deadly – lithotomies. The technique is found highlighted in the literature from as far afield as Russia and New York, as well as in the more traditional arenas of Austria, Edinburgh and England.

Despite his significant contributions– and awards from Paris' Academy of Medicine- Civiale too apparently met with some degree of hostility from the medical establishment. It seems that surgeons of the day were particularly

opposed to the new-fangled idea of litrotripsy, since they were trained to perform lithotomies, which involved the complete surgical removal of the stones rather than just crushing them. Such hostility is apparent with the 1828 decree by Vincenz von Kern, the imperial physician in Vienna, who stated that lithotripsy was “high treason against the arts and humanity.”

In any case, it appears others before Civiale achieved moderate success using similar techniques. Yet Civiale’s combination of elegant design and greater clinical success set him apart, marking him as one of the first to perform minimally invasive surgery for urology. Civiale continued to innovate, making improvements to techniques and instruments some twenty years after his initial invention, including a sophisticated retracting scalpel for the treatment of urethral strictures in 1844.

Despite his pioneering ways, Civiale was no renegade. When it came to applying these endo-urethral instruments, he demonstrated great circumspection, making it clear in his publications that surgical incisions of prostate pathologies especially, were to be done only in rare cases and with the utmost of prudence.

In summary, this type of procedure was overall really looked down upon and looked at with great skepticism based on the literature of the era. It wasn’t until almost thirty years later that we “hear of fresh undertakings in this field.”

Conclusion 19th Century Early Endo-Urological (Transurethral) Surgery
The medical historian and early endo-urologist Gutierez brings to our attention that during these days cases for employing endo-urethral treatment (before electrocautery which stopped the bleeding) had to be chosen “as a matter for very cautious considerations,” and “must be rare and exceptional…” The urologists of this era did recognize that the obstruction had to be cut out, but that only by those with skill using the endo-urethra instruments and method.

Jean Pierre Bonnafont and his Otoscope – 1834
Recently, another physician of this era has secured some recognition for his work, though to most he still remains lost in historical obscurity. Jean Pierre Bonnafont, a French physician specializing in otolaryngology, had been using his own self-designed otoscope [5] in clinical practice for twenty years, since he first presented it to the Paris *Academie du Medecinel* in 1834. Considered by many to be a forerunner to Desormeaux’s endoscope of 1853, Bonnafont’s work had been overlooked until Desormeaux arrived on the scene twenty years later to claim priority on similar design principles. Indeed, upon witnessing the acclaim Desormeaux received, Bonnafont protested to the *Academie*, stating that Desormeaux’s device was “only an exact copy” of *his* own otoscope.

The important difference was that Bonnafont’s instrument, being solely designed for ear inspections, may have been perceived as less qualified to handle more complex procedures.

Referring to his invention as a “speculum autostatique,” Bonnafont’s device was essentially a two-leaved otoscope that he improved by adding a sophisticated lens system adapted from microscopes and the simple but important detail of a conical mirror (in the style of Segalas), which enhanced illumination considerably. Unfortunately the historical records are again rather muddled concerning the usability of Bonnafont’s otoscope. Some have claimed that Bonnafont was in fact able to perform simple therapeutic procedures within the ear cavity, including paracentesis, a procedure not of the ear, but of the abdomen. However, other sources note quite distinctly that Bonnafont’s device was only a working model not yet suitable for clinical trials. Consequently, Bonnafont has not (yet) earned the same level of acclaim as Desormeaux. Notwithstanding these contested aspects, overall Bonnafont’s part in endoscopy’s history cannot be readily dismissed, for his instrument was said to have “displayed all the technical sophistication” of endoscopes presented by other innovators two decades later. Moreover, years before others, he recognized the importance of incorporating the optical systems of microscopes.

Early 19th Century Gynecologic Endoscopy
Other Early Practitioners
Others mentioned during this early 19th century time period include the French gynecologist, Guillon, who apparently used a Bozzini-inspired illumination device along with his newly designed speculum. His innovations and use of an early endoscopic device were highlighted in lecture notes from the Academy of Medicine in Paris in 1827, and later from his own 1827 publication.

Once Upon a Time When Prudery Prevailed in America
Reality is merely an illusion, albeit a very persistent one.
-Albert Einstein

A Peripheral Obstacle to Endoscopic Exams - Societal Exigencies
Up until this point it seemed Europe was having all the fun when it came to endoscopic development. Before pursuing endoscopy in earnest, American physicians, more so than Europeans, faced another unanticipated hurdle: strict societal mores. Physicians in the disciplines for women’s health would have to overcome a great deal of resistance stemming from entrenched societal concerns about proper decorum. “False modesty and prudery,” as one ACOG past president described it, would limit research into ob-gyn fields for quite some time. For instance, as late as 1850, it was actually considered improper to show live births in U.S. medical schools. One famous case demonstrating this intense unease involved one of the first documented live births as part of the curriculum in a New York teaching college, which led to a flurry of censorship and claims of scandalous conduct. Referred to as “demonstrative midwifery,” the progressively-minded clinical professor responsible for this new teaching method thought it would be instructive to present a woman in active labor to his room full of medical students. This action resulted in an immediate call for the suspension of his license, while a strong rebuke was issued in the local Buffalo Medical Journal, which reported as follows:

”The propriety of the exhibition of the living subject before the graduating class…does not in our view admit of a public discussion…and ... the practice does not commend itself to the cordial approbation of the medical profession. We deem it unnecessary for the purposes of teaching, unprofessional in manner and grossly offensive alike to morality and common decency.…We hope that this innovation will not be repeated in this or any civilized country,” (Mengert presidential address, vol 7, no 3, march 1959).

Paradoxically, many fairly advanced gynecologic operations had actually been performed by pioneering Americans as early as the 1800s; the first ovariotomy was performed in 1809 by Ephraim Macdowell; the first successful myomectomy with preservation of the uterus took place in 1844 by Washington Atlee of Philadelphia; and two of the first documented and successful abdominal hysterectomies were achieved by Walter Burnham of Massachusetts in 1853, and a few years later by William J. Baker of Tennessee in 1856.

Still, lingering sentiments concerning propriety persisted. Some reports published by medical societies of the late 19th century suggest that vaginal examinations were considered “too great an infringement of the woman’s person to be attempted.” Some physicians even believed that such examinations might “induce a lax moral sense in the patient.” It is no wonder that many aspiring American medical students of the 19th century flocked to Europe to obtain their medical educations.

Modesty Aside, Americans Join the Fray - John Fisher, an American Pioneer
Against this backdrop of ultra-conservatism within American medicine, there arose a physician from Boston named John D. Fisher (1798-1850), whose work captured the attention of the world’s medical centers [6]. Fisher, like many of his contemporaries, was able to provide care for many different ailments since medicine had not yet divided into sub-specialties. As such, his clinical work focused on ailments of the bladder, urethral, esophagus, as well as gynecologic disorders. As reported by an article from *The Lancet*, Fisher conceived of his “instrument for the illumination of dark cavities” (a name later changed to the more prosaic “esophagus mirrors”) in 1824 while still a medical student. He subsequently published his findings in 1827 in the Philadelphia Journal of Medical and Physical Sciences.

Though some of his designs were not necessarily the first of their kind, many credible sources have referred to Fisher’s instrument as particularly impressive, even superior to that of Segalas’ work. In fact, some of endoscopy’s most important pioneers, including Cruise, credit Fisher specifically gave credit as being the original inspiration behind their own ideas. Some of his most salient innovations include the incorporation of a lens system derived from a periscope. To improve the ability to examine difficult and awkward angles of the body, Fisher also devised a clever mechanical system of wires attached to the bottom of the candle light source itself that served as levers to move the candle up or down, so as to easily direct the focal point of the light. Ever the visionary, Fisher

also suggested the use of galvanized wire (aka, precursor to electricity) as an improved source of light. However, like Segalas and others before him, Fisher was unable to modify galvanized wires into a form safe enough for medical procedures. This should not be considered too surprising, considering that Edison's electric bulb– an encased and tamed galvanized wire system of sorts- was still six decades away.

When Chivalry Met Endoscopy

An interesting glimpse into Fisher's sensitive personality (as influenced by the aforementioned prevailing social attitudes) comes to light in a unique account of one patient, who became the inspiration for his innovation. As the story goes, Fisher stated that his modified device was created to accommodate one of his female patients, whose shyness was so great that a medical examination of her was proving to be impossible. As one journal relays the account, Fisher developed his instrument "in response to the need to examine the cervix of an unusually shy young woman who could not countenance him coming so close to her pudenda as was required by the standard vaginal speculum." Fisher by his own words wrote that he had "a strong and chivalrous desire to protect the feelings of delicacy of this maiden." To achieve this, he designed an elongated and angulated speculum and added a double convex lens to sharpen the image, so that the examination could take place from a greater distance from the patient. Though no further information was given about this incident, Fisher nevertheless paints a lovely romanticized rendition of how the history of endoscopy became forever untwined with a chance encounter with chivalry.

Summary - Fisher

Despite these positive reports, the record on Fisher's work is nevertheless mixed. For instance, it is not known whether Fisher achieved success with his device on living patients. As well, other sources described Fishers' instrument for the urethra in particular as "impractical." And despite his sophisticated design principles, Fisher's work apparently failed to garner much attention within the medical establishment of his time. Fisher himself suggested that his instrument was "easily susceptible of improvement." Perhaps the long-standing difficulties associated with poor visualization were still perceived as insurmountable obstacles that may have persuaded the medical community to dismiss the endoscope in its formative years.

Notwithstanding these unresolved contestations of history, looking back, one can recognize that by adapting the more advanced lens technology derived from periscopes, Fisher did in fact make significant contributions that marked an important transition away from simplistic lens systems and closer toward modern endoscopes with greater visibility and magnification. For example, when comparing Fisher's work to that of Segalas, it is clear that Fisher's endoscope was not just a rehashing of Segalas' work; it was indeed an instrument clearly unique in its design and sophistication. Fisher also achieved a crucial milestone for the United States in particular, as he was one of the first in the country to successfully initiate interest in the field of endoscopy.

British Give It a Go - British Pioneer, John Avery
I am easily satisfied with the very best
-Winston Churchill

Meanwhile, back across the great pond, John Avery of London was making some headway in endoscopy's development, though, like Fisher, there remains some difference in opinion as to just how significant his contributions really were.

The laryngoscope Avery introduced in 1840 [7] was designed as an illumination device for urethroscopy and laryngoscopy. Avery's main innovation seems to have been his addition of a large head reflector as a supplementary light source [8]. This modified reflector (called a Palmer's lamp, used by miners for years) intensified and redirected the candle light toward an attached Bozzini-inspired speculum. As for the overall design, Avery credited Segalas as the inspiration behind the underlying design principles.

Avery's colleagues however were apparently far from impressed with the rest of his design features. Henry Thomspon, the leading British urologist at the time, observed one of Avery's procedures, and noted that the urethroscopic device was "impractical and too thick in diameter." Thompson also noted that urine was getting in the way and as a result, "very little could be seen in the bladder," an observation which indicates that Avery's instrument may not have included a properly constructed catheter.

Yet the record is not so clear-cut, for others cited Avery's design ideas as inspirational to their own work. And his device could not have been a complete failure, for, based on the content of instrument catalogues during this period, Avery's instrument was made and marketed by the most prominent instrument makers of his day despite these modest advances and the fact that many other pioneers continued to incorporate Avery's large head mirror into their instrumentation, it seems that Avery's work was otherwise deemed impractical.

First Trials With Electrical Applications in Surgery - Precursors to Electro-Surgery
The British lithotripist, George Robinson of Newcastle upon-Tyne accomplished what appears to be one of the earliest documented cases of harnessing electricity (in the lab) for the treatment of bladder stones. Described in 1855 as what he called *electro-lithotrity*, he apparently was able to crush all types of stones (again, not in living patients) with this method by sending repeated discharges of electricity from his leyden jar. He led two isolated copper wires through a flexible catheter to accomplish this. Their ends were then brought into contact with the stone, which was pre-positioned in a water-filled bladder. He suggested this to surgeons, but at the time most were not willing to try this method on living subjects.

Notes
1. It was actually a cystoscope.
2. It may seem that polished metal may have been used with greater ease.

However, the ability to make highly polished and smoothed metal was limited during this time. Therefore, gum elastic must have been seen as a reasonable substitute.
3. This claim derives from Reuter source, which refers back directly to Segalas' own publication on the matter.
4. The textbook was called *Traite des retentions et des maladies qu'elles produisent suivi d'un grand nombre d'observations* (Treatise on urinary retentions, diseases caused by it, followed by a great number of observations).
5. The record is unclear as to whether this instrument was used for other endoscopic disciplines besides otoscopy.
6. A few different dates have been cited, including both 1821 and 1823. However, the most credible source, *The Lancet*, approximated the date as sometime around 1824. In addition, some sources cite 1797 as Fisher's date of birth.
7. Jahn source cites the date as 1844.
8. The reflector was not worn on the head, but was instead repositioned to stand in front of the candle stick.

CHAPTER 8

Desormeaux
1853

Antonin Jean Desormeaux – The First Successful Operative Endoscopic Procedures in Living Patients
There are two ways of spreading light; to be the candle or the mirror that reflects it.
-Edith Wharton

The mid to late-19th century stands out as one of the world's most extravagant eras of innovative splendor, with breakthroughs in just about every discipline; the invention of the telegraph, advances in germ theory, Darwin's theory of evolution, Sir James Simpson's introduction of chloroform (anesthesia) in 1846, all were part of this time period's great discoveries.

As for our emboldened endoscopic pioneers, this era was equally heady, with a rush of innovative vigor pouring forth from all directions. Leaving off from the sub-specialty of laryngoscopy, we flip a u-turn back out of the esophagus and return to the lower GI as the primary focus for the remainder of our historical survey. By this juncture, the pace was really picking up for endoscopy's development and no doubt this growing fervor awakened the imaginations of many minds. However, the French urologist, Antonin Jean Desormeaux, stood out as one of the most influential leaders, earning acclaim as one of the "fathers" of endoscopy. Desormeaux's most outstanding accomplishment is that he put operative endoscopy on the map by performing the world's first successful operative procedures using an endoscope [1]. Desormeaux is also credited with coining the word "*l'endoscopie*," a term he introduced, along with his revamped device, to the Academy of Science in Paris on July 20th, 1853.

Though Desormeaux's innovations were not radical deviations from the design principles established by earlier pioneers, he is credited with constructing the first functional endoscope (what we would consider a cystoscope or urethroscope today [2]) which enabled the consistent and successful diagnosis of urethral and bladder diseases in living male patients. In many cases too, he was able to perform simple therapeutic operations endoscopically, some for the first time ever.

Achieving such results marked a clear turning point, for up until this point in time the endoscope had proved to be of very limited clinical value. By refining the endoscope in subtle yet significant ways, Desormeaux was able to demonstrate not only its value as an effective diagnostic tool, but also demonstrated its promising therapeutic possibilities. In this way, Desormeaux helped to significantly transform surgical practices of his era and beyond. Of course, a change of this magnitude was no small task. Therefore, in order to gain a better understanding of just why Desormeaux represented such an important turning

point in the story of endoscopy, let's review in detail the many formidable obstacles he overcame to bring to life his vision for endoscopy.

Endoscopy's Great Transformation

As with other innovators, many of Desormeaux's contributions were not necessarily the first of their kind. What made Desormeaux's unique was his ability to recognize just the right combination of adopted technologies needed to improve the endoscope. This point leads us to a detail in the historical record that should be addressed at the onset: Desormeaux is often credited as being the first to have used endoscopy on living patients. However, as previously noted, Bozzini was in fact the first documented to do so. Several others also succeeded in using their endoscopes diagnostically on living patients, such as Segalas, Cruise, possibly Avery, and many of the laryngoscopists already mentioned.

The most crucial distinction here is that Desormeaux was able to perform the first known operative endoscopic procedure. This was only possible because of Desormeaux was able to achieve better visualization, which allowed him to become one of the few to successfully- and consistently - utilize the endoscope for therapeutic procedures; in other words, *operative* endoscopy. These therapies consisted of simple but effective operations, including cauterization with chemicals (e.g. silver nitrate), which could be applied through open slits in the shaft of the endoscope [3]. In this way, Desormeaux was able to treat diseases of the urethra, such as strictures and gonorrhea.

In defining this category of the first ever-operative endoscopic procedure, we do make one key distinction here and exclude the various minimally invasive techniques used in lithotripsy, in which stones had been crushed or removed. Desormeaux's first operative endoscopic procedure– that of lysing of strictures in the urethra– is different because living tissue is removed.

A Turning Point for Endoscopy: Desormeaux and True Visualization

Some of the amazing firsts Desormeaux is credited with include the first ever endoscopic excision of a urethral papilloma, and one of the first endoscopically-assisted urethrotomies, circa 1865. In addition, our research indicates that Desormeaux did indeed become one of the few to actually endoscopically*visualize* and treat bladder stones, though this remains as part of the contested history [4]. Desormeaux demonstrated this ability by drawing up diagrams of the bladder neck, bladder mucosa, and bladder stones, all aided solely by peering into his scope. This is important because, prior to Desormeaux, many of the endoscopic therapeutic procedures actually were not always performed with full endoscopic visualization; in other words, many were performed semi or entirely *blind*. Though Desormeaux too was not always able to reach full visualization in all of his patients (or in all types of procedures), he nevertheless achieved more than any others had at this time as a result of his exceptional skill and development of improved techniques and technologies. Desormeaux's success in achieving such high quality visualization for his era not only demonstrated endoscopy's invaluable diagnostic role, but it also raised

awareness about its potential therapeutic value. This transformation therefore marks another significant turning point for endoscopy. Finally, his textbook, *De l'endoscope*, was highly influential and helped to popularize endoscopy.

Technical Details

Concerning the technical aspects, much of Desormeaux's endoscope was a compilation of technologies that already existed. In fact, several sources claim that Desormeaux derived his idea from the prior work of J.P. Bonnafont. As mentioned previously, Bonnafont's protests went unnoticed for the most part. Still others went so far as to say that Desormeaux's endoscope was essentially the lichleiter resurrected. Cruise, on the other hand, suggested that his idea had come from instead Segalas and Avery. Desormeaux apparently didn't take such suggestions lightly and in one known instance, countered his critics by calling into question the work of Avery in particular, whose attempts he described as "fruitless."

Such contestations over priority may never be fully resolved. However, certain features of Desormeaux's instrument were commonly accepted as having roots in earlier works (which in any case does not diminish the validity of newer inventions). For instance, centrally bored concave mirrors - utilized also by Bozzini, Fisher, Segalas and others - had been an established lens technology available since the 17th century. And of course, the overarching design theme– that of long thin tubes connected to a light source to convey the illumination– had been a shared feature for essentially all endoscopic pioneers since Bozzini. The distinction then is one relating to subtle refinements that yielded substantial results. Desormeaux's improved light source is a prime example of this talent for optimizing existing technologies. It appears that Desormeaux was able to achieve better clinical results, mainly due to his incorporation of a new light source, as well as from subtle changes made to the angles of the lenses. Regarding the light source, he had been experimenting with various technologies, but settled upon the "gasogene" lamp, a mixture of four parts 96% alcohol with one part turpentine, which in turn was introduced to a burning flame. As a result of this unique mixture, the light generated was substantially brighter and at the same time more transparent than regular candlelight. This produced a more condensable beam of light that enhanced examinations. Desormeaux was also able to reconfigure the angles used in the lens system so that the light could be concentrated more precisely to one area. This involved changing the positioning of the lenses so that lateral reflection could be achieved. Through the combination of these insightful changes, Desormeaux was able to finally achieve consistently reliable clinical diagnoses. In fact, Desormeaux's endoscope was the basis for virtually all further designs that used reflected light until the next generation of pioneers arrived (such as Bruck, Trouve and Nitze) whose improvements were in part the result of newly available electrical technologies [5].

Desormeaux's contributions to the medical literature were also substantial. With his penchant for collecting precise and extensive clinical data, his publications

proved to be seminal works. One of his most acclaimed, his book entitled *Endoscopy and Its Applications in Diagnosis and Treatment of Diseases of the Urethra and Bladder* (Paris, 1865) ("De'Lendoscope et ses applications au diagnostic et au traitement des affections de l'urethre et de la vessie"), was said to have produced "great astonishment among the surgeons." Another important article, published in the journal *The Chicago Medical Journal* and entitled "Endoscope's usefulness in diagnosis and treatment of Urinary Affections" (1867), served to highlight Desormeaux's considerable progress in therapeutic procedures. Combined, these publications helped redirect the attention of the global medical community to the great potential residing within the world of endoscopy.

Some Technical Flaws and Other Hindrances

Despite such substantial innovations, Desormeaux, like so many pioneers before him, certainly had his share of critics. To begin with, some sources assert that Desormeaux achieved only moderate success, specifically in terms of visualization. One such adverse report claimed that when Desormeaux demonstrated his urethroscopy to German doctors, about "three or four out of the ten present" purportedly could see nothing. In this instance then, that translated to an error rate of approximately 30-40%. Of course, we cannot project our own modern perception onto these results; a 60% success rate was possibly the highest standard achieved at the time and therefore would be considered an extraordinary achievement. Whatever the case, a few similarly described criticisms were voiced by other physicians when Desormeaux's earlier devices were initially tested.

Concerning the technical flaws, there were a number of drawbacks mentioned as well. The voluminous size has been singled-out as a particularly distracting feature. One source in fact asserted that Desormeaux's device had been considered "a clumsy monster," noting its weight as topping one kilogram and measuring 48 cm high, with a 12 cm rectoscope attachment (though nowadays of course rectoscopes are much longer). And while the brighter light was appreciated, it tended to produce a rather sooty, smoking residue. The required positioning of Desormeaux's endoscope also created some distinct hazards. Because the device had to be held between the legs of the patient, consequently there was always the danger of either burning the face of the physician or the thighs of the patient. In addition, without an effective catheter system, urine would often "extinguish the flame, ruining the examination."

Summary – Desormeaux

Despite these minor flaws, overall Desormeaux's work was instrumental in catapulting endoscopy to a greater developmental stage. Though his work was not necessarily the first or most original, Desormeaux was nevertheless able to refine existing endoscopes and adapt better technologies in order to bring to the world one of the most functional endoscopes of his era. Desormeaux's systematic collection of clear and indisputable clinical data of his experiments was also a

significant contribution, one which no doubt influenced others to conduct similar high quality research.

With respect to the four tasks hindering the endoscope, Desormeaux made considerable headway on multiple fronts. His development of an improved solution for the second task of illumination by using gasogene enabled more accurate clinical outcomes to be achieved. His publications were also highly influential and were said to have revived interest in the subject the world over. And it bears repeating that his vision of the endoscope as a therapeutic technology was quite ahead of his time. Overall, his genius was in demonstrating the enormous potential of endoscopy by establishing sound methods for others to follow. Ultimately of course, time becomes the true arbiter in matters such as these. In this respect, Desormeaux's endoscope did in fact stand the test of time. His design principles were displaced only after the next generations of innovators were gifted with the invention of Edison's electric bulb.

Notes

1. We make a distinction here and exclude the minimally invasive techniques used in lithotripsy, in which stones had been crushed or removed. Desormeaux's first operative endoscopic procedure– that of lysing of scrictures in the urethra– is different because this is living tissue that is removed.
2. Desormeaux's cystoscope is synonymous with today's hysteroscopy, a topic we will cover separately in the next chapter.
3. These same slits were a part of Bozzini's lichleiter as well. However, unlike Desormeaux, Bozzini was not able to use his device for procedures in living, male patients.
4. The well-respected history of Endoscopy by Reuter indicates that other procedures by Desormeaux were performed blindly, specifically the treatment of urethra scrictures.
5. Some of these referenced electrical technologies, such as galvanized platinum wires, were actually available during Desormeaux's time. However, at that time, they were considerably more complicated and therefore quite cumbersome for medical usage.

CHAPTER 9

~ After Desormeaux ~
Dublin's Francis Cruise
The St. Petersburg Trio
Hysteroscopy

Francis Cruise - More than the Luck of the Irish
Nothing is gained from Certainty. All affairs turn upon Hope.
-Rumi

The year 1865 was remarkable for a number of reasons. Americans were just beginning their recovery and reconstruction from the aftermath of The Civil War. This same year too, Lister of London began conducting experiments with antiseptics in surgery. And just a short jaunt away, in Dublin, Ireland, another innovator was devising new strategies to address the shortcomings of our dear subject the endoscope. The urologist, Francis Richard Cruise, having found earlier models insufficiently illuminated, introduced an improved version of Desmoreaux's endoscope in approximately 1865. In fact, his work was so fruitful that, next to Desormeaux, Cruise was considered the most successful endoscopist of his time.

According to Cruise himself, he derived his construction principles mainly from Fisher. However, unlike many of his predecessors, Cruise's clinical successes were almost unmatched. Like Desormeaux, Cruise focused mainly on work with male patients for urological procedures. And just as Desormeaux achieved many firsts, so did Cruise. Along with Desormeaux, Cruise achieved great acclaim for performing some of the world's first operative endoscopic treatments successfully in living patients. Among the most notable was one of the world's first endoscopically-assisted urethrotomies that Cruise claimed to have been performed with full visualization. Cruise was also among the first and the few capable of endoscopically evacuating the bladder, treating strictures of the urethra, and performing other modest operations.

Using his newly improved endoscope, Cruise could also diagnose for the first time varicose vessels, granules, columnar bands, saccular offsets, tumors, and observe the orifice of the neck of the bladder.

There remain discrepancies in the historical records as to whether Cruise was able to fully visualize any of this operative procedure or actually see bladder stones. Some sources assert that he was able to achieve this, while but most emphatically disagree with this claim. Of course, questions about whether bladder stones were truly visualized accompanied the careers of many early endoscopists, including Segalas, Bozzini and others. What is fairly well established is that the first endoscopic *removal* of bladder stones– with full visualization- was not achieved until *after* Cruise, about a decade later.

As for Cruise's technical innovations, his endoscope differed from Desormeaux's device on several grounds. For example, Cruise came up with the idea of using a mixture of petroleum and a bit of dissolved camphor to replace Desormeaux's bright but bothersome gasogene mix. This resulted in a more powerful light source that also transmitted colors more accurately. Cruise's petroleum-camphor mix generated a flatter flame that projected light better (compared to the smaller, more round flame produced by the gasogene flame). This feature magnified illumination tremendously, while at the same time eliminated much of the mess, though its significantly heightened heat level did become somewhat problematic. Cruise also significantly enhanced the lens system by becoming the first to successfully incorporate a binocular system, a system which Cruise apparently used for the first time in one of the earliest reported cases of an endoscopically performed thoracoscopic surgery. If the historical record is accurate on this point, this thoracoscopic surgery by Cruise would have been an astonishing achievement, light years ahead of the time. However, no other records of repeat performances of such a surgery during this early time period could be found, nor were further details or citations uncovered [1]. Alas, further research is necessary before deciding on the validity of this aspect of Cruise's history.

Still, Cruise's other innovations to the lens system were equally impressive. In addition to the aforementioned binocular device, another modification entailed having the light from the narrow side fall directly onto a collimating lens without a reflector. Adding a mechanical clamp of sorts, the reflector could be adjusted higher or lower to perfect the reflective properties. Cruise differentiated from both Segalas' and Desormeaux's devices by dividing his lens apparatus into two separate systems; one part was used as the reflecting module, while another concave lens was set up specifically to focus the light more intensely onto the field of view. Cruise improved upon the earlier endoscopes in other nuanced ways too, from changing the bistoury device, to rounding off some of the endoscope's edges, and improving the wadding system for the cautery delivery mechanism.

Summary - Cruise
Though limited in quantity, Cruise's publications also attracted a great deal of interest. The 1865 article entitled "The utility of the endoscope as an aid in the diagnosis and treatment of diseases," was particularly well received and helped to establish Cruise as one of the leaders in the field. Notice too that Cruise added the treatment of disease as part of the endoscope's usage, not just diagnostic, as had long been the predominant trend. This in itself demonstrates his visionary brilliance concerning the scope's potential. Overall, the scope and ingenuity of his innovations were a resounding hit on the endoscopic playing field, marking Cruise as one of the few to have made endoscopy a practical technique at this time.

Precursors to Electro-Surgery
The St. Petersburg Trio

In many histories of endoscopy, medical discoveries outside of European centers have often been greatly overlooked. Thanks to the outstanding research by such experts on endoscopy's history as Litynski, Figdor, Reuter and Storz, we now have a greater depth of knowledge about endoscopy's other superstar innovators. One such overlooked metropolis of innovation was St. Petersburg, Russia, one of the 19th century's most preeminent centers of science and medicine. Three of St. Petersburg's most outstanding contributors to endoscopy were Alexander Ebermann, Alfred Couriard, and Tarnowsky.

Alexander Ebermann

Alexander Wilhelm Ferdinand Ebermann (1830-1902) designed some of the most cutting-edge and technically demanding endoscopes the world had ever seen for his time. Utilizing uniquely modified electrical technologies, along with devices of mechanical precocity, Ebermann generated a long list of firsts that rivaled the work of such leaders as Desormeaux and Cruise. Having learned of Desormeaux's work and recognizing its significance, Ebermann made the long, treacherous road trip to Paris to visit Desormeaux himself so that he could learn from the reigning master. Soon thereafter, Ebermann began his prolific outpouring of innovations. Ebermann was in fact one of the earliest to adapt the newly available electrical technologies for use in endoscopic applications. In approximately 1865, he modified an electrical illumination device, called a jablonchkow light, to be worn as either a headlamp or attached directly to the endoscope. The light itself was described as an "electrical ball of light," with a center composed of carbon tips. Devising a way to wear a light source as a headband was in itself an excellent innovation, evoking the quintessential image of *20th century* surgeons wearing the similar apparatus. And yet just as striking is Ebermann's early adaptation of electrical light (though battery generated at this point) for use with endoscopy, which is a groundbreaking milestone in endoscopy's history, one that preceded the more famous work of Nitze and Trouve in this department by at least a decade.

However, despite this prescient precursor to modernity and despite supplying the bright light endoscopy so desperately needed, the system apparently never gained much popularity due to its expense and the cumbersome nature of the heavy batteries (needed to electrify the wires) which limited mobility. Equally impressive, Ebermann was also one of the earliest to introduce an endoscopically-guided (though still blind) punch instrument used to excise and evacuate urethra polyps, strictures, and prostate bars. The device consisted of a scalpel attached to a modified cystoscope and a rubber balloon operated like a mechanical vacuum to aspirate and remove the excised tissue. Modified versions of this method actually were still in use as late as the 1960s, testament to Ebermann's remarkable acumen. Other inventions include a uniquely designed ureter clamp. Though further accounts of his work have been difficult to uncover, it is clear from what records we do have that Ebermann stands out as one of endoscopy's most brilliant and prolific innovators.

Alfred Couriard

Alfred Couriard contributed subtle yet sophisticated technical expertise relating to the physics of light especially. Determined to improve the quality of the reflected images, Couriard concentrated on refining subtle design details. In 1864 he discovered a way to have the light source directly reflect its light into the shaft of the scope. This was achieved by attaching a convex lens inside a covered lens case, which was then attached to a kerosene lamp. The collected light now could be reflected directly into the examination probe, rather than being redirected to another set of lens housed inside of the scope. Couriard found other ways to improve upon Desormeaux's original design, including one simple but brilliant change that considerably improved the quality of the reflected image. By expanding the outward ends of the scope's distal shaft ever so slightly, there was a significant decrease in the blurring and distortion of the reflected images. Couriard was also able to increase the light's ability to penetrate more deeply down the scope making the side shafts of the scope fully cylindrical.

Couriard is also famous for being one of the first to deviate from the prevailing norm of a unified scope, established by Bozzini sixty years prior [2]. Determined to make the scope more nimble and compact, Couriard split up its three central components- the light, the lenses, and the scope– into separate units. By detaching the scope from its awkward base, physicians were no longer burdened with the cumbersome tasks required of earlier unified models, such as holding the light or scope steady in peculiar positions. In this way, the actual scope itself was rendered more mobile; in other words, it transformed into a 'user-friendly' device that could then yield superior diagnostic and operative results. This change actually established a new methodology, what is referred to as *direct* endoscopy. This referred to the fact that since the scope itself no longer housed an internal lens, this meant that the images were obtained directly rather than indirectly as was the case with internally-placed reflecting lens. Amazingly, a version of this Couriard-inspired direct endoscope was still in use well into the 1930s.

Tarnowsky

Together with Couriard, they changed the Bozzini-inspired endoscope to a more compact version that separated the light source and other components.

Others Involved in the Post-Desormeaux Era

Robert Newman of New York is also mentioned as being quite influential in popularizing endoscopy in America. Also from America was E. Andrews of Chicao who in 1867 attempted to improve Cruise's endoscope by lighting it with burning magnesium wire, though ultimately his tinkering was to no avail.

Hysteroscopy: The Mysteries of the Un-Wandering Womb Revealed

Hysteroscopy takes special pride of place within gynecologic surgical history, for obstetric-gynecologists (and urologists) practitioners were the driving force behind many of endoscopy's most important developments. We can mark the

formative years of hysteroscopy as officially starting with Desormeaux's introduction of one of first working cystoscopes in 1853. Other instruments were designed with mainly obstetrics in mind. In 1863, EJ Aubinais claimed to have "watched a baby's head emerging from the cervix by inserting an instrument in the vagina," a description of possibly the first vaginoscopy.

However, it is Commander DC Pantaleoni of Ireland who is credited with performing the first truly successful diagnostic *and operative* hysteroscopy. As described in an 1869 publication, Commander Pantaleoni utilized a modified cystoscope lit with reflected candle light to examine the uterine cavity of a patient with post-menopausal bleeding. Using silver nitrate, he cauterized a hemorrhaging "polypous" uterine growth. Though the cauterizing was actually performed blindly, Pantaleoni's success nevertheless paved the way for greater advances in women's health.

Though hysteroscopy debuted long before laparoscopy, later its development stalled somewhat until such time that more effective methods for uterine distension could be found. We will return to hysteroscopy in the 20th century, when new technologies became available to catalyze its development even further.

Notes

1. Since such a surgery was apparently never repeated by others in the field, and since detailed reports are lacking concerning this surgery, we must approach these claims with some conservatism.
2. The source states that all three St. Petersburg pioneers made the change from a unified scope, though it is not clear which one was the first to do so. Based on other texts, it appears that Couriard was most probably the first.

CHAPTER 10. THE LARYNX ILLUMINATED

Early Laryngoscopy, Esophagoscopy/Gastroscopy

Introduction

The great tragedy of science - the slaying of a beautiful hypothesis by an ugly fact.
-Thomas Huxley

Now, sometimes anatomy got the best of endoscopists. In the case of the upper GI the ugly fact was that it gave practitioners a good flummox. It took a great deal of endoscopic engineering magic, along with some sword-swallowers here and there, to overcome such ancient anatomical difficulties. As a result of these natural anatomical constraints, laryngoscopists [1] proved to be some of the most clever innovators involved in the endoscope's formative years. Some of these early pioneers even risked their own larynxes to figure out how to adapt endoscopy to this field. And as a consequence of this treacherous anatomical landscape, finding the perfect patient position became an especially creative undertaking. Sniffing and supine, end-over, down under, hanging; all manner of bodily contortion was contemplated in order to come up with just the right *angle of repose* for peering beyond the darkness.

All this was surely no walk in the park. It was demanding work navigating blindly down to the depths of the soft spiraling esophagus. Not all had the skill- or nerve- to perform these delicate maneuvers. And with only the early rigid endoscopes available, lit with only intermittent sunlight or the meager light of candles, it took great clinical judgment and knowledge of anatomy to avert danger. These early days were filled with suspense, as one small move in the wrong direction could easily spell disaster. And since the throat cavity is not expandable, it was more important than ever to make the light brighter and ensure it was reflected and directed deeper down the throat cavity (more difficult than the easier to access lower pelvic regions of the human anatomy). The instrumentation also had to be modified with more safety features and smaller dimensions in order to fit into the narrow recesses of the throat and esophagus.

In other words, when it came to laryngoscopy, we were essentially flung back to the time of Bozzini, having to deal with the original obstacles of insufficient lighting and problems getting the image reflected back to the eye.

The Earliest Pioneers

To meet these challenges, a whole progression of men and methods ensued, summoning their best efforts to overcome what seemed to be insurmountable odds. Many histories of laryngoscopy begin straight away with the story of Manuel Garcia, the most commonly cited founder of the discipline. However, more recent research has uncovered information about many others who preceded Garcia. Not surprising, Bozzini is cited by most as the true founder of

laryngoscopy, for the obvious reason of having introduced the field of modern endoscopy in general, as well as because his auxiliary attachments were designed with the upper GI in mind [2]. Though ultimately Bozzini was unable to visualize the larynx in living patients, his main design principles served as blueprints for many years thereafter. The French surgeon Levret is the next most commonly cited predecessor to Garcia, whose device to view the larynx, though not as technically sophisticated, preceded Bozzini's work by over fifty years. Introduced in 1743, Levret's angled-mirror instrument for viewing the larynx indirectly, in addition to his novel way to ligature laryngeal polyps, apparently did enable practitioners to visualize the larynx. The historical records on this however are not clear.

Guy Babington - 1829

Aside from these few emboldened pioneers, because of the serious anatomical constraints, many abandoned the quest altogether. Only the truly persistent troubled to carry on. One such dogged individual insistent on finding a solution was Guy B. Babington, a physician from London. Babington is now cited as the first to have viewed the upper larynx [3] using endoscopic principles. Babington's "glottoscope," presented in 1829, was unique in that his was the first instrument to combine the previously separate devices of a reflecting mirror (a common dentist's mirror) and a tongue depressor into one clinically practical unit. Some of his later modifications were even more exceptional in that his design principles closely resemble modern-day laryngoscopes.

Though not especially mechanically challenging, Babington's innovation nevertheless produced excellent results, for it freed up one hand which could then be used to hold or maneuver a second reflecting mirror into just the right angle to enhance the concentration of light. Prior to this innovation, physicians faced the cumbersome task of holding the viewing mirror in one hand with the tongue-depressor in the other, while an assistant blindly directed the use of the second reflecting device, finding the correct angles only as verbally instructed by the seeing physician. This awkward trio of tasks severely limited accuracy, visibility and mobility. With his simple innovation, Babington improved light reflection capabilities and increased the efficiency and safety of the entire procedure, allowing physicians to concentrate more fully on the actual therapeutic procedures.

As usual, some aspects of the record are unclear. For instance, it is not clear whether Babington was truly able to visualize the larynx. Part of the confusion stems from the fact that the details concerning Babington's clinical trials were not found in the main body of his first article on the subject, but were added as an appendix at a later publication date. In any case, in these appended notes, Babington did claim to have visualized the larynx in a living patient using reflected light, a feat which would have made him one of the first in documented history to do so. Babington was also unique in his usage of two reflecting mirrors of different sizes, each held at 120 angles to achieve just the right results. The smaller one, held in the right hand, was used to reflect the

image back to the eye, while the larger one, a “common hand looking-glass,” was held in the left hand and was used to concentrate the solar rays back toward the first mirror. As for the light source, Babington relied exclusively on natural sunlight instead of artificial illumination.

Despite his remarkable achievements, over the years Babington has been overshadowed by other pioneers in the field. However, many laryngoscopists today have now reconsidered the record and have come to view Babington’s contributions as nearly on par with others of repute, such as Garcia.

To the Larynx or Bust – Honorable Attempts
As it turned out, not every physician could achieve what Babington did in these early days. A great many tried and failed to replicate Babington’s methods. It seems it wasn’t just the technical innovations; the dexterity, judgment and skill of the physician came into play as well, factors we see affecting the outcome of endoscopic surgeries even today. A whole progression of men and methods followed in these early years of the 19th century. Some of the more well known to have tried but failed include of course Bozzini, then Senn from Geneva, Trousseau and Belloc of Paris, and John Avery of London.

Horace Green - 1838
With such high failure rates, those who did achieve any degree of success were often referred to as either virtuosos- or charlatans. Horace Green of New York (1802 – 1866) surely fell into the former category. Considered by many as the “father of laryngoscopy in America,” Green’s work was significant because he was the first to achieve *direct* visualization of the larynx, rather than relying on reflected images from mirrors [4]. Contrary to other historical accounts, it was Green– and not Kirstein or Tobold- who was first to achieve this. This change to direct viewing anticipated modern laryngoscopic methods and required fairly sophisticated manipulation of light sources for inspecting what had been generally considered inaccessible. Retrospectively, American laryngoscopists also credit Green for establishing the field of laryngoscopy, since he was also one of the first to limit his practice to diseases of the throat.

Green gave new meaning to the word *industrious*, and his unwieldy list of “firsts” bears witness to the prolific outpour that was his life work. Perhaps of most significance, Green was one of the first ever to perform what must be considered the first successful laryngoscopic *operative* procedure. His case involved an 11-year old girl who suffered from severe sleep apnea, caused in part by a mass obstructing her glottal aperture. At the time of this procedure,*laryngotomy* had been successfully achieved in only one adult patient. Green therefore decided to instead try excising the mass *transorally*; in other words, in a minimally invasive manner. Under direct visualization, using his whalebone [5] laryngoscope and reflected sunlight as his source of illumination, Green removed the polyp, thus curing the patient.

In 1838 Green also was the first to introduce other forms of operative laryngoscopy, using his endoscope to deliver a sponge saturated with a

cauterizing solution of 10% silver nitrate. Remarkable for his time too, Green was also apparently able to reach his treatment as far down as the lungs. Green's ability to perform such difficult procedures defied the medical understandings of his day. In fact, few others could repeat his procedures. One professor of anatomy refused to believe his results, brashly declaring his work to be an "anatomical impossibility." As a result of such skepticism, Green was repeatedly accused of fabricating his data and fellow colleagues demanded his expulsion from the New York Medical Society. A committee was even formed to investigate his claims, which were condemned as an "unwarrantable innovation into practical medicine."

Yet Green possessed uncommon fortitude, for despite such hostility, he boldly continued his research and clinical practice, producing prolific volumes of work, including two textbooks, as well as groundbreaking articles. Ultimately, he was vindicated of all charges, as eventually other pioneers were able to understand his work and achieve similar results. Like so many innovators, Green had simply been too far ahead of his time.

Manuel Garcia - 1854

Despite the priority by many others in the field, medical historians conventionally date the beginning of laryngoscopy to 1854 [6], when the Spanish voice professor, Manuel Garcia, demonstrated to London's Royal Society of Medicine an endoscopic method for indirectly viewing his own larynx. Noted for his charisma and persuasive communication skills, Garcia was able to capture the medical community's attention even without formal medical or scientific training. With his unique blend of personality and persistence, Garcia earned the title as one of the "fathers" of laryngoscopy.

Despite his acclaim, Garcia's method appears to have been no more sophisticated than Babington's work from twenty years earlier. Relying solely on the most rudimentary principles of endoscopy, Garcia utilized a simple dental mirror (which he warmed beforehand to decrease condensation) and a second hand-held mirror to reflect sunlight.

Though his ideas were not entirely original, Garcia nevertheless deserves mention in the history of endoscopy based on his tireless advocacy and persistent desire to perfect his technique. Famous for being the singing teacher to the opera stars of the day and filled with uncanny vigor, Garcia enjoyed a colorful and long life, living past the age of 100; and he was said to have maintained his sprightly spirit right until the very end.

1857 - The Tangled Tale of Turck and Czermak

Up until this time, the history of laryngoscopy had been rather staid, save for some of the more intrepid adventures of Horace Green. However, by the 1850s, as endoscopy in general began to take off as a legitimate field, things got a bit more complicated. Disputes over priority became common. Within the world of laryngoscopy, one of the most notable contestations occurred between Ludwig

Turck and Johann Czermak. They are jointly cited as founders of laryngoscopy in Europe, though Czermak is generally given the bulk of credit.

Ludwig Turck
The story began in the fall of 1857 with Ludwig Turck, a professor of laryngoscopy from Vienna, Austria. Hearing of Garcia's successes, Turck traveled to Paris himself to observe his work. Then, utilizing Garcia's main principles, Turck modified the instrumentation somewhat by using a larger reflecting mirror. From this point however, some discrepancies exist concerning Turck's degree of clinical success. Some sources refer to Turck as the initiator of clinical-diagnostic laryngoscopy, indicating that his work must have been fairly significant. However, others claim that his efforts were unsuccessful, stating that by 1858, he had completely "abandoned" further work in the field.

Johann Czermak
Entering the picture shortly after Turck was the Czechosovakian professor of physiology named Johann Nepomuk Czermak (1828–1873). Most accounts agree that Czermak learned the main tenets of laryngoscopy directly from Turck, even borrowing his instrumentation. It seems however that Czermak continued his work throughout the winter of 1857, just as Turck (who relied predominantly on sunlight) was said to be abandoning further experiments due in part to the lack of sufficient sunlight in the Viennese winter. This account is contested however, as other sources describe Turck as using an independent light source in the form of a "pump lamp with double wick." Whatever the case, it was Czermak who is most often cited as being the one who overcame difficulties with sunlight by relying exclusively on an artificial light-source, an innovation which would have been one of the decisive factors for outperforming Turck. Czermak's introduction of a concave head mirror to concentrate the light also played a role.

With these and other subtle changes, Czermak ultimately was able to produce better results than Turck. And by 1858, he was in front of the Viennese Medical Society claiming to be the first to visualize the living larynx using a practical method [7]. Though Turck vigorously contested this claim and Czermak apparently did apologize, the damage was done. Thereafter, Czermak came to be known as the founder of laryngoscopy. Today, medical historians have revisited the records and now both Czermak and Turck are named as the co-founders of the field of laryngoscopy.

Despite this contested beginning, Czermak's work overall must take center stage for a few key reasons. To begin with, Czermak's more successful adaptation of an artificial light source was a clear improvement over sunlight [8], for it finally freed laryngoscopy from the "clock and the barometer," [9]. As well, Czermak later affixed a tube to the simple dental mirror, which made his method closer in kind to our modern understanding of endoscopy.

A Crucial Milestone - Endoscopic Photography by Johann Czermak
However, Czermak stands out most especially for achieving one of the most significant firsts in endoscopic history by becoming the first ever to take a

photograph endoscopically [10]. Introduced in 1858, Czermak's ingenious idea was completely novel for his time in both technical and conceptual aspects. Though the first known photograph was taken over thirty years earlier by Nietce in 1829, no other person since that time had come close to adapting the existing photographic technologies for surgical applications.

Like Garcia before him, Czermak conducted his laryngoscopic experiments on himself. Using the techniques derived from Turck and others, Czermak photographed his own larynx. The photographic method itself was referred to as stereoscopy that consisted of a box that housed a system of several lenses. The images were captured using metal plates coated with silver nitrate. Amazingly, all of this was achieved using only magnified candlelight as the light source. Ever the ingenue, Czermak also demonstrated remarkable foresight with his innovation of a detachable eyepiece that allowed for up to four viewers to simultaneously view through the scope. Czermak's work was especially remarkable too because many other physicians during this time were not even able to visualize the difficult to reach larynx endoscopically, let alone obtain photographs of it. Though the grainy images obtained are barely discernible by today's standards, these early photographs inaugurated an entirely new concept in surgery– that of photodocumentation– which in turn set the stage for later breakthroughs relying on similar principles, such as videoendoscopy. For the first time too, physicians could examine images of living anatomy without having to be present during the procedure. This enhanced visual knowledge alone was responsible for generating a more sophisticated understanding of disease pathologies, which in turn led to better treatment options, not just for the field of laryngoscopy, but within all disciplines. Czermak's innovations therefore marked a true turning point, one that helped to catapult endoscopy into the next stratosphere of progress. By recognizing the value of photographic technology, Czermak proved himself to be a true visionary, years ahead of the mainstream mindset.

Another Turning Point – 1867: First Electric-Based and Distally-Placed Light Source

Bringing light into the far reaches of the upper GI continued to be the greatest limiting factor for laryngoscopy, making successful therapeutic procedures a rarity. Yet laryngoscopists wanted desperately to achieve progress in this field, especially since mortality rates for injuries or obstructions involving the air passages were so high. One particularly telling report, published in 1867 by G. Adelman, describes a clinical analysis involving 314 patients with untreated foreign bodies of the esophagus, 109 of whom would ultimately succumb due to perforations of the heart, aorta, or other great vessels. Yet the limited and often risky endoscopic methods for treating such cases remained fraught with great uncertainty. Physicians therefore began experimenting with various forms of light energy in order to solve the formidable problem of insufficient illumination that so plagued laryngoscopists especially.

Galvanized platinum wires, which produced glowing hot light, stood in as the pre-Edison best contender for solving endoscopy's illumination growing pains. Scientists were known to have experimented with galvanized light sources as early as the 1820s, driven especially by the growing interest in electromagnetism in general. Of course, experiments with non-medical applications of electromagnetism led to such famous outcomes as Faraday's electric motor, Hertz's wireless (radio) telegraphy, and Marconi's continuation of the same.

One of the earliest surgical applications of electricity came in the form of electrocautery with Viennese dentist Moritz Heider in 1845 and Albrecht Theodor Middeldorpf of Breslau, Germany in 1854 as two of the early pioneers in this technique. Middeldorph in fact described his device for the cauterization of urethral strictures, though he described only theoretical concepts rather than work on living patients. Another early adaptation was the invention of electrolysis (electrochemistry) that was said to have been founded by Crussell in circa 1850.

However, applying this technology specifically as a light source for inside the living body was problematic because the heat generated from the electric wires was simply too intense for delicate human tissue. Many physician-inventors tried and failed to find a solution to this obstacle.

Julius Bruck and His Galvanized Platinum Wire

However, Julius Bruck, a dental surgeon, also from Breslau, started a new chapter in medicine when he provided one of the earliest and best theoretical solutions for addressing the dilemma of excess heat. His 1866 [11] proposal to encase galvanized wires into a glass cooling system (aka, a precursor to the light bulb) as a source of internal illumination for endoscopic purposes therefore stands out as an important contribution. Of equal importance, it marked an important conceptual shift toward positioning light sources *inside*rather than outside a body cavity, as had been the only option in endoscopy's candlelight era. The light emanated from galvanized wires encased inside a glass tube that contained a separate nested compartment in which to receive circulating water used to cool the device. Bruck then attached the light source to the distal tip of an endoscopic instrument (though to which type precisely, the records do not make clear); the complete ensemble at one time referred to as a *galvanoscope*.

Not surprisingly, there are considerable discrepancies within this historical account. Notwithstanding the symbolic significance of Bruck's innovation, there is some room for questioning whether or not he actually used his invention in any clinical setting [12]. This becomes an especially glaring inquiry since very few specific details about the application of his device exist within the historical documents. Conflicting reports concerning priority also exist. One source describes the light source as an instrument and method invented by Mikulicz-Leiter sometime around 1880. Still other more valid sources explicitly state that Bruck was responsible for the entire package, cooling system and all. Based on a

thorough analysis of all the various sources, it appears almost irrefutably likely that Bruck did in fact invent the instrument and technique, but that he only used it in a limited number of patients and in modest ways, such as partially inside the mouth. One source states that Bruck went on to use his new instrument to perform other procedures, such as a stomatoscopy, though this has not been verified by any other sources. Later, in the 1880s, the Mikulicz-Leiter team offered an improved version of the original idea which allowed them to carry out extensive and successful patient trials. Though these outstanding questions of fact remain unresolved, at the least Bruck's documented attempts to harness an electric source helped to inaugurate the concept of using electricity (though only in its rudimentary form) for medical application.

Sword-Swallowing as Therapy: Adolf Kussmaul, the Sword-Swallower, and the First Direct Esophago-Gastroscopy

Though early 19th century laryngoscopists devised some of the most advanced and elaborate magnifying lamps for amplifying light, in the final analysis a laryngoscope in the early days really was essentially only your everyday dental mirror. Eventually though laryngoscopists did start adopting more sophisticated instrumentation, taking for instance Desormeaux's urethroscope and rigging it for use in the upper GI tract. Adolf Kussmaul (1822-1902), of Freiburg, Germany, was one of the earliest to use a modified version of Desormeaux's device, a factor that helped him to become the first to perform a *direct*esophagoscopy [13]. For this achievement, Kussmaul is considered an important pioneer whose work not only introduced gastroscopy as a diagnostic possibility, but also initiated the shift away from indirect approaches, toward the safer and more modern direct gastroscopy.

The procedure itself, performed in 1868, was ultimately made possible by Kussmaul's insightful decision to engage the services of a professional sword-swallower whose unusual talent allowed for Kussmaul to understand more precisely how to navigate through the body's most treacherous contours. Using Desormeaux's urethroscope as the source of light and attaching his custom-designed 47 mm long and 13 mm in diameter tubing with speculum, Kussmaul was able to pass the scope all the way down to the stomach. This modified device is considered the first gastroscope. Several sources state that, in this manner Kussmaul was able to diagnose pathologies of the esophagus (though only on a few occasions), including specifically a cancer of the thoracic esophagus in one instance. Other sources contradict this, stating instead that Kussmaul was in fact unable to see anything. One of the most reliable of sources verifies that Kussmaul achieved modest levels of visualization, including the diagnosis of pathologies, but that, owing to patient difficulties in tolerating the long device, along with the suboptimal visibility, Kussmaul abandoned further efforts in the field. Of note too is that, though he did give live demonstrations of his techniques to medical societies, Kussmaul never followed up with any published reports. It was only through his well-known student, Killian, that we have learned of his work at all. Though his esophagoscopies were ultimately judged as

unsuccessful, Kussmaul's contributions were nevertheless influential in bringing to light important ideas and observations. Kussmaul's gastroscope was repeatedly cited by later pioneers as the source of their inspiration. In fact, the famous Mikulicz-Leiter team (whose work we will examine shortly) held Kussmaul in such high esteem that they sought out his personal advice before proceeding with their own designs.

Johann Mikulicz – The First Successful and Practicable Esophago-Gastroscopy
Despite these and other such impressive first attempts, it was Johann von Mikulicz, in collaboration with Leiter, who is credited with performing the first*successful and useful* direct esophagoscopy in 1881. A Czechlasovakian hailing from Vienna, Mikulicz enlisted the help of the renowned instrument maker from Vienna, Joseph Leiter, to find a solution to the pesky and persistent problem of poor illumination. Drawing in part from the prior works of Kussmaul, Mikulicz and Leiter constructed the first clinically successful gastroscope, equipped with distally-placed galvanized wire as the light source and cooled by an ingenious cooling system.

The placement of the light source *inside* the body (a continuation of where Bruck left off) again signified one of the most crucial developments for endoscopy. The galvanized wire light source itself was exceptionally well designed, no doubt the result of Leiter's brilliant input. The light derived from a distally-placed, u-shaped platinum wire that was encased in a double-barreled glass tube surrounded by tiny hollow circuits. Part of the water coolant system, these circuits served as the conduit for circulating water. The other end of the wire was attached to an external Bunsen battery unit that served as the energy source that lit (galvanized) the platinum wires. A unique method for minimizing the scope's diameter was also invented. Not able to house both the specialized guiding mandarin and the optical system without increasing the diameter, Mikulicz-Leiter made these component parts modular so that, after introduction of the scope had been achieved, the guiding mandarin would be removed, thereby allowing room for the optical apparatus to then be inserted. Topping off these innovations were also improvements to the optical system, including the addition of a prism. In addition to these instrument improvements, Mikulicz also made several important clinical observations that contributed to greater overall clinical success. By recruiting his own version of a sword-swallower- a woman with a talent for swallowing instruments (don't ask!?)- Mikulicz noted that the *only* necessary condition for ensuring safe insertion was that the head of the patient be angled into the 'sword-swallower' position. With this simple yet crucial observation, Mikulicz was able to more consistently achieve clinical success. The use of a general anesthetic was mentioned as being required for most patients. However, given the fact that most of the illustrations depicting Mikulicz' procedures indicate an upright, awake patient, a cocaine anethetic was the most likely product used.

Not to spoil the fun, but one area of historical dispute must be mentioned. In 1879, before Mikulicz's work, Nitze has been credited with working on a

gastroscope with almost the exact features as that of Mikulicz-Leiter's device. Further, it seems that Nitze was also working with Leiter to produce this instrument, but that later, after an altercation between the two, Leiter began working instead with Mikulicz. Even though it is not clear whether Nitze was able to get his device *working* before Mikulicz, some consideration to these facts must be given when exploring claims of priority. Putting aside this point of contention, the achievements of the Mikulicz-Leiter team were nevertheless undeniable smash hits. Mikulicz and Leiter were among the first to combine three of the most important elements which define endoscopy; the unification of an electric light source, an optical system, and a viewing tube into one device with proven clinically success. As a result of such substantial innovations, Mikulicz is considered one of the most significant pioneers and founding fathers of gastroscopy. In a strange twist of irony, sadly Mikulicz died fairly young of stomach cancer at the age of 55, the very sort of pathology he tried so diligently to endoscopically diagnose and treat throughout his lifetime.

Summary - 19th Century Laryngoscopy

By the late 19th century, the simple dental mirror that surely had aspired to be so much more, finally did transform into a true endoscopic superstar: fully-loaded, with advanced optics, distal light, and capable of diagnostic and therapeutic procedures once thought impossible. Driven in part by developing technologies in other fields, such as lens technology and electricity, the field of laryngoscopy gained considerable momentum toward the end of the 19th century and charged forward into the 20th century with whistles and bells and high hopes. Several of endoscopy's finest, including the great pioneer, Georg Kelling, continued to make crucial advances to the field in the years just shy of the 20th century. We will review these developments in subsequent chapters. As we will see too, the plot ripened. Soon, the indirect method for viewing, so predominate in the 19th century (with the exception of Kussmaul and Mikulicz's early direct attempts), would find itself scuttled to the scrap pile of history as the newer, safer, better *direct* approach found its groove. Still, despite such extensive efforts, for the next 70 years only the most skilled *virtuosos* could actually wield a rigid or semi-flexible laryngoscope well enough to make a living at it. We will have to wait until deep into the 20th century to see this story unfold, for it was only with the appearance of fully flexible instruments lit by fiber optics that the practice of laryngoscopy transformed into a more accessible surgical art form.

Summary of Part II

There is a loftier ambition than merely to stand high in the world. It is to stoop down and lift mankind a little higher.
-Henry Van Dyke

As for the field of endoscopy in general, the original four obstacles which had stood for so long as ancient impediments, were about to be challenged by a new generation of pioneers whose efforts would indeed stoop down and lift endoscopy a bit further with the help of the great late 19th century technological coup: electricity. For the next few decades, electricity would be the driving force

behind endoscopic innovations and the decisive factor in overcoming the obstacle of poor visualization and illumination.

Progress toward achieving some relief from the fourth obstacle- expanding the field of vision- was also just about to materialize with the next wave of pioneers who quickly seized upon the latest lens technologies, creating finally a viewing range that was large enough to catapult endoscopy away from simplistic diagnostics and closer toward its greater operative potential.

Notes

1. Sub-specialization as we know it today did not truly exist during this time.
2. Per Bozzini's own instructions.
3. There is some discrepancy in the record concerning whether Babington did in fact view the larynx.
4. Laryngeal introitus per Zeitels.
5. Some sources actually refer to his instrument as a *probing*, a long, curved probe made from a whale-bone.
6. The dates 1853 and 1854 have been also commonly cited. However, our research indicates that 1855 was the year in which Garcia actually introduced his technique to the Royal Society.
7. The records do not indicate whether mention was made of earlier pioneers, such as Babington and Garcia.
8. Others before Czermak had also added artificial light source, including John Avery in 1844. However, Czermak was the first to make its use practical and reliable.
9. Recall again that there are discrepancies as to whether Turck tended to rely predominantly on sunlight.
10. The specific technique was referred to as stereoscopic photography.
11. Other sources cite 1867.
12. The German source Reuter only alludes to the possibility that the device was placed "inside of the mouth."
13. Not to get confused with being the first to view the larynx with direct visualization– as was mentioned, this was accomplished by Babington years earlier. The important distinction here is that Kussmaul was the first to actually perform a procedure using direct visualization.

PART III) 1870s-1899: THE ERA OF NITZE

CHAPTER 11. THE ERA OF NITZE

This era continued to be dominated by endo-urology. It was also an era which was first touched with the taming of electricity for illumination, first with cruder versions called galvanized wires, and later with the invention to end all inventions, Edison's 1880 electric mignon light bulb. We left off at Part II with Bruck's work in the galvanized wire department. In part III, this idea is extended not only as a source of illumination, but also as an early operative technique for coagulating tissue. The early pioneers in this era include Grunfeld, Trouve, Bottini, Kelly, Pawluk, Brenner, Billroth and von Dittel, in addition to the well-known father of modern endoscopy, Nitze. This was also one of the first eras in which we see significant contributions by American endoscopists. We also witness the continuation of endo-photography, first inaugurated in Part II by Czermack, and now blossoming into an exciting and established component of endoscopy, made especially practicable by the ingenious innovations of Stein.

Of most importance, this era is characterized by the establishment of operative procedures. Though crude by our own standards, these early forms of operative endoscopy, in the form of endo-urological electro-cautery, marked one of the most crucial milestones for endoscopy, for this was the moment when the scope first began to transform from a mere diagnostic tool to one with therapeutic value.

By the end of this section, cystoscopy has become a widespread diagnostic and operative procedure, with practitioners from all over the world working to improve and expand its applications.

We first review the work of Grunfeld and Trouve, who were described as the most important pioneers of this era, outside of Nitze. Their trailblazing work in technologies as well as operative procedures were said to have paved the way for Nitze's innovations.

Grunfled Helps Pave the Way for Nitze

One of the era's most significant achievements was the first documented case of *therapeutic* endoscopy, achieved in 1873 by the dermatologist-turned urethroscopist Joseph Grunfeld. Known commonly as one of the founders of modern urethroscopy, Grunfeld founded modern urethroscopy at the Clinic for Syphilitic Patients in Vienna.

He also developed a whole range of sophisticated instrumentation. Using his own specially designed cystoscopes made especially to remove tumors from the urethra and bladder, Grunfeld became the first documented to remove bladder stones and polyps with the endoscopic direct visualization. His polyp removal was one of the earliest versions of a punch instrument, which was a technique that was popular well into the early 20th century. Prior to this moment, all other instances of bladder stone or polyp removal had been essentially blind

procedures. Therefore, Grunfeld is considered the founder of operative endo-urology and urologists today recognize his work as groundbreaking. His ingenious design made his method work better than others. It was considered the first workable punch instrument to remove polyps from the urethra. Grunfeld introduced other brilliant technological innovations and made especially well-known improvements to Nitze's devices, including correcting for the inverted image problem. He was also able to expand the field of view even more than Nitze's early efforts. Other novel auxiliary instrumentation include loop threaders, scissors, forceps and cutting knives. His scopes were the very symbol of the late industrial age fascination with mechanized components, with his scopes featuring automation buttons which controlled the movement of these auxiliary instruments.

Grunfeld also incorporated Coudee's ingenious innovation to the catheter, which is commonly referred to as the *Sonde Coudee*, (which is the curve in the point). This allowed Grunfeld and others after him to keep urine back, thereby allowing for direct contact endoscopy with the bladder to be possible for the first time. Grunfeld also added the innovation of blackening the inner surface of the shaft in order to prevent scattered beams of light from occurring.

Grunfeld also contributed to the literature, publishing in 1881 the textbook called *Die Endoscokie der Harnrohre und Harnbiase* (Endoscopy of the Urethra and Bladder), edited by Billroth und Lucke, vol. 51, F. Enke, Stuttgart, which was one of the few textbooks specifically dedicated to endoscopy at the time.

Trouve Also Paving the Way

The Parisian engineer Trouve is considered by many scholars to be as crucial to the development of endoscopy as Nitze. Trouve in fact was the first- before Nitze- to found electro-endoscopy, with his distal placement of the galvanized platinum wire. Trouve founded electroendoscopy around 1873, adding illumination to the tips of endoscopes with glowing platinum light. He presented this idea in Vienna, using the name electrical polyscope. Trouve's device also included newly designed and uniquely placed prisms, including the double prism system. These increased the field of vision to 90 degrees. Unlike Nitze's device, Trouve's scope did not require the awkward cooling system. Trouve designed several different types of scopes including a urthroscope, cystoscope, rectoscope, and gastroscope.

Of particular note, Trouve was able to dispense with the complicated water-cooling system (around since Bruck's time). He did this by making the wires really flat and thin (referred to as "thin platinum filaments") by hammering them down to measure about 1/14th to 1/6th mm thick. Modified in this way, the wires, while sufficient to conduct the current, produced such little heat that Trouve said "every examination…is possible." Although this particular claim of Trouve's was apparently "intensely debated" by Nitze and Leiter, ultimately it was proved true that Trouve's design innovation did what he said it would; reduce heat so it could be safely brought inside the body.

Other innovative technical improvements include a built-in eyepiece which was based on magnifying glass as introduced by Galilei, which was able to magnify by 2.5 times. As well, he constructed a rheostat which helped to regulate the strength of the source of the current. After Leiter presented his Nitze endoscope (with the so called “new” distal source of light) in 1880, Trouve took a very strong stance to protect his priority, writing in to the main journal. Eventually Trouve received his rightful recognition for primacy on this innovation. Some of the most credible sources assert that modern endoscopy “was founded by Trouve, and perfected by Nitze.”

NITZE - 1877
Preface to Nitze
One important point to make at this point is that, even with all these ingenious innovations to date, at the end of the day it was still only possible to observe fields of view no larger than the size of the lenses. For almost seventy years, since the time of Bozzini, the optical field’s development had been conspicuously arrested; it did not budge outside of the size of the aperture of the scope itself.

Maximilian Carl-Friedrich Nitze
1848 - 1906
The life of Nitze was probably the most difficult to reconstruct for this history. At turns described as “irascible,” other times as “shy,” this was a man who unquestionably was touched with genius, years ahead of his time. Perhaps this was why he seemed to live a life of exquisite intellectual torture, trapped in a state of implacable visionary reverie for technological advances which could only remain ever elusive. One source summed up Nitze as being “a shy and often irascible loner who reportedly did not care much for society or politics, yet he was pegged as brilliant at a young age.”

Nitze was born on September of 1848 in Berlin, Germany. He studied medicine in Heidelberg, Würzburg and Leipzig. Nitze obtained his medical degree in 1874. Aside from these few biographical details, not much else is known about his private life. Speculation about the man himself will go on forever, but the confirmed truth is that Nitze is one of the most important fathers of endoscopy, whose brilliant discoveries ushered in the modern era of endoscopy. Urologists today also claim Nitze as their own father of modern urology for his imponderably vast contributions to the field. No other pioneer of his time came close to achieving such a sweeping revolution of change for endoscopy. He is most known for being the first to make routine operative endoscopy safe and reliable, to bring distal light to life as a practical reality, to apply the latest microscope optics to the endoscope which ultimately expanded the field of vision (so that he could achieve those routine operations), and to be the first (along with V. Dittel) to introduce a miniaturized version of Edison’s electric light bulb to the endoscope (although Newman was the first actually). The scope of his accomplishments is almost too great for this short survey. Yet we begin with his 1877 debut of an endoscope of his own design that marked the beginning of modern endoscopy.

1877 – Nitze and the Adaptation of Microscopy Optics Technology to the Endoscope

Every endoscope with a telescopic feature in fact is said to be the legacy of Nitze. Indeed, his series of innovations forever changed how urologists inspected the urinary tract. In collaboration with Josef Leiter, Nitze developed the first rigid endoscopic instrument with a built-in light source– often referred to as first direct-vision scopes. This instrument was primarily used for urologic procedures, but was also later adapted for the upper gastrointestinal tract, and indeed, was the same instrument design that was applied for the first series of laparoscopies in the 20th century. The lens system was actually three lenses in one, described in detail by one source as (paraphrased) "essentially a mini microscope that included a wide angle lens which was fully immersible in the watery environment of bladder. The second lens produced the combined objective, and the objective reflected the image onto the middle lens with as little light loss as possible at that time, which then magnified the image even more (though it darkened it considerably)." Despite all this technical brilliance, the image was in fact upside down (Ringleb would correct for this problem a bit later). Of note, Nitze apparently did offer a solution via an auxiliary part to be added to the eyepiece, but for reasons that are a bit unclear, this solution was never accepted.

The Complicated Cooling System of His First 1877 Cystoscope

Nitze's illumination system (prior to his use of the electric bulb) was actually the main design drawback of Nitze's scope. The electrified platinum wire (the only technology available to create light which could be used inside the body) required the use of a complicated and elaborate water-cooling system, a system which was a modification of the Bruck's from the 1860s. Nitze introduced his "kystoskop" and "Urethroskop" in Berlin on October 2, 1877, demonstrating first on cadavers. Two years later, in 1879, he began full clinical trials.

The Second and Third Nitze Cystoscope With Edison Electric Light Bulb

A crucial breakthrough for Nitze came by way of Edison's invention of the electric bulb, officially introduced to the world in 1880. This technological coup helped to change Nitze's earlier complicated system into what most sources cite as being the first "practical operating cystoscope" which was a safe, simplified, inexpensive, and readily usable instrument. In 1888, Nitze adapted a miniaturized bulb (as developed by Koch and Preston) for use with his second generation cystoscope. This new and improved cystoscope made bladder stones easily located and removed, something which had long been inaccessible by most endoscopic methods, except for by the few virtuosos in the field. Using this new scope, Nitze became the first to coagulate a bladder papilloma using hot, galvanized wire loops. This breakthrough led ultimately to the systematic treatment of bladder diseases in this manner, with Nitze eventually reporting 150 cases of bladder tumors removed cystoscopically with only one death and 20 recurrences.

Other Innovations

Nitze worked on dozens of other inventions and modifications of the scope. His

forceps equipped with electro-cautery devices at its tip, introduced in approximately 1886, were especially successful and gave rise to his ability to make simple operative procedures on bladder tumors a fairly routine and reliable procedure for the first time.

Indeed, this invention was similar in concept to the 20th technique of TURP, although without the benefit of modern electro-current technologies of course. Nitze is also credited with designing the first ureter balloon catheter in 1905, as well as the earliest practical irrigating cystoscopes (although Leiter and Berkeley-Hill are also cited as the first to introduce these). As well, Nitze (along with Fenwick) was the founder of trocar cystoscopy, a newer method for removing bladder stones which involved the use of a guiding trocar in the suprapubic region.

He continued to develop the irrigation cystoscope, as well as a photocystoscope (derived from Stern's) and additional version of his operating cystoscope in collaboration with the instrument makers Hartwig, Loewenstein, Hirschmann and Heyneman. He also contributed to the literature substantially by publishing the first atlas on cystoscopy in 1894.

Even Nitze Faced Criticism

It is amazing to think that even the master Nitze's ideas were rejected by officials of his day. In one instance, when applying for recognition of his invention in 1880, a court counselor dismissed his device with the following: "the devices are interesting in themselves, but appear to have no future," (letter from Dr. S. Th. Stein, published June 19, 1880). As for the specific of the lens system, the field of view was 70 degrees, and "there was considerable perspective distortion inside the bladder because the distances in the bladder are no more than 8 cm."

Also, Nitze's scope was apparently difficult to manipulate, and galvanic cautery using the wire loop proved to be an unreliable treatment for bladder tumors.

When other technologies came along in the early 20th century, specifically diathermy currents and also instruments with the Albarran lever system from the United States, Nitze's methods of electro-coagulation were made obsolete. Finally, his system was considered prohibitively expensive.

Of course, the final drawback of Nitze may have been Nitze himself! Apparently prone to pugnatiousness, he was involved in several highly publicized heated altercations between his one-time collaborator Leiter, and later too with Stein, who lodged a lawsuit against him on behalf of Trouve, whose idea for the distal placement of light was essentially borrowed from Nitze without giving full recognition to Trouve. HH Young from America personally reported almost getting into a " knock down, drag-out fight" with Nitze because of some less than flattering remarks that he apparently made to Young concerning his work.

Conclusion Nitze
Despite the tales of altercations, Nitze was ultimately recognized for his brilliant contributions. His work was especially lauded in America and when the AUA was founded in 1902, Nitze was bestowed as an honorary member. More on Nitze is yet to come, for his inventive genius continued on into the 20th century.

Leiter
After the friendship with Nitze dissolved in disagreement, Joseph Leiter continued to work with other physicians to improve upon Nitze's designs. He was said to have introduced before Nitze one of the earliest irrigating cystoscopes in 1887. Leiter also introduced a photographic camera which could be attached to his gastroscope, though most sources describe it as essentially useless.

ENDO-PHOTOGRAPHY, AFTER CZERMAK
1874 – Theodor Stein
Still, although Czermak's work had priority and was significant, it was nevertheless Theordor Sigmund Stein of Frankfurt who has been credited with establishing scientific photography in 1874, bringing unique improvements to the field that were clearly ahead of his time. After Czermak, Stein was the first to construct an automatic endocamera, or photoendoscpe. This very clever system, which he referred to as a heliopiktor, has been described by many as a forerunner to Polaroid technology. Stein also improved upon Czermak's system by utilizing an even brighter source of light called gas magnesium light. Unfortunately, there is a somewhat messy history that coincides with these innovations. His various systems included photoendoscope, magnesium lights, heliopiktor, photo-ophthalmoscope, photo-otoscope, photo-laryngoscope, photo-urethroscope.

It appears that Stein's system was not well received by some of the top endoscopists of the day. Nitze for instance, apparently tested Stein's invention without much success, while Grunfeld did the same and reported similarly negative results. In 1881, perhaps in response to all of the negative feedback, Stein initiated a lawsuit against Nitze and Leiter for patent infringement. Despite all of these unpleasantries between the pioneers of the day, Stein and Czermak's technical breakthroughs in photographic documentation systems were truly wonderful innovations for endoscopy. A plethora of scientific possibilities was created by this newfound ability to investigate human organs and other tissue pathologies.

Others after Stein to make contributions to this field include von Dittel's modifications in 1888, Olbermann's idea of a gastrocamera in 1890, Robert Kutner's photos of the stomach in 1891, and even forays by the famous director Fritz Lange, along with his colleague DA Meltzung, who experimented with gastrophotography in 1898. Trocar photography was also introduced by the end of the century.

OTHER INFLUENTIAL PIONEERS
Karel Pawlik

The gynecologist Karel Pawlik of Prague was one of the first to probe the female ureter under direct visualization in an air-filled bladder. He apparently achieved this by approximately 1886, but didn't publish on it until 1894. Pawlik used a urethroscope custom made for the female anatomy, and which was modified according to Grunfeld, using a distally placed platinum glowing light. This helped launch endoscopy into procedures for female patients. Before this, catheterizing the two ureters was apparently very difficult.

Howard A. Kelly

Though often erroneously credited as the inventor of air-cystoscopy, (that credit goes to Pawlik, Grunfeld, and Otis), Howard A. Kelley's "tremendous experience and prestige" with the method catalyzed its introduction and wide acceptance in America. Kelly was a professor of gynecology and obstetrics at The Johns Hopkins University. His modified aero-urethroscope, advanced in 1893, and had shafts as small as 5-20 mm in diameters. Air cystoscopy is partially related to the positioning of the female patient, which when placed in the knee-elbow position, allows the bladder to fill with air. Initially Kelly failed to get air cystoscopy to work in men. But later in 1896, Kelly was able to solve this problem (with Otis also being one of the first to do so in 1887). In addition to his ob-gyn work, Kelly was also one of the earliest pioneers to apply the endoscope for use in diagnostics of the colon. Kelly introduced in 1894 "the first long 30 cm rigid rectosigmoidoscope which subsequently became known as "Kelly tubes" by his colleagues. Kelly published the description of his work in the Annals of Surgery in 1895. Through the use of several amplification systems (including a forehead lamp), Kelly was able to increase illumination significantly, which was described as being as bright as approximately twenty candles.

Other Pioneers

In 1883, David Newman of Glasgow developed the first urethroscope- before Nitze- with Edison's light bulb attached at the distal end; the mignon lamp is the novel feature of this adaptation (though other sources say that this innovation of Newman's was for the minielectric bulb that he used). This is important because it was the first light system which no longer required a complicated cooling system. Double-channeled irrigating cystoscopes were available since 1889, with Brenner apparently the first to introduce these multi-tasking scopes, followed by Nitze, Boisseau de Rocher, James Brown of New York, and eventually many others; Felix Guyon of Paris (Civiale's successor) around 1888, among others, reported bladder tumor operations using alternative methods ; Leopold von dittel of Vienna also advanced the same; Bottini's work marked the beginning of electro-surgery of the bladder and prostate, even earlier than Nitze and in approximately the same time frame as Trouve. In particular, Bottini's introduction of an endoscopic approach to treatment of prostate disease with the use of galvanized wires (electro-cautery), introduced as early as 1874 was especially significant. His work was said to have gained "considerable success." James Brown of Johns Hopkins University invented a new catheter system in 1893 that made it easier to insert in male ureters (using the Brenner cystoscope). In

1899, Boisseau du Rocher introduced a dual channel scope which had the ocular part separated from the rest of the sheath. This enabled the surgeon to add different telescopes through the sheath without having to take the scope out and reconfigure it. Felix Martin Oberlander (1849-1915), a colleague of Nitze, is cited as being the one to make Nitze's device usable "for the first time" in 1888. Oberlander improved urethroscopy and developed endoscopic treatments of the urethra. Moreover, with the discovery of the anesthetic properties of cocaine, he was able to stretch the urethra further than most and insert wider caliber shafts.

OTHER SIGNIFICANT TECHNOLOGIES AND MILESTONES OF THE ERA

Cold Light

Other significant milestones of this era include the introduction of cold light technologies which helped obviate the need for an elaborate and cumbersome cooling system. Some of the earliest work into cold light advances was both Preston or Valentine in approximately 1895 and Koch in 1899. His innovation, the koch urethroscope, was the first endoscope equipped with the Preston cold lamp (a cold mignon bulb possibly derived from Valentine), which replaced the ultra hot and therefore difficult system of electrified platinum wires. This light bulb was described as "pea sized."

Koch's advertisement in one of the earliest catalogues of endoscopy gives a quite fascinating glimpse into the era, over 100 years ago:

"In this instrument, devised by Dr.Koch, we offer to the profession an endoscopic urethral tube in which the entire lumen (inside the tube) is clear and unobstructed, thus giving ample room for the manipulation of applicators, etc. Along the side of the tube proper is our small auxiliary tube for the light carrier and lamp. Through a fenestra at the distal end the light is thrown directly upon the surface to be examined or treated, thereby giving a clearly lighted field and permitting the application of medicaments without the possibility of cotton catching on the lamp when the applicator is withdrawn" - As researched by Reuter.

Hysteroscopy

S. Duplay and S. Clado, in 1898, two Frenchmen who wrote the first completed book on hysteroscopy. Their hysteroscope was an open tube with a battery-powered light source. Also, RT Morris in 1893 added an interior obdurator, which could be withdrawn once the instrument had been introduced into the uterine cavity.

Lithotripsy

Continuing where we left off with the great innovations that made open surgeries on bladder stones a dead art, we now turn to a great breakthrough by Henry J. Bigelow of Boston who developed a lithotripter which also included an efficient catheters system and also aspiration balloons, introduced in 1876. Apparently Bigelow adapted this idea of a rubber balloon attached to a glass container by Clover of London who introduced it a few years earlier in 1874.

CONCLUSION PART III – Summary of the Late 19th Century
In summary, by the end of the 19th century, endoscopes had been well established as a means of evaluating the urinary tract, anorectum, larynx, esophagus and stomach. Although the chest and abdomen were not yet accessible, the methodologies had been developed for this possibility.

Despite all this progress, cystoscopy was still plagued by great disadvantages. By the late 1880s, it was still considered a procedure which was not reliable and which could cause grave injuries, including cases of life-threatening, uncontrollable hemorrhaging. To these problems, we look to the 20th century pioneers to work out novel solutions.

CHAPTER 12. EARLY 20TH CENTURY

Introduction

Formerly, when religion was strong and science weak, men mistook magic for medicine; now, when science is strong and religion weak, men mistake medicine for magic.
-Thomas Szasz, M.D.

Perhaps no one is more relieved to enter the 20th century than you the reader. Though it might have seemed unnecessarily cruel to have kept you in the 19th century for so long, the insufferable waiting indeed had a purpose, for we can now begin the story of truly modern endoscopy with a sound understanding of its scientific, social, and technical contexts in mind. The previous background information also helps us to appreciate more fully the extensive number obstacles that were overcome in order to make it to this 20th milestone, a process which actually required hundreds, if not thousands, of years of accumulated scientific knowledge to achieve, not to mention the tenacious work of innumerable pioneers.

As the introductory quote alludes, the 20th century was one marked by a true domination of the sciences, though sometimes not always for the best. Indeed, some have said that the modern era of science and technology was both a blessing and bane. On the positive side, thanks to modern medicine, the western world was gifted with a nearly doubled human lifespan relative to their 19th century counterparts. Yet, co-existing with these healthy, humanitarian applications of science were advances in war technologies that caused a level of destruction that broke every standing record of mass death in human history. More than any other century, the 20th saw more human lives lost due to advanced technologies of war.

In contrast, medical advances were, for the most part, deployed for the good of humanity. Surgical sciences especially experienced a unique renaissance and enjoyed growing prestige in the eyes of the public. By 1900, most open procedures, once deemed unthinkable just a few decades earlier, were now made possible through the advent of improved antiseptics and anesthesia. Yet here began a strange twist to the tale of endoscopy; for while these same medical advances were naturally beneficial for endoscopy's continued development, they also worked paradoxically to forestall further progress toward more complicated, *operative* endoscopy. This occurred because open surgery trumped the still-developing endoscope when it came to the most crucial aspects: providing definitive diagnoses, finding and stopping internal hemorrhaging, and treating pathologies in the most complete way possible.

Without overcoming its shortcomings in these three areas in particular, endoscopy was in danger of remaining in the shadow of open surgery as a mere ancillary concern.

Re-Evaluating the Original Four Obstacles

If endoscopy was to overcome its diminished status relative to open methods, it was still imperative to make further progress toward solving more perfectly the original four obstacles. Even though these hindrances had actually all been resolved to some degree by the end of the 19th century, endoscopy still could not measure up to open methods, which remained the standard by which most other procedures- even those diagnostic in nature- were to be measured. Much of the literature on endoscopy during this early 20th century period made a point to remind the practitioner that no matter how advanced endoscopy had become (especially laparoscopy) it could never, would never replace open methods. Indeed, another 80 years or so would have to pass before a conceptual understanding of laparoscopy's potential was achieved.

However, the scenery of surgery was about to change dramatically with the introduction of new 20th century technologies. In particular, the advent of electricity created a whole new dimension to surgery that thoroughly changed the landscape of endoscopy especially. In fact, this early period of 20th century medical history was often referred to as the *electro-surgical age*. Electricity improved the visualization of the inner body so substantially that an entirely new understanding of human physiology began to emerge as a result. Pathologies of living organs could now be visualized with unimaginable accuracy. Therefore, instead of being viewed from the imperfect perspective that biopsies or autopsies gave, organs could now be visualized in living color, just as they existed within the living body. With this newly enhanced understanding of the human body, the still fairly young field of human physiology was able to advance considerably.

In short, the electric bulb, appearing so simplistic to us today, gave endoscopy what it had been longing for all along: a bright yet soot-less, streaming beam of cold [1] and consistent light, which could be safely placed inside the body. As a result of the superior visual perspective obtained as a result, surgeons were now able to focus more keenly on perfecting highly specialized endoscopic techniques, rather than continuously troubling themselves with ineffective light sources or unsafe, over-heated galvanized wires. Patients and physicians alike were also relieved from the dangers associated with live, electrified wires going into their bodies and all the grave potential consequences of such a scenario that you can imagine. News of this new technology swept the world and by 1900, improved and miniaturized versions of Edison's original bulb became widely available to all endoscopy medical device makers, alternately placed at either the distal or proximal end.

Limited Field of Vision Revisited

Of course, 20th century pioneers would still have to contend with one of the lingering, original problems; expanding the field of vision. Even though Nitze, Ringleb, and a handful of others had made some headway toward solving this problem in the 19th, the field of vision was still prohibitively small in the opening hours of the 20th century.

In fact, lens technologies (as applied to endoscopes) stayed relatively the same for almost 70 years after Nitze's 1880s work. Even with Nitze's innovation, only about a palm-sized area could be viewed, and both Otto Ringleb and Grunfeld only managed to expand the field ever so slightly. The average field of vision achieved amounted to no more than approximately 44.2 millimeters in diameter at a range of 2.5 centimeters. These diminutive dimensions naturally inhibited the ability to conduct more complex operative procedures.

New Inventions Lead to New Obstacles

Despite having just about finished off the first four obstacles, the pioneers of the early 20th century still had their work cut out for them. This was especially true since new technologies naturally bring along new and unexpected difficulties. For instance, the new methods established by Kelling, Ott, Jacobaeus and others, presented additional concerns specifically related to endoscopy, such as insufflation issues and intra-operative bleeding caused by trocar injuries. Another unforeseen issue centered on the need to better understand electricity so that it could be used safely and predictably in surgery. Naturally, the biophysics relating to the interactions between living tissue and electrical instrumentation was not well enough understood at this juncture, since the use of electricity in surgery had only been in practice for less than twenty years. As a result of this new wave of inexperience, endoscopy unfortunately underwent another difficult phase of trial and error. Many serious accidents involving electricity occurred, such as thermal tissue damage, electrocution, and other serious mishaps. Finding optimal electrical currents became a serious undertaking during the early days of the 20th century and remained a troublesome aspect for endoscopy for almost another hundred years.

As well, injuries caused by incorrect trocar placement or over-insufflation began to occur more frequently as endoscopy began to enter the mainstream. It was also necessary to further increase magnification levels if endoscopy was to truly evolve into a more useful form. By the 1930s, magnification capabilities (as applied to endoscopic devices) still only achieved 20-fold increases, as opposed to our current levels, which reach 80-fold magnification.

Endo-Photography

And finally, interest in advancing endo-photographic technologies kept the pioneers ever on the hunt for improved lighting. By 1900, endoscopes were being built with photographic powers. Called stereo-cystoscopes, these new scopes could split the light source, one beam for immediate viewing, and the other for photographic purposes. Jacoby and Ringleb were among the early 20th century's most active innovators in this technology. Of course, with the splitting of the light source in this manner, this meant that even more powerful light sources were necessary.

Revised List of Obstacles

All of this leads us to a revised list of hindrances that emerged– or re-emerged- in the early 20th century:

1) improving magnification
2) increasing the field of vision still further
3) taming electricity inside the body
4) understanding insufflation issues
5) increasing light further (to be solved by the advent of fibre optics)
6) improving endo-photographic capabilities

This new set of encumbrances, along with the need to perfect even the old tasks, kept the minds of many pioneers preoccupied for another 100 years. Like the original obstacles from a hundred years prior, many of these problems were not sufficiently resolved until well into the 20th century.

The New Era of Endoscopy Made Treating Diseases Much More Feasible
Electricity at least helped solve the old dilemma of providing adequate light for use inside the human body. The now amplified illumination, combined with improved anesthetics and antiseptics, made diagnoses so reliable that a broader spectrum of conditions could readily be confirmed and treated endoscopically. In this way, in the eyes of internists, gynecologists, and urologists in particular, endoscopy began to emerge– ever so slowly at first- as the preferred diagnostic method over open procedures. With the vastly improved visibility brought on by electricity and fluoroscopic methods, along with the greater precision in electro-cautery, the endoscope now allowed for safer biopsies, a diagnostic procedure that previously ran the risk of causing fatal internal hemorrhaging. Performing risky blind biopsies of even the liver and other "bleeders" became significantly safer (though still racked with some lingering risks as we soon shall see).

By the turn of the century, endoscopy was also finally able to access areas that had been nearly impossible to visualize before electricity and other technological improvements.

Cystoscopic renal diagnosis (chromocystoscopy) was one of the most significant breakthroughs for 20th century endoscopists. With the use of dying agents, for the first time ever intricate details of the vessels were finally visualized.

Therapeutic (AKA Operative) Endoscopy Just Burgeoning
Despite these undeniable early successes, a greater body of convincing evidence supporting endoscopy's efficacy had yet to be collected and confirmed. And here the story of this underdog of surgery really begins to unfold in all its true glory, for the evidence proving endoscopy's tremendous value and potential finally became utterly irrefutable during this early 20th century time frame.

Proof to endoscopy's growing indispensability as a therapeutic tool was evidenced by the great success found in removing pathologies of the bladder. By the 1880s you will recall, Nitze, Grunfeld, and a handful of others had made great progress in this domain with their respective successes in removing pathologies from the female bladder under direct visualization. Yet these were considered essentially rare feats, even in the late 19th century. However, by the early 20th century, removing bladder tumors endoscopically (via the urethra) had

become a fairly routine procedure, as had the electrical cauterization of strictures, polyps, and other such conditions. Compare this relative operational ease to the year 1800, when the surgical removal of bladder stones had an associative mortality rate of 20-40%!

As for forays into therapeutic gynecologic endoscopy, we would have to wait just a couple of more decades, as it lagged somewhat behind the work of urologists and gastroenterologists.

Endoscopy and TB - Old Societal Scourge Meets New Technology
Curing an old nemesis of society was one way that endoscopy clearly gained a decisive victory in proving its unmistakable potential. One of the most notable advances during this time frame was the endoscopic treatment of tuberculosis, a disease that was still a dreaded scourge throughout the first half of the 20th century. So fearful were people of TB that many turned to dangerous, 'alternative' therapies, even at one point inhaling chlorine gas vapors for supposed relief. Until antibiotics and other treatment methods for TB were perfected in the late 1940s, endoscopic approaches proved to be among the most effective therapeutic measures that physicians could offer. Patients infected with TB often succumbed to internal hemorrhaging caused by TB-induced lesions afflicting the lungs and sometimes the peritoneum. Before endoscopy, diagnosing and treating such internal bleeding could only be achieved via laparotomy.

Georg Kelling - Brilliantly Synthesizing Existing Technologies
TB however, was about to meet its match with a persistent pioneer who believed endoscopy could help treat such diseases in a much safer way than laparotomy.

Georg Kelling, a gastroentologist from Dresden, Germany, ingeniously combined already existing endoscopic technologies with a previously invented insufflation method, performing for one of the first times a successful endoscopic procedure within the abdominal cavity of a living dog. Using a Nitze cystoscope designed for children and insufflating the abdomen with filtered air from a device he constructed himself, Kelling successfully inserted the scope through a small incision in the abdominal wall, thus allowing for the endoscopic examination of the dog's peritoneal cavity. Through a second trocar insertion, he then established pneumoperitoneum in order to visualize the interior body to avoid, as he described it, "damaging any of the internal organs." This occurred live at the 73rd Congress of the Naturalist Scientist's Medical Conference on September 23rd, 1901, in Hamburg Germany,

There is a great deal of confusion in the historical record on Kelling, matters we will address shortly. However, it is important to point out early on that, contrary to what other histories report, Kelling did in fact eventually go on to perform many endoscopic procedures on living human patients in his private clinic, apparently achieved between the years 1901-1923. He published an account of his extended clinical experience in a 1923 article that recapped his 22 years of experience using endoscopic methods. Kelling mentioned that his increased usage of the scope's diagnostic capabilities was partly influenced by the poor

economic situation of Germany after the First World War, which made the cost of laparotomies, which required hospital stay and anesthesia, prohibitively expensive.

As for the disputes over primacy between Kelling and Jacobaeus, we perhaps can never know for sure at this point. However, based on Kelling's own insistent testimony in the matter, it does appear that Kelling did successfully perform laparoscopies on two human patients sometime between 1901 and 1910, thereby making him– and not Jacobaeus– the first to perform a laparoscopy on a living human patient. Kelling's own testimony on the subject is our source in this case. After Jacobaues claimed to be the first to perform a laparoscopy in 1911, Kelling defended his primacy with a written response which was published in the same journal two months later, which stated that he had in fact successfully performed *his* laparoscopies on several human patients between 1901 and 1910. The exact total of these procedures in this timeframe vary in the literature, but the most reliable source states that Kelling reported a total of just two human cases at this point in time. By the time he published his last article in 1923, Kelling claimed to have achieved even greater clinical success in human patients, but our research was not able to uncover the precise details on this matter. From these cases, he described the appearance of the liver, tumors, and tuberculosis.

In any case, though his first *published* clinical trials up to the year 1901 never reached beyond a few dogs, Kelling nevertheless deserves recognition for boldly developing an entirely new field of endoscopy. Specifically, Kelling was the first to establish laparoscopy as a field by using the novel combination of three methods most closely related to today's procedure; the abdominal approach, artificial insufflation, and reliance on scopes with full optical equipment (as opposed to simple tubes without optics).

Artificial Insufflation

Kelling's technique of insufflation was actually a brilliantly new and improved solution to one of our ancient obstacles; expanding the body cavity. He adopted the technique of expanding the abdomen with air with two main purposes in mind: *First*, he realized it was useful for improving the safety of endoscopic procedures since it helped surgeons avoid hitting organs, a problem which had earlier limited the ability of the endoscope to safely enter the abdomen:*Second*, as was commonly believed during this time period, the use of injected air into the lungs had been shown to sometimes act as a curative for TB. Artificial pneumothorax therapy, as it was then called, was a somewhat crude surgical procedure that had been known since the time of Hippocrates. However, it often resulted in infection and death from emphysema, especially prior to the use of antiseptics.

To adapt this technology in a safer manner, Kelling mainly referred back to the principles established by the Italian physician Carlo Forlanini, whose substantial innovations in insufflation in the late 1880s helped provide inspiration for many of Kelling's own techniques.

Even before Forlanini, insufflation of the abdomen was not an entirely new concept. Many others had made important contributions related to this field. Reports about its use as a therapeutic measure were published as early as 1870 by Robert Simons of Bonn, Germany (among others). The earliest known creation of peritoneum in a person was achieved by Albert von Mosetig-Moorhof of Vienna, who in 1882 cured a 4-year old boy infected with TB using this method. Other early contributors who helped advance understanding of the physiology of pneumoperitoneum include John Murphy, a surgeon from Chicago, Willem Nolen of Leiden, Netherlands, and Wegner of Germany. Kelling also worked in tandem with the Czech surgeon Vitezslav Chlumsky. As for early endoscopists, many urologists had been practicing the use of using natural insufflation methods which entailed positioning female patients in the deep Trendelenberg to allow for air to come into the pelvic regions (called air-cystoscopy).

Kelling however, was ultimately the first to take these existing technologies and combine them in a uniquely practicable fashion. He also used a two-trocar site entry (although he had apparently returned to a one-punch site according to Nadeau), a method that was fairly new at the time, and one that most modern laparoscopists of today have ultimately chosen as the best way. And since Kelling lived during an era in which TB was killing some 2 million people around the world each year, he had great incentive to find a safe solution fast.

Kelling also promoted his technique as an efficient way to investigate intra-abdominal bleeding, another common condition which often proved fatal for patients in those days. Kelling not only believed that endoscopic diagnosis could achieve a safe and precise understanding of the origin of internal hemorrhaging, but went further to hypothesize that adding air pressure to the abdominal cavity might even stop the bleeding entirely. Though this particular hypothesis turned out to be wrong, such attempts nevertheless demonstrate that Kelling was well ahead of the curve in attempting to address difficult to treat conditions endoscopically.

Even today, identifying and treating internal hemorrhaging continues to be one of the most formidable problems plaguing surgery. During Kelling's time, its causes not only stemmed from TB-induced lesions, but also were the result of a wide range of medical conditions, from ectopic pregnancies to ulcers and pancreatitis.

Therefore, Kelling's pioneering work provided insight into solving a broad swath of very serious conditions which had stopped short the lives of millions. In recognizing how endoscopy could help treat such devastating medical conditions, Kelling's work proved to be visionary in establishing and defining laparoscopy as an indispensable new field of surgery.

One of the First to Recognize Laparoscopy as a Safe Alternative to Laparotomies

An under-recognized achievement of Kelling's is his early insight into laparoscopy's potential role to make diagnostic laparotomies obsolete. Kelling

was in fact one of the first in the literature to mention the desire to avoid exploratory laparotomies.

However, during this time period, endoscopic methods could only play an occasional role in providing what really was only a tenuous diagnosis at best. Ultimately however, a laparotomy was the only way, in most cases, to definitively diagnose conditions affecting the abdominal region. Kelling noted however that the patient's condition often worsened after such aggressive surgery. He therefore introduced his new endoscopic technique as a way to save patients from the dreaded laparotomy. Specifically, Kelling stated that his inventive drive was influenced by a desire to treat patients afflicted by the growing TB epidemic without having to resort to laparotomy, which he knew to be painful and traumatic for the patient.

Kelling was therefore one of the first to recognize and advocate endoscopy as an alternative to laparotomy. By 1898, he had already published two articles on endoscopic methods. In one publication entitled "Endoscopy for Esophagus and Stomach," [2,3] Kelling wrote: "The endoscopic method finds more usage than has been the case until now, considering the fact that it is truly more useful than the method of laparotomy…"

This foresight was quite unique for his time, for many surgeons still relegated endoscopy to the backwaters of surgery, as it continued to suffer from unpredictable outcomes and seemingly insurmountable technical difficulties.

To help make his new technique more predictable, Kelling also focused on the tiniest details. In fact, Kelling gave some of the most precise instructions concerning the preparation of the patient, some of which were just as rigorous as today's standards. For instance, he was one of the few laparoscopists then (and even up until very recently) who recognized the importance of purging the patient before the surgery as a preventative measure in case bowel perforation occurred at the time of the trocar entry. This is evidence to astonishingly keen foresight, for even as late as the 21st century, we find that some laparoscopists still have not incorporated this simple preventative measure as standard procedure! Kelling was also cautious enough to recognize important contraindications (relevant to his time period), with the presence of abdominal adhesions being one of the most important. As well, he had experimented with various placement methods for the trocar, finding the preferable angle to be 45 degree, an angle remarkably similar to today's standards.

Kelling's Early Days: 1897-1898

Even before his seminal 1901 debut of laparoscopy, Kelling was actually beginning his pioneering discoveries several years earlier. Kelling's training as a gastroenterologist first led him to explore the possibility of treating ailments affecting the esophagus, lungs, and stomach. In fact, Kelling's writings emphasized that his methods were (initially) intended for examining the esophagus and stomach and not obstetrical or gynecological related procedures. And the endoscopic world was small back then. To bring us back to previous

chapters, it turned out that Kelling learned from and worked closely with Mikulicz of the laryngoscope sword-swallower fame.

For gastroendoscopists, one of the most difficult obstacles was the difficulty in viewing the multiple blind spots of the stomach. After some initial trials, Kelling developed a brilliantly conceived flexible esophagoscope/gastroscope in 1897, inspired by Mikulicz and Stoerk's "sectional" instruments, respectively. One of the first of its kind, it was designed with the human finger in mind, constructed of vertebrated segments of hollow tubes covered with India rubber, the tip of which could be angulated or pulled straight with what one source referred to as an "ingenious" system of wires which were controlled proximally. It was then illuminated by Leiter's panelelectroscope or a Kasper hand-held lamp. All the same, this particular instrument of Kelling's failed to find wide favor.

There is no consensus in the historical record concerning this early work of Kelling's. One source referred to his flexible gastroscope as "clumsy," and emphasized its lack of commercial success. However, other recent and credible sources describe it as "a masterpiece of optics and mechanics." Nevertheless, Kelling apparently wasn't racked with doubt on this matter. He was so supremely confident of this creation that he decreed "no essential improvements remain to be made." He did, however, admit that "for long esoph-scopes, the illumination is sometimes not altogether sufficient if one is looking for small objects which are not easily visible." Kelling also honored his mentors and gave credit to Mikulitz (of 19th century fame) with being the first to recognize the need to look straight into the esophagus as contrasted with various indirect reflective methods using mirror methods (As it turns out, Kussmaul is actually generally cited as the first to recognize the principle of straight endoscopes and of successfully using them in living human beings).

One point can certainly be agreed upon; Kelling was well ahead of the curve in introducing a flexible gastroscope, since flexible esophagoscopes are today the preferred instrumentation for esophagoscopy (made possible only after the invention of fiber optics technologies).

Kelling Conclusion

Kelling's innovations, particularly the introduction of laparoscopy with insufflation, were truly some of the most spectacular and novel developments to have kicked off the new century. What is most impressive overall is the fact that, more than any other physician of his era; Kelling's methods are strikingly similar to modern laparoscopy, even down to the most minute detail. Nadeau in his 1925 article summed it up best when he said that Kelling's work "becomes all the more remarkable when we consider that the technique which he applied and describe almost 25 years ago is with little modification the technique used today." Indeed, Kelling came closer than any other practitioner of his day to achieving progress in the three areas in which laparatomies were then dominating: providing definitive diagnoses, finding and stopping internal hemorrhaging, and treating pathologies in the most complete way possible.

Though ultimately Kelling's work did not overcome these three objectives entirely, his work did provide some of the most crucial and groundbreaking insight towards understanding how such goals might be attained endoscopically.

Concerning both our original and new set of obstacles respectively, Kelling made some progress on several fronts. Finding a novel solution to the original problem of expanding inner cavities was a particularly unequivocal success. However, Kelling did fall somewhat short in obtaining an accurate understanding of the complicated physiological effects of insufflation. However, given the nature of his era's medical understanding of such matters, such a shortcoming is understandable.

However, because of his (initial) limited clinical trials and lack of further publications about laparoscopy, Kelling has been somewhat marginalized over the years. For instance, only the address to the audience from his September 23rd, 1901 presentation at the medical congress was published in January of 1902; his work that day was never followed up with a full clinical account or subsequent publications until almost twenty years later. Being late to publish on these results proved to be a mistake of great consequence, for Kelling's work ultimately became overshadowed by that of Hans Christian Jacobaeus, who achieved greater clinical success, expanded the field of laparoscopy considerably, and made sure to publish his results (publish or perish!).

However, this hasty judgment seems to be rather unjust, for his inventive energies were quite impressive, even by our modern standards. His ingenuity took him across a broad spectrum of endoscopic experiments, ranging from esophagoscopy to gastroscopy to, of course, laparoscopy. By 1923, he was one of the few in the world who could claim twenty-two years of clinical experience using laparoscopy.

As well, Kelling engaged in extensive research in other issues relating to laparoscopy, such as attempting to understand the precise physiological outcomes associated with insufflation. In this area, some of Kelling's ideas did prove to be a bit off the mark. For instance, he did not realize that too much insufflation could have fatal consequences. However, this failure again must be understood in the context of a time when naturally the medical knowledge of insufflation issues was quite limited.

Even so, many have revisited Kelling's contributions and have concluded that much of his technical expertise was even more sophisticated than previously thought. Kelling's innovations were cutting edge technologies of his day, and many of his design principles are still in use. In particular, his idea of a flexible esophagoscope, though ultimately ineffective in his own day, was in fact adopted late in the 20th century after fiber optics made such a design concept possible. In retrospect, though much of his work was not fully developed, his unique design principles and innovative thinking about endoscopy have stood the test of time and changed the field of surgery forever.

Kelling's legacy has been difficult to reconstruct for another reason, though one far more tragic. During the final days of WWII allied forces destroyed the German city of Dresden in February of 1945 with 650,000 firebombs, killing thousands of its residents in the process. The actual death toll remains unknown to this day, but unfortunately the record is clear that he and his wife perished in this attack. With their entire home charred to the ground, few of Kelling's own memoirs and other biographical records could be recovered. This is one of the greatest tragedies not only within medical history, but for the history of humankind, for the world lost a great humanitarian on that day.

Dmitry Ott [4]
For the 20th century, we finally begin to branch out of Europe and attend more fully to the rest of the world's endoscopic pioneers, whose earlier works may have been marginalized somewhat through the process of inadvertent historical inaccuracies. We turn to the historic city of Petrograd (now St. Petersburg), to revisit Dmitry Ott, the first surgeon in the history of endoscopy (before Kelling by a few months) to successfully view the pelvic organs in a living human patient using endoscopic principles. For this and his other outstanding contributions, Ott is remembered as one of the Russia's greatest surgeons and pioneers of gynecologic endoscopy. A professor of gynecology and obstetrics, Ott also headed the Princess Helene Midwife School.

Though some unresolved discrepancies remain within the records, it does appear that Ott did in fact peer inside a living human abdomen a few months before Kelling's work with a dog by using a modified colpotomy approach, assisted with laparoscope-like techniques. Despite Ott's primacy over Kelling, over the years Kelling's work has overshadowed his mainly due to Kelling's innovation of the modern-styled abdominal approach. In fact, some critics didn't even consider Ott's vaginal approach as an endoscopic procedure at all. However, putting aside these contested details surrounding issues of priority and definitions, it stands without question that Ott indeed was the founder of modern gynecologic endoscopy in Russia. In addition, he was one of the first to demonstrate the feasibility of pelvic endoscopy by the vaginal route, establishing an important alternative modality for laparoscopy.

His work was based on the principles of a posterior colpotomy, a well-known (but essentially blind) procedure used by gynecologic surgeons for many years, though the exact originator of the method appears to be unknown. Its primary use was for the removal of cysts, ovaries and fibromas. As well, prior to the perfection of modern-day operative laparoscopic techniques, it had served as the only way to extract the appendix and gallbladder during a laparoscopy. However, Ott's modified version of this standard colpotomy made the procedure one that for the first time allowed for the direct visualization of the lower abdominal cavity, utilizing endoscopic methods. Naturally, by enhancing visualization, this was the safer choice over blind methods. Ott's technique (which he named *ventroscopy*) was an innovation conceived independently of Kelling. His approach was showcased on April 19, 1901 [5], in St. Petersburg's Meeting for the Gynecology

and Obstetrical Society, and was subsequently published in an article entitled *Illumination of the Abdomen (Ventroscopia)*.

Ott was able to achieve visualization of the abdominal cavity by using a combination of instruments, including his own custom-designed vaginal retractor, along with a "tube" to facilitate the actual exposure of the abdomen. An important distinction must be made at this juncture concerning the various types of endoscopes available during these early days. Broadly speaking, there were two types of endoscopes; those with optical equipment and those without. Ott had used the type without optical lenses, which often was referred to as an "open" scopes, or more colloquially, simply a "tube." Kelling on the other hand used the more sophisticated Nitze scope, which came with lens systems similar in concept to telescopic systems.

For illumination Ott attached to the end of his retractor a "peanut-sized lamp and a spoon-shaped shield to protect the patient from burn," which was reflected into the cavity using metallic mirrors and a headlamp. This instrumentation was inserted vaginally through an incision made in the Douglas cul-de-sac (posterior fornix). A cotton filter was placed in the vagina, with the patient in deep Trendelenburg position, head downward, pelvis upward. In this way, the abdomen vacuumed the filtered air into the abdominal cavity, creating a natural condition of insufflation. Though other historical accounts credit Nordentoft as the first to adopt the Trendelenburg position for endoscopic procedures, it was in fact Ott who became the first to do so. Ott did not apparently rely on any method of artificial insufflation.

With the ureter catheterized, Ott was also able to inspect the bladder, uterus, and other parts of the pelvic region. During Ott's era, his method briefly gained some popularity within Europe and was in fact nearly identical to the culdoscopic method so favored by European endoscopists in the early 1920-1930s, and later by Americans throughout the 1940s-1960s.

By introducing a new method of pelvic endoscopic by the vaginal route, Ott created a niche surgery that served a population of patients who may have otherwise been contraindicated for other methods, particularly laparotomy. It is also important to bear in mind that laparoscopy had not yet been officially invented during this time period. Nor were the endoscopic technologies of the day adequately evolved to handle the types of cases we routinely treat today. Therefore, given the means available during his time, Ott does deserve recognition for adapting existing technologies in combination with his own technical innovations, to come up with a novel solution that enjoyed successful clinical outcomes.

As for Ott's technical innovations, several stand out. Firstly, he designed special retractors which had light bulbs affixed to the tip which were used for both diagnosis as well as surgeries within the lower abdominal area, bladder, bowel, and uterine cavity. He also modified the operative table and equipped it with

stirrups and shoulder-holders, which enhanced his ability to perform procedures in the steep Trendelenburg position.

Other Achievements
Though Ott's work remains less well known relative to other endoscopic pioneers, this does not diminish the reality of his work, which was characterized by great ingenuity and insight into the problems of endoscopy in its formative years. Ott's contributions also went beyond his 1901 debut of ventroscopy. He also advocated another version of minimally invasive surgery with a minilaparotomy, and published the results of this new method in 1909.

As well, in 1914, Ott, along with co-author Paul Kapolsky, published a textbook, entitled *Operative Gynecology (Operativnaia ginekologiia)*, which, though not exclusively on endoscopy, nevertheless helped to broaden knowledge about the field considerably for future Russian endoscopists. Because of his numerous works, Ott eventually was appointed head of one of Russia's most prestigious research institutes in St. Petersburg, which was renamed the *Ott Institute of Obstetrics and Gynecology* as a tribute to his outstanding contributions.

Discrepancies
Some sources have refused to categorize Ott's work as laparoscopic or even endoscopic, claiming instead that it was, as one source claimed, simply "a disguised laparotomy." To be sure, an incision into Douglas cul-de-sac is not necessarily a minimally invasive procedure. Yet at the same time, it is not equivalent to a full-blown laparotomy that calls for incisions 10-12 cm long. In all fairness, it may be best to leave such essentially insoluble contestations to future historians to sort out. What we do know for sure is that Ott successfully introduced an alternative to open laparotomy using endoscopic principles. At the time, few others had the visionary mind to think so far ahead.

Ott Conclusion
Ott was described as an "outstanding surgeon," whose repertoire of inventive outpourings ranged from creating specialized endoscopic instruments, to recognizing a need avoid laparotomies. Establishing a new way to safely access the lower abdomen was Ott's main contribution toward overcoming endoscopy's main obstacles. However, Ott's work transcends the list of obstacles in a way, for he helped establish an entirely new conceptual understanding of just what endoscopy might achieve, and made the possibility of finding an alternative to laparotomy a reality.

Ott's main contributions were fairly substantial. Yet, he worked on the minutiae details as well, including improvements to the operating table, such as shoulder straps to help patients maintain proper positioning, to inventing a completely revamped operating bed for further enhancement of his specialized procedures.

Though ultimately the preferred laparoscopic approach has come to resemble Kelling's design principles more closely, Ott's vision for the field nevertheless

provided crucial impetus and momentum toward expanding the burgeoning field of laparoscopy.

Hans Christian Jacobaeus

Hans Christian Jacobaeus, a professor of internal medicine at the Karolinska Institute in Stockholm is credited as one of the founding fathers of endoscopy, not only for becoming one of few to successfully perform laparoscopies using abdominal entry on human patients, but also for performing the world's first thoracoscopic therapeutic procedure in a living human patient in 1910. Jacobaeus stands out from all other pioneers of his generation mostly for his achieving a greater quantity of clinical success in laparoscopy in human subjects and for boldly envisioning and extending endoscopy into operative use in the thoracic cavity. Jacobeaus was a prolific publisher of articles, with at least ten that we were able to find. Jacobaeus published his last article in 1922, in which herecapped his lifetime of experience with both laparoscopy and thoracoscopy.

Laparoscopy - The Moniker is Born

Jacobaeus was the first to coin the term *laparoscopy* (originally "laparothorakoskopie") with his 1911 publication on both laparoscopy and thoracoscopy in humans in the journal *Münchener Medizinische Wochenschrift*. Jacabaeus reported what he believed to be the world's first laparascopic case, performed June 10th, 1910 on an electrical worker suffering from hepatic cirrhosis. During this first series in his career, Jacobaeus treated a subsequent 19 patients laparoscopically. Concerning the final total of successful laparoscopies, there are conflicting numbers in the record. What seems mostly agreed to is that his first article of 1910 covered a total of 19 laparoscopies and 2 thoracoscopies. As for Jacobaeus' seminal 1912 publication, which was by far the most detailed and substantial article, the most credible source cites a total of 97 laparoscopies (with no further thoracoscopies). Others sources report the number to range from 109 to 115. The confusion may stem from subtracting those cases which were not done in humans, but rather in living dogs during demonstrations.

This 1912 report described cases in which Jacobaeus diagnosed patients with various forms of liver disease, including cirrhosis, Pick's disease, syphilis, liver blockage, as well as other abdominal pathologies such as tuberculosis peritonitis and ascites. Despite all of this phenomenal success with laparoscopy, sometime around 1913, Jacobaeus reportedly switched his attention back to predominantly thoracic concerns related to TB, possibly under the influence of his great advocate Brauer. Despite this shift away from specifically laparoscopic research, Jacobaues' work nevertheless remained the foundation and gold standard, for thoracoscopy especially, for at least the next 15 years before other technologies, diagnostics, and pharmacologics displaced much of the work. It was to this work that Kalk, Ruddock, and other great early pioneers looked to for much inspiration.

Some of Jacobaeus' techniques were quite different than Kelling's. For instance, Jacobaeus did not inflate the abdomen with air as had Kelling. Instead he relied

on different positioning techniques that enhanced the visibility of the internal viscera.

For this reason, Jacobaeus generally was only able to perform laparoscopy when stomach-enlarging (bloating) ascites were present in the patient, who mimicked the effects of insufflation. In his career, it appears he only examined eight patients without ascites laparoscopically. His reports on the outcomes of these procedures were overall quite optimistic. His description of laparoscopy's future was however somewhat muted, stating that the implications for its use would lead someday to the full visualization of both the front and upper parts of the liver, but that he had been unable to obtain any views of value in the stomach region.

Another Small Dispute in Endoscopy's History
Jacobaeus' claim to priority concerning the first laparoscopy in humans instigated a strong response from Kelling, whose written retort on the issue appeared two months later in the same journal. Kelling claimed that he had in fact successfully used celioscopy in two humans between 1901-1910, though for reasons left unstated, never published on this until much later in 1923.

Thoracoscopy
In 1910, Jacobaeus had achieved what no one else had been able to at the time [6]: he performed the first ever thoracoscopic procedure on a living patient. A Nitze cystoscope was inserted into the pleural space of patients with pleural diseases so that a visual inspection of the pathology could be established. Jacobaeus pushed beyond these initial diagnostic measures, eventually performing what must be considered some of the early examples of operative endoscopy. Using one cystoscope to achieve direct visualization, he made a second incision, which was used to insert a galvanocautery instrument into the pleural space to cauterize adhesions between the lung and chest wall. Like Kelling, Jacobaeus' initial innovations were made to treat patients suffering from TB. This particular thoracoscopic technique was designed to establish therapeutic pneumothorax for patients with pulmonary tuberculosis. Jacobaeus' first article outlining his thoracoscopic methods, entitled "Concerning the possibility of applying cystoscopy in the examination of serous cavities," was published in October of 1910. In this article, Jacobaeus, like Kelling, paid tribute to Forlanini whose work, as he stated, proved "that one can enter the pleura without injury to the lungs." Of course, with legends like Kelling and Jacobaeus both citing Forlanini, this brings to light an important realization about Forlanini's work, which might need to be reevaluated and given more recognition in the history of endoscopy.

Jacobaeus achieved an important milestone in his career during the 1912 2nd International Congress on TB. Many of the greatest pioneers working to combat TB were there, including Forlanini. They were quite interested in hearing about Jacobaeus' artificial pneumothorax method. Professor Rudolph Brauer, one of the world experts on TB at the time, as well as editor of an important medical

journal took particular note. With Brauer's influence Jacobaeus' work gained the attention it deserved. With his respect for Jacobaeus, Brauer's influence may have helped ensure that Jacobaeus' work was not overlooked. Overall, this conference was one of the most important for Jacobaeus' legacy, for his work in the field of TB treatment using artificial pneumothorax did gain worldwide recognition after these presentations. In fact, Jacobeus' methods, along with advances made by Kelling in this area, were the cornerstones of TB treatment until the discovery of streptomycin in 1944 .

Despite the acclaim afforded him for establishing the field, the success of Jacobaeus' use of thoracoscopic methods seems somewhat debatable. In one of Jacobaeus' initial findings, he reported that nothing at all could be seen within the pleural cavity with his procedure. His limited clinical data in thoracoscopy seems to corroborate this view, since he apparently only initially reported on two successful cases in 1910, with the next reports on thorascopscy not arriving until 1922. There are records indicating that Jacobaeus continued to perform still more thoracoscopic operative procedures (lysis of adhesions) beginning again in 1913, using galvanocautery techniques. The full report on these procedures is apparently detailed in his 1922 final article entitled "The practical importance of thoracoscopy in surgery of the chest," published in the journal*Surgical Gynecology and Obstetrics*. It is not clear however, whether or not his procedures after 1913 were actually fully endoscopic; some may have been open with only thoracoscopic diagnosis without operation, or thoracoscopic-assisted open procedures, rather than full-blown endoscopic operations. Even with these additional cases after the initial two, it seems clear that he achieved success with laparoscopy in a greater quantity of patients, eventually achieving at least 97. Despite these clinical set backs in thoracoscopy, Jacobaues actually reported in his 1911 article that he viewed it as the procedure with greater promise than laparoscopy.

Interesting Detail

One of the most striking peripheral aspects revealed in Jacobaeus' papers relates to an apparent on-going debate Jacobaeus' and his colleagues were having in the 1912 era, about whether or not to use exploratory laparotomy or laparoscopy to diagnose patients. Jacobaeus stated that he had heard "very different opinions" on this matter, and that some surgeons indeed approved laparoscopy in some types of cases.

This is an obscure, but all the same amazing allusion if there ever was one, for it demonstrates that laparoscopy was taking place in Germany, at least to some limited degree by unknown early pioneers. There is brief mention of another internist named Hegler, who apparently had investigated for himself Jacobaeus' endoscopic techniques. Without more details, we certainly cannot speculate further on the matter at this point. However, it would be a good research query for the next generation of medical historians to pursue!

Conclusion

For the early era of the 1910s, nobody came close to achieving the degree of success that Jacobaeus did just in terms of the sheer number of successful laparoscopic surgeries. This is especially impressive when we look back and see just how limited the lighting and optical technologies were at that time. More than that though, it was Jacobaeus great vision concerning endoscopy's potential that demonstrated his true visionary gifts. He boldly pushed for operative thoracascopy when it had not been proven feasible and predicted that laparoscopy held especially tremendous value for diagnosing tuberculosis, cirrhosis, cancer, and syphilis in humans. Jacaobaues was also quick to adapt the latest technologies for endoscopy and was already using x-ray technology by 1912 in order to diagnose stomach and other gastro-intestinal diseases. Jacobaeus continued to travel throughout Europe demonstrating his techniques and remained throughout his life a prominent and vocal proponent of both laparoscopy and thoracoscopy. His work seemed to have catalyzed an entire generation of laparoscopists in Europe especially, since soon after Jacobaeus' debut a great flurry of reports on laparoscopy cropped up throughout Europe, and North and South America. Ironically, it was new medical technology that displaced much of Jacobaeus' work. His therapeutic thoracoscopic method for TB eventually fell out of favor when other treatment options became available, such as improved methods of chemotherapy. It took almost another 100 years for Jacobaeus' techniques to be rediscovered as important contributions to the field of thoracic surgery. Since lung collapse therapy was no longer needed after cures were found for TB, his work for a time was overlooked. Today, however, thoracoscopic surgeons rightly honor Jacobaeus as the founder of their field. As for laparoscopy, Jacobaeus is universally recognized as one of its most important founding fathers.

Other Important Early Pioneers

Apparently catalyzed by Jacobaeus' work, many other reports on laparoscopy came out. From the reference list of Nadeau and Kampmeir's influential 1925 article, from the period between 1901-1925, there are a total of 23 different names listed, 13 of which we have not covered in this review, including work from F. Tedesko (also Todesco) of Austria; WE Stone from Kansas, who reported in 1924 on his experiments which had extended to dogs only at the time; Stewart and Stein of USA, with their 1919 article, Louis Renon of France in 1913, G. Rosenthal, also of France, with a 1913 article, EJ Stolkind of Russia in 1912, A. Johnsson of Finland, 1916, Janssen of Denmark, JL Tierney 1920, Unvericht's article from 1922 (also the inventor of a new optics system in 1923), Andrea Roccavilla of Itlay with his 1920 publication, Schmidt of Germany, Meirelles of Brazil with a 1913 publication entitled "A laparoscopia" from the journal *Tribuna Med of Rio de Janeiro*, LR Sante's 1921 publication, and finally Bernheim of the United States whom we are about to cover. Nordentoft, the next pioneer to come onto the scene, may also have been influenced by Jacobaeus' work.

Notes

1. The minituarized mignon lamp, which gave off less heat and was therefore considered “cold,” was invented a few years after Edison’s original bulb.
2. Later he revised this publication, changing the procedure name to “coelioskopie.”
3. The article was originally named “On viewing the esophagus and stomach by means of flexible instruments.”
4. Also Van Ott.
5. One source has mistakenly cited the debut of his work as having been in 1903. However, our extensive research uncovered the original manuscript concerning Ott’s work, which was indeed dated 1901.
6. An exception is made for the early work of Forlanini, who apparently did enter the pleural.

CHAPTER 13. THE GLORY DAYS OF ENDOSCOPY

1910s-1920s, Post-Jacobaeus

Introduction
From the outset, the 1910s looked like the roaring 20s for endoscopy. Some of the obstacles that stunted the growth of endoscopy in the 19th century were just about cured by the newly invented technologies of the early 20th century.

Within just a few years of Kelling's, Ott's and Jacobaeus' groundbreaking successes, a heady collection of bold pioneers continued to push the still-developing technology to ever unprecedented heights. The successful expansion of the scope into areas once thought inaccessible– namely laparoscopy and thoracoscopy- proved to be just the catalyst needed to plant the fledgling seeds of a unified framework for all endoscopic disciplines.

Indeed, the glory days had arrived. If you had been waiting with baited breath for a true launching pad to help endoscopy take off, now more than ever the time seemed just ripe enough. Physicians from multiple disciplines all across the world were enthusiastic about this promising surgical method. It seemed everyone wanted a piece of the action, from bronchoscopists to urologists, from Boston to Berlin, the enthusiasm was simply brimming and irrepressible. By this time too, several textbooks had been published on endoscopy (though not yet on laparoscopy specifically). And many articles even began one of the earliest calls for temperance in the enthusiasm for endoscopy, warning that endoscopy could not- and should not– replace the more tried and true laparotomies.

Of most significance, we at last begin to see a great deal of progress in advancing endoscopy toward more operative procedures, rather than just diagnostic. Electricity allowed for scopes to be made with more gadgetry, with new features to make more complicated procedures possible for the first time. Indication to this technology spillover phenomenon and of the endoscope's popularity can be deduced by noting the many medical device companies that seemed to sprout up over night, effectively placing many different types of endoscopes on the market. There were now also operating endoscopes available. A bewildering array of novel instrumentation and auxiliary parts were invented as well to accommodate these new operating scopes. From ligasures to automatic electro-cautery devices, it was clearly a trend in the making and one that held great promise based on the reported clinical successes.

With such a fantastic outpouring of new technologies at their disposal, the next generation of pioneers were blessed with a great burst of momentum to set them sailing on to the new target, taking the reigns where Jacobaeus left off– the abdominal entry.

The Continuation of Laparoscopy in Its Infancy
1) Nordentoeft 1912
2) Americans 1911

Severin Nordentoeft (also Nordentoft)
Danish surgeon Severin Nordentoeft, from the city of Aarhus, appears sporadically and mysteriously throughout the early years of the 20th century. Recent research by Kieser CW, Jackson RW has uncovered new information about his brief but important contributions to endoscopy, namely that he was the first to found the field of arthroscopy, and as well, was one of the earliest– after Jacobaeus and Bernheim– to successfully perform laparoscopies as early as 1912.

Arthroscopy - A Brand New Endoscopic Application is Realized
Nordentoeft is most important because he developed an entirely new application of the endoscope. Nordentoeft was one of the first to realize that endoscopy would facilitate the diagnosis orthopedic conditions, a procedure that became known as arthroscopy. To facilitate this work, Nordentoeft designed an endoscope reminiscent of the Jacobaeus-model thoracoscope; it was comprised of a fluid valve, trocar 5 mm in diameter, and an optic tube. He also made an innovative discovery to use a saline solution as the optical medium in order to help maximize visibility. With these innovations, Nordentoeft was able to capture exquisite visual detail of the anterior region of the knee. Regrettably, the record is not clear as to whether his descriptions were the result of working with live patients or with cadavers.

One of the other most astonishing facets uncovered about Nordentoeft was that he was among the earliest in 1912– just after Jacobaeus and Bernheim- to view pelvic organs with the scope using an abdominal approach. The details of his clinical work were outlined in a paper he presented to the 1912 German Society of Surgeons, held in Berlin, Nordentoeft, called “Endoscopy of Closed Cavities by the Means of My Trokart-Endoscope.” As well, he is credited for introducing the technique to American practitioners.

Orndoff, Ruddock and others would prove to rely peritoneoscopy a great deal (Orndoff 1920, Ruddock 1934). Also, though Ott was the first, Nordentoeft was an early advocate of the Trendelenberg position for endoscopic procedures. In addition, he also experimented with suprapubic cystoscopy. These modalities were less common, and so establishing their safety and efficacy during these formative years of laparoscopy were especially important.

Conclusion Nordentoeft
After Nordentoeft’s initial groundbreaking work with the scope, it seems he shifted his attention away from arthroscopy entirely and dedicated his energies instead to the field of radiotherapy, which was just beginning to develop as a promising specialty at the time. In fact today, Nordentoeft is recognized by Danish radiologists as a pioneer of x-ray therapies rather than endoscopy per se. Though his pioneering work in arthroscopy and laparoscopy has been largely overshadowed by the better-known work of Kelling and Jacobaeus, today we recognize Nordentoeft’s primacy in groundbreaking endoscopic efforts.

American Endoscopists Burst onto the Scene
Though many historians have referred to the 20th century as the *American*

century, from the perspective of endoscopy, one would have been hard pressed to have come to such a conclusion. And given that the world was still facetiously referred to as *Pax Brittanica*, America certainly did not seem poised to take the helm as a superpower, much less the reins of endoscopy. However, American innovators were about to explode onto the scene, bringing with them even grander intrigues of the imagination. No doubt catalyzed by the great strides that German pioneers had made, a new generation of the Americans began one of their greatest eras of endoscopic ingenuity. After Kelling, Ott, and Jacobaeus, American gynecologists were some of the next to embrace the new field of laparoscopy, finally making laparoscopic gynecologic procedures visible on the horizon.

Bertram Bernheim

One of the most influential American endoscopic pioneers contemporaneous with Jacobeaus was Bertram M. Berheim, an assistant surgeon at Johns Hopkins University Hospital. Bernheim is the American pioneer credited with performing the first laparoscopy in the United States at John Hopkins in 1911, within just a year of Jacobaeus' 1910 debut. Using a 12 mm proctoscope with a half-inch diameter, and ordinary light for illumination, Bernheim inserted the scope through an epigastric incision in order to inspect the peritoneal cavity of a jaundiced patient. Before learning of both Kelling's and Jacobaeus' prior work, Bernheim published his experiences, naming the procedure "organoscopy." Bernheim stated that he believed the procedure had potential, but that his superiors at the hospital were not convinced of this apparently new-fangled technique and encouraged him to abandon the idea.

Nevertheless, Bernheim persisted and was one of the earliest in the States to provide detailed and quite fascinating accounts of his early experiences. Bernheim's narrative was also one of the most conservative of voices in these early years. He cautioned endoscopists to proceed slowly and to take note of the very important contraindications. In one patient a diagnostic laparoscopy was performed on a patient with suspected carcinoma. The clinical results were mixed, which led Bernheim to forewarn of troubles concerning patients afflicted with cancerous conditions. For this patient, he failed to visualize the tip of the pancreas, which turned out to have been cancerous. Only upon examining the patient via open laparotomy, was the cancerous pancreatic tip found. Bernheim's negative outcome for this case may have been influenced by the fact that he only suspected liver or gallbladder cancer, not pancreatic. Even so, Bernheim concluded that the pancreas was essentially inaccessible, noting that "obviously, a structure lying as deeply as the pancreas could not be inspected." Aside from this near miss, Bernheim did eventually report that overall, the diagnostic success rate was very high for laparoscopy.

Bernheim's well-respected and amply published successes helped to catalyze a new frontier in surgery, and he is recognized for his numerous contributions to both endoscopy and medicine in general. Not only did he do critical initial research in cardiovascular surgery and blood transfusion, he the first to perform

a laparoscopy in America. However, with the disruption caused by WWI, Bernheim drifted away from laparoscopic surgery and leaned toward vascular surgery and biology. Rising to the rank of captain, he served the effort as operating surgeon.

Otto Steiner - 1924
We often keep them so interested in our description of their organs that they are quite amused.
-Otto Steiner, 1924

Otto Steiner's 1924 publication on laparoscopy, what he termed "abnominoscopy" has been cited as an influential event which affirmed the scope as a tool of immense diagnostic value. Steiner practiced at Grady Hospital in Atlanta, Georgia. Perhaps no other article of this period offers the reader more poetry in its description of the method, which he believed he had been first to discover. Upon viewing the pelvic region for the first time, he said it was like "the fulfillment of a dream." Of course, like Kelling and others at the time, the potential dangers associated with insufflation were apparently not understood. Concerning the process of filling the abdomen with atmospheric air, Steiner stated unequivocally, "At first we measure the quantity of air used, but we have found that this is unnecessary for the abdomen is not very sensitive to inflation and easily withstands the quantity of air necessary…." Steiner only used local anesthesia (novocaine), and again boldly stated that this was not a problem for his patients, even going so far as to say "We often keep them so interested in our description of their organs that they are quite amused." The position of the patient was changed depending on what region he wanted to see, with at times even having the patient sit upright, but mostly horizontal, with a deeper than horizontal position (he did not use the term Trendelenberg) required to view the lower pelvis. In the end, he declared the procedure to be a method "not difficult, is not dangerous and does not require a special amount of skill. The examination can easily be done under local anesthesia." He mentioned that the gynecologist would especially find the method of great value. The liver, stomach, spleen, appendix, pelvic region organs, and gallbladder, including the sounding for stones, were all visualized. He found the palpation of the organs with the scope to be the most important diagnostic benefit. The main drawback to Steiner's article is the lack of clinical feedback about his patient trials. At first reading, one gets the impression that these experiments were only carried out on "fresh cadavers" as he described them. In any case, this article has gone down in the American history of laparoscopy as one that ignited (or re-ignited) great interest in the method.

Stewart and Stein
An article in 1924 by WE Stone of Topeka, Kansas mentions in passing that laparoscopy entered the US in 1919 by Stewart and Stein. Stein and Stewart reported early use of a radiological exam in 1919- 20, in which they insufflated the abdomen to obtain better radiological views.

Handy New Inventions
Despite all this flurry of activity, there were still tedious details to attend to, such as irrigation and insufflation problems that seemed to be pricking at the heels of the pioneers enough to make much of their attention have to be tied up with such dilemmas.

Albarran Lever – 1906
We can't forget to mention J. Albarran and his 1897 catheter lever and the role he played in the advancement of catheterization. Albarran's work replaced just about all other methods catheterizing of the ureter for his day. This Albarran lever made the ureterocystoscope generally more accepted, and practitioners like Nitze and Casper immediately adopted his invention into their own designs.

Otto Goetze - 1918 Goetze Developed an Automatic Pneumoperitoneum Needle
In 1918, Goetze developed an automatic pneumoperitoneum needle. This innovation was characterized for its safe introduction to the peritoneal cavity for use in diagnostic radiology. He suggested in an article entitled "Die neues Verfabren der Gasfullung fur das Pneumoperitoneum," that the needle could be used in laparoscopic procedures.

Richard Zollikofer
Richard Zollikofer, a Swiss gynecologist, was one of the first to recognize the benefits of using carbon dioxide to create pneumoperitoneum and introduced his method for doing so in 1924; (other sources cite the date as 1920). This procedure could be performed in place of filtered air or oxygen because of its fast absorption and to minimize the risk of explosion. Later, JC Rubin in 1925 also used CO2 gas to distend the uterine cavity.

1910 – PHOTO FILM
A Movie Star is Born: The Scope's Screen Debut and the Continuation of Endo-Photography
Finally, we begin to see developing the great stir of interest brought about by the invention of cinema, a technology which completely changed the landscape of human cultures throughout the 20th century. The fantastical possibilities this represented for medicine was definitely not overlooked by our endoscopists of this era, who were some of the first indeed to adopt this new technology for medicine.

As it turned out of course, the endoscope was the perfect ham for the movie camera. Photogenic from any angle, slim and gleaming, she was just a knock-out on film. Of course, she was no match for living, pulsing internal viscera, a shoo-in to steal the show. Today, we can only imagine the awe-struck wonder it must have been like to see for the first time these images on screen. The medical literature of the era helps orient us to this time. We begin with the first documented case of a live endoscopic film.

Endo-Photography
To accommodate the growing interest in surgical endoscopy, this new generation of inventors also focused on trying to make the endoscope's light source bright enough to allow for photographs to be taken inside the body cavity. There had been at this time at least a 30 years of surgical photography serving as historical precursor for early 20th century endoscopic photography.

In 1898, Lange and Meltzing designed the one of the very first flexible gastrocameras, publishing their results after using it on fifteen patients. True, this instrument did not have operative or diagnostic attachments; regardless, it is stunning to consider that a flexible scope was actually developed so many decades previous to the era of fiber optics. The invention of fiber optics did not occur until over fifty years later.

Soon after, fresh photographic wonders fell onto the scene one after the other, and by the beginning of the 20th century endo-photography became quite sophisticated. Other particularly significant highlights were: Felix Schlagintweit's suprapubic photography in 1902, Casper's photo and demonstration cystoscope in 1903, Jacoby's sterocystoscopy in 1905, Hans Goldscmidt's irrigation urethroscope complete with Nitze-camera in 1907, C. Benda's color film and microscopic positive color pictures of the same year, Fr. Fromme's female photocystoscope and color photograms of 1908, Otto Ringleb's improved telescopes and cysto-photo apparatus of the same year.

Training as a Focal Point Just Developing
The split arm attachments not only held endo-photography equipment, but also were referred to sometimes as demonstrating devices, since the telescope end had two viewing stations. This was obviously beneficial when working with assistant surgeons and the like and an incredible foreshadowing of what we would eventually come to take for granted today; video endoscopy. The training devices available, bladder phantoms and other endoscopic training simulators, were on the market as early as 1887.

CHAPTER 14. RECAP OF WHERE ENDOSCOPY STOOD

1920s

And die the death, the long and painful death, which lies between the old self and the new.
-DH Lawrence, The Ship of Death

Introduction
As usual, we must contain ourselves here and reign in our own exuberance, for there were still rather substantial limitations hounding our poor fledgling scope, despite the great transformations taking place. This generation's pioneers were still contending with many of the same outstanding technical difficulties that had thwarted the minds of the late 19th century. These still-lurking limitations would become especially apparent now that greater quantities of endoscopic procedures were being performed, but without the attendant application of additional training and proper instrumentation needed to insure safety. Rising death rates caused by endoscopic mishaps were now an inextricable part of the medical landscape and had to be immediately attended to. Ironically, the same conditions that give rise to complications for today's surgeons were affecting our early 20th century counterparts too: lack of adequate training or equipment, inexperience, and improper technique or instrumentation. As well, problems with limited visualization, inability to detect or stop intra-operative hemorrhaging, deaths caused by unpredictable insufflation complications, burns caused by electro-cautery, bowel perforations, and injuries to major blood vessels still served to scare off would-be practitioners from attempting endoscopic techniques in the first place or investing in its further development.

Yet, like generations prior, the inventiveness of this era's endoscopic pioneers would soon devise ways around these barriers. These challenges were met head-on by a new breed of pioneers, who now had increased understanding of human physiology, especially with respect to electricity, as well as greater transportation and communicative resources to help spread knowledge at their disposal. This period was also characterized by wider sharing of scientific knowledge. There were far more textbooks, whose exportation sped along scientific finds and medical discoveries to other continents.

Continuation of Technical Obstacles
The next decade was one marked by a continuing and clear evolution and striving toward more therapeutic uses. The next set of pioneers began pushing for ways to help extricate endoscopy out of its diagnostic days toward its true operative potential. However, the laparoscopists of this 1920s decade were still struggling with the existing technical limitations that had plagued all endoscopists since the 1900s. Even though many new devices and improvements were made throughout the early 20th century, problems with limited visualization, inability to detect or stop intra-operative hemorrhaging, deaths caused by unpredictable insufflation complications, burns caused by electro-cautery, bowel perforations, and injuries to major blood vessels still served to limit further development of laparoscopy.

Technical Innovations of the 1920s
Many technical developments which increased safety and efficacy were introduced during this formative stage that helped laparoscopy to become a more accepted procedure. These were just a few:

- the first needle for introduction of a pneumoperitoneum by Korbsch in 1921
- invention of the insufflator by Goetze also in 1921
- a new optics system in 1923 by Unverricht who was instrumental in designing a lens system with a widened viewing angle through the lap
- Orndoff's improved trocar in 1920
- Zollikofer's introduction of CO2 as a means for insufflation in 1924

LAPAROSCOPY IN THE 1920s
Complications Beginning to Be Reported More
Another reason is that, as the rise in popularity of endoscopic procedures occurred, so too did the attendant complication rates. For instance there were many more deaths being reported from laparoscopic surgeries in particular, including the still somewhat blind biopsies, as well as problems related to anesthesia, insufflation, and possibly electrical current mishaps (though the literature only states that insufflation and internal hemorrhaging from blind biopsies were the main mortality risks).

American Pioneers
In America, a few milestones had been reached by the 1920s. Bernheim's well-respected and amply published successes helped to catalyze a new frontier in surgery. Other sources cite Stewart and Stein have having introduced laparoscopy into the US in 1919. Yet earlier than this period were several other American pioneers.

B. H. Orndoff – 1920s
BH Orndoff, an internist hailing from Chicago, was just the exemplary pioneer that the times needed, for he paid particular attention to defining and articulating the precise contraindications for laparoscopy, definitions which had never really been categorized thoroughly at this time. In other words, he recognized laparoscopy potential, but also recognized the need for more training and information on the subject.

In this way in particular, Orndoff took endoscopy by the horns and gave it just the push into modernity that it needed with his meticulous emphasis on proper recording of statistical outcomes and detailed clinical reporting. Orndoff was also was the one who coined the term *peritoneoscopy*.

Using many of Kelling's techniques, especially as related to insufflation, Orndoff was able to successfully diagnose ectopic pregnancies, TB of the peritoneum, ovarian cysts, and other pathologies of the reproductive tract. Of special note, Orndoff switched from looking into the scope and then back to an x-ray screen to guide his actions, a method which comes quite close to the concept of operating off the monitor! In addition to his incredible clinical success, Orndoff is also well

known for his 1920 [1] report on 42 (48 is also a number reported) peritoneoscopies, which was one of the first large published series of its kind. In this seminal article, he meticulously tracked the precise presenting conditions, outcomes, contraindication and complications associated with these 42 peritoneoscopies.

However, it wasn't just Orndoff's clinical reporting that set him apart. He also made several technical innovations, including a sharp pyramidal trocar point that allowed for greater ease for the initial trocar puncturing. This was especially crucial since, like today, many complications arose from damage caused by initial trocar entries.

Orndoff also experimented with other details of peritoneoscopy and treatment options. For instance, he changed from using regular atmospheric air to the more pure (but less stable) element of oxygen.

Deaths

The switch to oxygen may have been prompted by Orndoff's experience with losing a few patients due to air embolism associated with carbon dioxide insufflation. Orndoff did apparently have a few deaths from air embolism using carbon dioxide. In 1921 he reported on these adverse outcomes.

Though it doesn't appear that Orndoff went further than diagnostics, as had Stewart and Stein, he did innovate in the area of radiological treatments via laparoscopy, which certainly can be considered a precursor to operative procedures. He worked early with radiological treatment for lesions and tumors, using a radiological device called a fluroescope.

Nadeau

Nadeau and Kampmeirer did one of the best reviews of the literature that could be found from the 1920s. In 1925, they compiled a meticulous meta analysis of the entire peritoneoscopy literature. These two authors, from University of Illinois College of Medicine, Chicago, focused on the fact that they found it strange that something so useful as abdominoscopy would be so rarely used. They acknowledged in particular Kelling's and Jacobeaus' crucial introductions to the modality. Their review of the literature was the most complete for the times and listed over twenty three early pioneers working to develop laparoscopy. Explicitly focused on its diagnostic value for surgeons, who then can make more informed decisions? They acknowledged the conservatism in the medical profession, stating "there is an enforced cautiousness since they are dealing with human life at stake. In the end, the method was said to be one which "…has hardly met with a clinical mishap which could serve as a hindrance to its acceptance."

Aside from their excellent clinical research, Nadeau and Kampmyer also devised a flexible cannula and trocar for use in peritoneoscopy. This would have been fairly significant, considering that most literature claims that flexible instruments only began with fiber optics. We could not uncover just what

materials were used to make the instrument flexible, but probably a type of India rubber, commonly available in those days, could certainly have been used.

Rendle Short – England – 1925: First Guidebook on Laparoscopy in English
Short is best known for being the first to provide a comprehensive textbook-format guide about laparoscopy in the English language, although there is some discrepancy in the records on this point. However, more than that, Short was one of the earliest that understood things from the patient's perspective. Like a true visionary he understood just how much potential the laparoscope had. He wanted to steer away from laparotomies for the sake of his patients. This is demonstrated with his statement from his publication of 1925: "An exploratory laparotomy, often referred to as though it were a mere trifle, may be from the patient's point of view a very formidable affair" (Short,"The Uses of Coelioscopy," 1925).

Korbsch – First Textbook on Laparoscopy 1927
In Germany, a physician named R. Korbsch published one of the first books on laparoscopy in 1927. As well, in 1921 Korbsch– before Veress but around the same time as Goetze- introduced improved instruments and techniques, including the "utilizing a separate pneumoperitoneum needle," which he described in his 1921 article entitled "Die Laparoskopie nach Jakobaeus."

Laparoscopic-Assisted Sterilization – First Round of Interest
Reproductive medicine could be said to have a history 2000 years old, with such compounds as queen anne's lace (wild carrot), silphum, the calendar plan, pomegranate skin, and other natural compounds used as natural abortants.

As for tubal ligations, that history dates back to as early as the 1820s, when James Blundell published a report suggesting this. However, the first confirmed tubal sterilization surgery (open method) was in 1880 by Lundgren of Ohio. Although some sources refer to attempts as early as 1919, the first documented example of tubal sterilization endoscopically was introduced to the US by Bosch in 1936, a development seen by many to be the start of operative gynecologic laparoscopy. Work by Hope, the US pioneer in the related field of diagnosing ectopic pregnancies, was also independently advanced during this same time period. Later in 1941, Power and Barnes reported success in tubal sterilization by coagulating the isthmic portions of the fall. Another American gynecologist, Anderson, also reported on his use and appreciation of laparoscopy for diagnosing gynecologic disorders. His 1937 article on the subject mentioned a wide variety of operative procedures that he believed the laparoscope would one day be useful for treating. He suggested laparoscopic tubal fulguration as a method that might be successful for tubal sterilization but provided no other detail on the matter. One point of confusion in the literature surrounds this particular subject, for some reports suggest that Anderson actually performed one of the earliest tubal ligations. However, after careful review of the documents, it seems that Anderson only alluded to it as a possibility, but provided no further clinical data on the subject. Even so, his recognition and advocacy of laparoscopy as a

potentially important part of gynecological surgery was a bold first step for our discipline.

Note

1. Other sources state 1919 as the year of this publication. However, this may have referred to a lecture presented in 1919, several months in advance of the 1920 publication.

CHAPTER 15. ENDO-UROLOGY

Heyday 1920s-1930s

Cystoscopy "was probably the most dangerous field in the whole of medicine because there is - in contrast to all the other fields - a great potential for mistakes leading to injury with serious consequences."
-1937, E. Pflaumer

Long before gynecologists or any other specialty was involved with operative endoscopy, endo-urologists in Europe and the United States were by far making the most significant advances, beginning as far back as the late 19th century work of such impresarios, Grunfeld, Nitze, Ringleb, Goldschmidt, Kelly, Brenner, and Casper. Even as early as the 1850s urologists had been experimenting with chemicals or galvanized wires in order to cauterize the prostate or bladder tumors endoscopically (though without visualization).

Albarran's 1908 innovations improved the practicality and safely considerably, while Beer in 1910 made what was described as the most groundbreaking discoveries for the field, whose influence reached well into the 1930s. By 1908, the endoscopic removal of bladder tumors had graduated to essentially a routine procedure for urologists.

However, just because it was a common practice doesn't' mean it was without trouble (note the same was true of the common practice of exploratory laparotomies). One of the best quotes to provide insight into this matter came from E. Pflaumer of Germany, who in 1937 stated emphatically that cystoscopy "was probably the most dangerous field in the whole of medicine because there is – in contrast to all the other fields – a great potential for mistakes leading to injury with serious consequences." Complications included some very serious ones, such as perforated bladder, hemorrhaging to death, while others though not as life threatening, were just as devastating in terms of quality of life, such as incontinence. Bearing in mind this paradoxical era of both impending peril and dynamic development, we review the developments of this field, starting with the continuation of trailblazing innovations by the original master, Nitze.

Nitze – The Master Wouldn't Quit!

The old 19th century nemesis of a small field of view continued to stifle further progress toward operative modalities. For such immensely confounding and complex sorts of problems, we can only take refuge under the tutelage of the great masters! The 19th century principles that Nitze and others founded continued to guide many pioneers toward the path of further discovery. Many of these companies were still holding Nitze as their point of reference and were still competing with him, attempting to perfect his original cystoscope. However, the master wouldn't quit! Up until his last moments on earth, Nitze was still designing new and improved instruments; Nitze cystoscopes were on the market until the 1930s. Granted, this may have been more to do with economics than with the fact that it was superior. Still, Nitze was one of the first to design

operating cystoscopes equipped with cautery knifes and loops for treating bladder tumors and so it made sense to use his examples to guide later pioneers into this slowly developing field.

New Contribution from Nitze - The Retrograde View Cystoscope
In 1903, Nitze became one of the first to come up with the idea of examining the anterior wall of the bladder and the bladder neck in 1903, a feat accomplished using his invention of the new *retrograde view cystoscopes*. This technological breakthrough allowed one to view the bladder from any direction. Achieving this required rather sophisticated optical engineering on Nitze's part, not to mention creative design techniques in order to fit all the necessary equipment into an instrument small enough to pass through the ureter. Limited to the optics available in this era, Nitze nevertheless was able to transform what was available– such as Trouve's prism- into a tiny, 3-in-1 telescope.

Naturally the whole system was bulkier, taking up the whole shaft of the scope, which reduced the field of view. All the same, the idea was a resounding hit and variations of the same retrograde theme streamed into the market. Most other endoscopists-engineers followed Nitze' design principles to create their own modified masterpieces, with newly minted names such as the *universal cystoscope* and the *pancystoscope*.

Though issues of primacy are not clear (Lewis and Baer are just two who have been cited as being the first to introduce the idea) we do know for certain that this innovation was crucial in making diagnostic cystoscopy that much safer and accurate, a win by any measure for the lives of patients. Also, ureter catheterization was made considerably easier for the endoscopists– and for the patient too.

Conclusion Nitze
Nitze's last invention was in 1905: a ureteral occlusion balloon catheter with accompanying occlusive ureterocystoscope. Nitze's inventions of this last era of his life are significant as well because the represent the first phases of *electro-endoscopy* really taking off. His death in 1906 of a stroke marked the end of Nitze's material life, but the legacy of his contributions remains with us today.

RINGLEB
Device Heaven – Ringleb's Brilliant Technical Contributions
If good instruments do go to heaven, Ringleb's newly improved scope, introduced in 1908, surely is resting peacefully. The outstanding amount of improvements and problems that this singular instrument solved is simply stunning. That he was able to tackle each issue one by one into a synthesized singular scope is truly the work of unrepentant genius. Before we get to all the happy details, we start with the general principle and feature which usually attracts the most attention. Most histories focus on the fact that his new device was spectacular for its having solved what is often referred to as "Nitze's error," which relates to having set the ? to infinity, thus not correcting for the inverted image crisis that rocked the endoscopic world for some time. To boil the problem down to its essentials, it

basically goes like this: All telescopes will have an inverted image unless an additional set of optics is placed correctly into the system to revert it; Nitze tried but initially failed to solve this; though (apparently) Ringleb wasn't the first to solve it, he did much more with his 1908 invention.

So although Ringleb was not the first to invert the image, he created an entirely new system in 1908. Another one of Ringleb's fantastic upgrades was his improvements of the resolution of the endoscope's image. He increased the angle of view by making it larger and gave it more light by increasing the diameter of the pupil. Ultimately, his innovations led to the first time that the image, intensity of light, luminosity of light, and increased magnification were significantly improved. True, increased magnification could only come at the expense of brightness, which would decrease as a consequence. He therefore limited the field of view. Ringleb's brilliantly designed cystoscopes were still on the market until the 1960s. Also, his optical systems were free of focus errors, such as astigmatisms and coma. In addition, the curvature of the field of view was not as noticeable due to the natural curvature of the bladder wall.

Ringleb also improved the view of cystoscope considerably with his "orienting cystoscope," a breakthrough in 1908. He attached five different lenses, each with a different range of depth perception which helped inside the body. This allowed for optimum light and resolution to at various different depths and allowed the cystoscope to stay thin in shape while maintaining the wide angle and intensive luminous light. In fact, Ringleb cystoscopes were still on the market until the 1960s.

Related to this 1908 New System – The Infinity Issue
Sources state that in 1908, Ringleb corrected Nitze's original mistake of setting the telescope lens to infinity, thusly solving the problem of an inverted image. However, there appears to be some historical dispute regarding Nitze's work in relation to Ringleb. Apparently, Nitze allegedly designed an eyepiece that corrected the then inverted image of the cystoscope. However, for some yet to be disclosed reason, this design was rejected by either himself or his peers. This certainly could be possible, as many of the optical innovations and so-called discoveries of the 20th century were based on theories from the 19th century. Accromatic inverting lenses were invented before Ringleb (Nitze for example). The difference appears to be that Ringleb designed them the better way. At approximately the same time as Ringleb's innovation, other probing minds were tackling the problem of inverted image, including H. Kollmorgen in 1907, ERW Frank in 1907, and CG Heynemann in 1907 and Jacoby, who in the same year also managed to set the image upright by building the first stereoscopic cystoscope. Later in 1910, Loewenstein did the same.

Amazingly and thankfully, the improvements did not stop there. In 1909, Ringleb's introduced the clarification cystoscope, which increased the magnification of the orienting cystoscope. Later in 1912, he synthesized all these great new technological improvements, even managing to reduce the size of the

instrument to a small diameter of only 7 mm. He also improved the lamps (that were later employed) by using different materials such as tungsten and osmium. Unlike other materials, these two usefully did not become hot. He also made improvements to the actual light bulb, increasing the light field.

Amazing
Ringleb's work seems to have certainly been beneficial to patients. Suprapubic prostatectomy used to have a mortality rate of 50% prior to the introduction of Ringleb's new method, after which the rate went down to 10%. Invigorated with confidence by his success, he wrote a textbook on cystoscopy in 1910.

Multi-Tasking Renaissance Man
Ringleb was also a great medical historian, publishing texts on the work of Bozzini, Desi, Grunfield, Nitze, Stoeckel and Von Rohr. Medical historians frequently connect his name with to the "advance and rise of urology in the first half of the century."

Ringleb was also substantially involved in endoscopic photography, referred to back then as stereocystoscopy. He invented new ways to improve the resolution of the pictures and kept trying to perfect the lighting in order to make better pictures!

Conclusion Ringleb
Alas, like many great men, the latter half of Ringleb's life was quite tragic. Ringleb's practice, apartment, and library were bombed out in 1944. American occupation forces then revoked his teaching license. He was also for a time interned at the American work camp for Nazi criminals of the medical faculty in Wannsee for ten weeks due to a false accusation against him. After all of this trauma he was found a crying and broken man after having been forced into hard labor. Shortly thereafter, he died in November of 1946.

Hans Goldschmidt
In 1907, Hans Goldschmidt introduced optical urethroscopes with air and water irrigation, complete with the Nitze-camera built in. Derived from the principle of blowing air into the urethra tube introduced in 1887, for the first time the urethra was stretched by using a water column and a telescope was employed for urethroscopy. Indeed, Goldschmidt revolutionized urethroscopy. His irrigation endoscope allowed the verumontanum and posterior urethra to be seen without difficulties for the first time ever. In fact, he used endophotodocumentation in order to prove this technique. He was also the first to perform simultaneous diagnosis of the bladder and the urethra. Moreover, his inventiveness in operative procedures includes the development of a prostate incisor.

At this juncture, he became interested in Nitze and the cysteomscope, going so far as to publicly advocate Nitze's work. As a result, Goldsmidt's work seems to have catalyzed operative endoscopy quite a lot; his version of the device is the one that is used today!

Leopold Casper (1859-1959) and the Start of Functional Renal Diagnosis
A urologist from Berlin, Leopold Casper was Nitze's self proclaimed chief adversary, designing and constructing his own modified cystoscopes and lithotriptors. Along with F. Richter, Casper founded functional kidney diagnosis with the introduction of the phloridzin test as early as July 16, 1900. He incited much public controversy with Nitze, not only openly fighting with him, but suing Nitze as well. However, all bets were off when the Third Reich reared its horrific head; Casper was dismissed in 1933 and had to emigrate to New York at age 82.

Kidney surgery experienced an immense growth during the first decade of the new center, partly due to cystoscopy and ureter catheterization. Cystoscopy by itself was insufficient for the diagnosis of kidney disease. However, it was sufficient for evaluating kidney function and whether urine was containing blood. The separation of urine from the individual ureter was not yet possible. The diagnosis of kidney disease was very difficult and problematic before the era of ureter catheterization.

Even as early as 1900 Leopold Casper and PF Richter founded "functional renal diagnosis by lowering the freeing point using A von Koranyi's procedure," i.e., evaluation of kidney function using a cystoscope, also called chromocystoscopy and using dying agents such as methylene blue, to see the vessels and processes more clearly.

Casper competed with Nitze, designing and constructing his own modified cystoscopes and lithotriptors. He had some controversies with Nitze– some fights– and then when the third reich came to town, he was dismissed and had to emigrate to New York.

Edwin Beer of New York
Edwin Beer was a Columbia graduate practicing urology at Mt. Sinai in New York and leader in the promotion of the adoption of the ureterocystoscope as the preferred operating cystoscope for bladder tumors. For the history of endo-urology, Beer's innovation is considered one of the most crucial of the 20th century. He employed a method that Oudin, a Parisian urologist, had already introduced for skin warts. With his improved device and Oudin's method of high frequency (monopolar high frequency current), he was the first to coagulate bladder tumors in 1910. Apparently, this new method for treating bladder tumors was in spite of "strong opposition" from surgeons. Beer also published extensively.

Hugh H. Young of Baltimore
Claiming to have told off and even to have almost gotten into a " knock down, drag-out fight" with Nitze over his newly designed cystoscope, Hugh H. Young innovated the punch resectoscope in 1909, going so far as to produce a new retrograde square prism system to improve the optics. He was also the first to conduct ureteroscopy with rigid endoscopes in 1912, doing so on a two-month-old child. Young also produced a new retrograde square prism system to improve the optics. By Young's own autobiography, he claims to have almost gotten into a

“knock down, drag-out fight” with Nitze, in response to his showing his newly designed cystoscope to Nitze. He says “in very bad German, I told him what I thought of him….”

Leo Buerger

Around 1911, Leo Buerger of New York constructed his own cystoscope telescope due to the inspiration of Ringleb. Buerger also constructed a successful universal urethroscope in 1917, which remained one of the most popular ever. Many other instruments were made by Bueger, in conjunction with Brown. The Brown-Buerger scope was quite sophisticated; it had two optical systems, and had either direct or indirect viewing, for catheterizing and operating respectively. It was versatile, capable of being both a cystoscope and urethroscope. The operating components were detachable (the catheterizing didn’t need telescope, but the operating unit did use the telescope).

Other Important Works in Endo-Urology

In 1918, AJ Cromwell reported successful treatment of ureter stones on several hundred patients with a new method of his with a 98% success rate. Cromwell’s method was still blind, though he did use infant cystoscopes.

Fenwick of London was a pioneer also who endoscopically treated ureteroceles, sometimes by cutting them open, other times by injecting them intermittently with chemical fillers. Sources also cite Fenwick was also the first to cauterize the orifice and was also was doing trocar cystoscopy as early as 1889. Heineberg in 1914 developed a system to rinse off blood from the lens.

1910 – FRENCH UROLOGISTS

George Luys

Today’s standard procedure of filling the parts to be examined with air was popularized in France in around 1905 by Parisian G Luys who apparently imitated the Valentine urethroscope and equipped it with an aspirating tube. Luys, among others, founded electrocoagulation in 1913-1914, a couple of years after Beer. From this year on, he employed the “forage de la prostate,” placing many coagulation necrosis in the prostate via a coil-shaped electrode; an air pump unfolded the bladder and posterior urethra. He used a ureteral cystoscope which had a bulb-tipped electrode (this part being the cautery part) on the end. It was applied to adenomyosis of the middle lobe and bladder neck. He reportedly achieved satisfactory results in more than 90% of his patients. His method was used mainly in France and Germany.

By 1926, he reported on over 100 electro-surgical operations of the prostatic hypertrophy. Luys is also considered one of the earliest to achieve urine separation for the catheterizing process.

Luys also created various modified designs of equipment, subsequently enjoying fairly wide success that was produced by the Gentile Company of his native land. Among the most important models included adjustable forceps and scopes with improved aspiration channels. He also made the practice of urine separation a

popular methodology. He also modified the Valentine model with men and women, going so far as to doing some modest operative procedures, such as cauterizing bladder tumors and the prostate; he removed foreign bodies with small forceps. Even still, he improved upon and extended the cystoscope, creating further therapeutic uses such as new methods for treating prostate conditions. Overall, Luys was important for further expanding urethroscopy and cystoscopy in France.

Luys took Young's method in 1914 and applied it to prostate obstruction operations, also under direct visualization. Luys seems to have modified it somewhat by changing the exact method of placement of the cystoscope. Luys recognized it as a great minimally invasive procedure, speaking of how it was superior to the "gravity" of a transvesical (AKA open) procedure for what amounted to a minor problem of discomfort.

Strangely, despite Luys success, it appears that open prostatectomies remained (as Gutierrez was writing in 1931) the procedure of choice in France.

Georges Marion
Georges Marion of Paris was one of the most important endoscopists and surgeons at the hospital Lariboisiere, where he was able to applied an indwelling catheter dilate and drained the ureter with the help of a permanent catheter in 1910. He introduced diathermy one year after Beer did in 1911. He also constructed his own resectoscope, modified after the Stern-McCarthy.

Heitz-Boyer
Heitz-Boyer achieved a breakthrough for endo-urology at the time by becoming one of the first to use high frequency treatment of prostate adenoma in 1911.

He designed his own high frequency (haute frequency) and by 1921 his instruments had three different optical systems and also three different electrodes. The French company Drapier later made another modified device using diathermy in 1927.

Heitz-Boyer had visited the American pioneer Young in Baltimore, who had demonstrated his punch operation. It was apparently Heitz-Boyer who advised Young to use high-frequency current and was apparently surprised that he was not using it.

MORE AMERICAN UROLOGISTS 1920s
American Endo-Urologists Make Significant Contributions
Ironically, even though European urologists pioneered and founded much of endo-urology in the 19th century, by this 1930s period Americans had embraced endoscopic surgical methods much more and were beginning to dominate the field in terms of significant breakthroughs. All of these developments in endo-urology were truly significant for decreasing mortality for open procedures. We often focus more on laparotomies for upper abdominal diseases, but laparotomies were also a method of choice for treating prostate disease up until

fairly recently. The mortality rate for open procedures was astonishingly high. A German report from the 1930s indicated that the mortality for open prostatectomies was as high as 25%-30% in many cases, prompting one urologist of that era, Schlagintweit of Germany, to comment about the open method that he would “rather wear a catheter for the rest of my life than die in one day.”

The 1930s certainly was a heyday for American endo-urology in particular. One of the most fascinating statistics uncovered is the rapidity with which the endoscopic of TURP-styled procedures supplanted open prostatectomies. Hugh Cabot from the Mayo Clinic in Rochester tracked the statistics at the Mayo Clinic carefully. He found that in 1928, 93.3% of the patients were being surgically treated, but by 1933, only 2% were. Further, he did an excellent comparative report, comparing the two methods side by side. Using data from 600 TURPs and 600 suprapubic prostatectomies, performed over the course of fives years, the results on mortality was astonishing. The open method had a mortality rate of 9.5%, while the transurethral resection had a mortality rate of 1.3%.

Concerning the 1930s urology era, this Gutierrez guy says “[all of these improvements make] this a surgical era of safety, accuracy, and great accomplishment, reaching its maximum of efficiency in the operation of prostatectomy with its permanent good results, its total relief of symptoms, and its very low operative mortality – the rate being approximately 2 percent in the hands of an average competent urologist.”

Caulk and His Report on 8073 Cases of Prostate Resection (TURP) by 196 Surgeons!

A prominent endo-urologist from the 1933, Gutierrez, made reference to the greater use of TURP in America versus Germany, noting that ”the comparison of the statistics of caulk and Alexander von Lichtenberg shows the serious difference in number, experience indication and quality of turp in the USA vs Germany.” This review was in reference to one of the largest studies ever, compiled by the American urologist Caulk who reported on 8073 prostate resections (not punch, but closer to TURP methods) by 196 surgeons, with an overall mortality rate of 3.74% One German source (Wohlleben) noted this great difference in approach too, stating in 1938 that in America “almost in every case of prostate disease was (sic) treated electrically with the removal of considerable quantities of tissue (30-35 grams).” During the same time period, the largest German study of the kind was by Lichie, who reported on 158 resections on 70 patients with mortality rate of 4.3%. Gutierrez and others found that the literature of Germany on TURP methods, between 1933-1934, showed a total of 1000 patients from several different surgeons.

1925 - Max Stern – A Crucial Turning Point for Endo-Urology

In 1925 Maximilian Stern, who later developed the first resectoscope, presented instruments for the application of diathermy to the prostate. Clearly urologists were looking for multiple different ways to treat prostatic enlargement, and diathermy, or heat application, was just one of them. He presented an

instrument consisting of an insulated shank that had two rotatable blades at the end. These rounded blades, when closed, could be inserted into the rectum and were then opened, hugging prostate and seminal vesicles. These were insulated and were connected to current for about 30 minutes. The indifferent electrode consisted of a tinfoil about 4" by 8" placed over the public area; a current of 1000 milliampere was used. In addition, he developed a urethral electrode, in shape similar to a van Buren sound, but with an insulated shaft and tip and an exposed metallic portion in the curvature of the instrument that was to occupy the prostatic urethra. Current application was the same as for the prostatic electrode, and he states that he did obtain good results with the prostatic instrument and felt that the combination of these two could also be applied to inflammatory changes in prostate and seminal vesicles.

Stern's Resectoscope – First Instrument with Electric Cutting Loop

Stern had worked for a couple of years on modifying the existing instruments for removal of prostatic tissue. As Young stated, "Stern, in 1926, modified myth punch by introducing a cystoscope and a platinum loop." Clearly he refers to the instrument he had developed with Loewenstein 15 years earlier. Stern combined the ability of current to cut with the idea of the punch, namely shaving out a section of prostate tissue. With Wappler's assistance, he created the first instrument that used an electric loop to cut prostatic tissue. As in all the previous punch instruments, the fenestra was near the tip but longer than in the punch instruments. He had a small moveable loop on a carrier that could be moved back and forth with a rack and pinion transport mechanism near the eyepiece. He presented this instrument to the genitourinary section of the New York academy of medicine in January of 1926, stating that his new invention was "capable of operating in a water medium…provide with a small moveable ring or loop of tungsten wire,…capable of removing a longitudinal spaghetti-like section of tissue…this instrument I have named …the Resectoscope." The initial instrument had two lens systems; one of indirect vision for exam and diagnosis prior to surgery. Cutting was down towards the bladder. His power source, constructed by ACMI, was called resecto-therm, and was described as an apparatus delivering radio frequency current of low voltage that did not arc or jump across a gap, thus making it possible to employ a bipolar instrument. Stern's report was made on a basis of 46 patents that he had operate on, all of them older men, with no pre selection made. He reported no bleeding of importance, or any other unfavorable outcome. In only 4 cases was a second treatment necessary (at least at the time of his report, which was 6 months later). He stated that he had no bleeding in his first 46 patients or any other unfavorable reaction, though all his patients were older men without patient selection. Four needed a second treatment.

Radio Frequency

Stern's introduction of radio frequency to endscopy stands as one of the most important milestones. Stern's resectotherm delivers a radio frequency current of low voltage and is peculiar in that it can be delivered in a continuous flow

through the cutting loop under water, by virtue of the fact that it does not arc nor jump across a gap, thus making it possible to employ a bipolar instrument.

Criticisms
Stern's reports about bleeding are a bit suspect b/c others at the time who used his device as he indicated got totally different outcomes, lots of bleeding. Others reported that while it did reduce bleeding "considerably," it did not seal larger arterioloes. Later, others modified this type of device to correct for all of this. Others reported that they did find his instrument "vastly superior to all methods that had preceded it."

Joseph McCarthy
Since approximately 1923, Joseph McCarthy of New York made several significant improvements to cystosocpes and resectoscopes. Some of his first innovations include a foroblique lens system that widened the visual field considerably, an improved irrigating cystoscope, and a punch resectoscope, among just a few. However, his most sophisticated and well known of resectoscope, introduced in 1931, became one of the most important contributions for the endoscopic treatment of prostate disease. Referred to as the Stern-McCarthy scope (for its use of many principles established by Stern earlier), featured the latest in dual current units for cutting and coagulating (as advanced by Stern and Davis, among others). He was also one of the first in America to incorporate a non-conducting Bakelite sheath, and added a lever to move the electric-arc cutting loop. This device was described in detail as the following:

"The McCarthy resectoscope and loop can take longer bites and more pieces in a shorter time than the punch. According to McCarthy himself, his was superior because it provided the most precise visualization of the prostatic urethra and had the greatest possible flexibility of manipulation under vision of the cutting loop and that ample electrical power to excise under water while at the same time allowing for minimal hemorrhaging and coagulation, interchangeability of electrodes for the closure of bleeding points, and the fact that only one introduction of his instrument was needed, including even to add the indwelling catheter. If oozing still occurs, his system also provided for one could at the end or later, add a balloon bag which was filled with water to apply pressure inside the urethra for a couple of hours. McCarthy was realistic in his understanding of post-operative bleeding and admitted that 'secondary hemorrhage ….is to be expected in a small number of cases in any type of coagulation hemostasis'."

McCarthy's lens system remained popular for a long time. It was considered the first practical cutting-loop resectoscope, and it quickly replaced fulguration (as had Beer's earlier) to become the most popular method used to diagnose and surgically treat bladder neoplasms for the rest of the 20th Century. The literature well into the 1930s and 1940s demonstrates that many of the cystoscopes (even many in Europe) had either the entire Mccarthy-Stern operating unit, or at minimum had the McCarthy lens system. Numerous modifications of the Stern-McCarthy resectoscope followed, but they were all

based on his original designs (along with Stern's). Although transurethral resection of the
prostate (TURP) has given way to newer methods, transurethral resection of bladder tumors (TURB) remains today a mainstay operation for these lesions.

Theodore Davis
"…brilliant as this work is, progressive as it is, curative as it is, we are not going to fall head-over-heels in love with it."
-example of criticism of TURP, circa 1930s

Theodore M. Davis, born in Greenville, SC, in December of 1889, was the next American urologist to make crucial breakthroughs in electro-cautery technologies, which not only substantially improved the safety and efficacy of TURP methods, but also ultimately influenced all disciplines of endoscopy.

Indeed Davis' introduction to a unit which had separate currents (collaborating with the famous American engineer, Bovie of Bovie current fame), one for cutting and one for coagulation (high and low frequency) was said to have "startled" the urologists of the time with the successes that he obtained with its use.

Davis first reported his resection technique in a movie that he presented to the AUA in 1931. In his presentation he made it clear that his aim was to "restore to a rightful heritage to the disinherited method of Stern." He found the results with the new separated currents to be so impressive, that he stated transurethral surgery to have been "reduced to a minor surgical operation" and that hospitalization was reduced "to several days as compared to several weeks for prostatectomy." Still, like so many cutting edge moments in the history of endoscopy, there were critics everywhere to scoff at new techniques. One critic of Davis' work, A. Randall, made a revealing comment concerning the opposition to endoscopic methods, stating that "In perfect frankness that, brilliant as this work is, progressive as it is, curative as it is, we are not going to fall head-over-heels in love with it. I would rather caution you to let Dr. Davis alone go on with the technical side of it."

1052 Clinical Cases!!!
Davis stands out for another important reason: he reported on one of the largest clinical trials of the time for TURP, with over 1052 cases being reported. Many of these early endo-urological pioneers actually had very little clinical success with their methods, despite what appeared to be glowing reports at congresses and in preliminary trials. This is why Davis stands out in this history especially. His 1052 cases stand as one of the most extensive clinical successes with any endoscopic method for his time. Davis also provided one of the few insights into the problems of complications, which were rarely mentioned in other reports of the time. He states that his technique "if carefully followed will enable others to accomplish with greater facility this operation that in the past has caused grief to both the operator as well as the patient."

1938 - Reed Nesbit – Turning Point: One-Handed Resectoscopes
Reed Nesbit of Ann Arbor, Michigan, introduced in 1938 a modification of the Stern-McCarthy resectoscope, which resulted in a crucial turning point because it was one of the first functional resectoscopes to permit one-handed operation. His novel features included a handle to the sheath which had a thumbhole which rotated with the hand of the operator. With this, it was said that “the surgeon’s hand was freed and allowed the surgeon to perform excellent resections down to the prostatic capsule.”

CHAPTER 16. THE GLORY DAYS PART II

1930s

The danger in the use of instruments of this type is over-enthusiasm.
–Beling, 1939

Introduction
Despite the great pall that had fallen over Europe and America due to the great depression events, amazingly, innovation in endoscopy seemed barely affected. Indeed, judging by the list of innovations that came through in this era, one would think it was the season of the bulls. By this time too a number of textbooks on laparoscopy had already been published.

Operative Procedures More Sophisticated, Greater Quantities Achieved
This era also witnessed the great expansion of operative techniques. In the 1930's, some of the first extensive reports of laparoscopic intervention for therapeutic purposes: lyses of abdominal adhesions, diagnostic biopsies under direct visualizations, and liver biopsies were some of the most commonly described laparoscopic procedures.

While these procedures actually were not exactly new– Kelling, Jacobaues, Nordie and others had performed them in the 1900s-1910s period- the difference during this time was that a greater amount of clinical successes had been reached, with some practitioners reporting upwards of 2000 procedures being performed.

Imaging and Radiology
Other technologies emerging (diagnostic imaging, hemotcrit) that begin to subtly compete with diagnostic lap with the original beginning of x-ray used for therapeutic procedures starting in 1897, by physician named Tuffier of Paris. Tuffier "managed to insert an x-ray opaque ureter catheter to the level of the kidneys and image the kidneys radiologically. By this 1930s time period, such procedures had been around for almost 30 years and were finally translating into significant improvements for diagnostics and minor surgical procedures, such as taking biopsies, which had been performed blindly. It was especially useful technology for stones and other conditions of the upper GI, as the precise location of tumors and calculus' could be seen. The x-ray images could now be used to control the extraction of stones by the 1920s. Of course, many of these methods were eventually abandoned due to the danger of radiation. Substantial improvements in blood transfusions, anesthesia, and antibiotics were made within the first few decades of the 20th century as well, bringing to medicine almost a sense of inevitable infallibility.

Endoscopic Photography
There was a brief resurgence of interest in the lap after 1939, when color photographs introduced by Hoff and Neefl in 1938 taken laparoscopically provided visual evidence to the lap's potential. The picture was produced using

kodachrome film, and also utilized a mirror reflex camera invented by N. Henning.

Modern Medicine
By this time too, an amazing array of medical knowledge had been discovered, which directly improved the safety and possibilities in surgical procedures of all kinds, with antibiotics, better anesthesia, and blood transfusions being the most influential innovations for surgery. We have here in fact a continuation of that great transformation that began starting in the 1910s, with the famous successes of Jacobaeus, Bernheim, Ott, Kelling, and up to 20 others if our analysis of the literature is correct.

Despite all the momentum in the beginning of this 1930s decade, brace yourself for yet another change of sentiments by the day's end. For, by the late 1930s, there is a cooling off period that is referred to in much of the American literature, lamenting why laparoscopy is still not that popular.

But before we burst that bubble, let's continue where we left off, in the bucolic bustling of glory days, part II, where there lived outsized pioneers who were tirelessly working for the great humanitarian cause that is endoscopy.

Introduction to the Laparoscopic Pioneers of the 1930s
Admittedly, during the 1930s it seemed laparoscopy was experiencing an awkward stage of developmental delay, at least when compared to other disciplines, such endo-urology for instance. Of course, they say you shouldn't compare yourself to others, but across the hall, our fellow endo-urologists were just about giddy with all the head-turning technologies teeming from their shores. For them, the 1930s seemed like the very incarnation of egalitarian endoscopy; there was an innovation for just about every man, woman, and child. Without assuming too much editorial leeway here, it was almost true that for laparoscopy, design techniques and other instrumentation remained relatively the same until the advent of the Hopkins lens and fiber optics. The exception to these overall lackluster realities came in the form of some of this era's most preeminent laparoscopists of all time: Kalk, Ruddock, Fervers, Hope, and Benedict.

Recap of Optic Technology and Why Kalk's Change was Significant
Part of the problem with this stall in progress related back to, as usual, that team of double troubles: poor lighting and inadequate optics. Prior to 1929, a puny field of view was still rather problematic for endoscopists, despite the best efforts of Nitze, Grunfeld, Jacoby, and Ringleb to solve this dilemma. Therefore, the fourth task of expanding the field of vision still loomed considerably over the heads of 20th century endoscopists.

To this task we turn now to one of the world's most famous laparoscopists, one who is considered today as the father of modern laparoscopy.

Heinz Kalk
The German gastroenterologist, Heinz Kalk, is considered the founder of not only the German school of laparoscopy, but has over the years earned the broader title of "Father of Modern Laparoscopy." His engineering genius led to a completely revamped laparoscope which Robert Fear called the “first high-quality instrument” ever devised at that time. Born in Frankfurt-Main in 1895, Kalk’s life has been described as “extraordinary.” Over the years, Kalk has become most known for his innovation of a lens system. However, like a true visionary, his contributions were in fact exceptional in multiple areas; in innovations of technique and technology, in research, and in his prolific publications. Perhaps of most significance, Kalk was one of laparoscopy’s first pioneers to routinely extend the scope into therapeutic procedures with verifiable success. This breakthrough alone launched what would become a century-long journey toward laparoscopy’s defining moment as the reigning champion of minimally invasive surgery.

1929 - Kalk’s Breakthrough Expansion of the Field of View
At the end of the 19th century, some of the best designed endoscope’s still only had a viewing angle between 80 degrees and 85 degrees, and a field of vision reportedly as small as 44.2 millimeters in diameter at a range of 2.5 centimeters. Though Nitze, Grunfeld, Ringleb, Jacoby, and so many others certainly gave it their best, at the end of the day their efforts amounted to only nominal changes. Therefore, the fourth task of expanding the field of vision still loomed over the heads of our early 20th century endoscopists. The world really needed a revolutionary change in order to rid our poor scope of its rinky-dink optics.

Enter Kalk:
In 1929, Heinz Kalk solved this field of vision problem, which had been one of the longest standing difficulties afflicting endoscopy. Though a forward-viewing instrument (135 degrees) had been introduced two years earlier by Kremer, Kalk was able to adapt this existing technology into a more practicable and successful instrument. With the introduction of his own modified foroblique lens system, Kalk was able to so effectively increase the field of vision that finally substantial progress could be made in both operative and diagnostic techniques.

Indeed, Kalk was so many light years ahead of the curve with this idea that another thirty years passed before any further improvements to the optical system were made. Other refinements in technique promoted or modified by Kalk include standardizing the use of a separate pneumoperitoneum needle, as had been introduced earlier by Kelling and Korbsch, among others. Kalk is also considered the founder of the dual trocar approach. Though again he was not the first to invent this technique, he was one of the earliest to routinely apply it, as well as make certain refinements in technique which increased its safety.

What Drove Kalk to Innovate - Liver Biopsies Made Safe by Kalk
It is amazing to think that just a few years before Kalk, taking endoscopic

biopsies of the liver (a rare procedure in those days to begin with) was fraught with a high risk of mortality because it could only be performed in a nearly blind state using still dangerously imperfect electro-cauterizing tools, all of which led to high incidence of uncontrollable bleeding and overlooking carcinomas to boot. Surgeons of the day believed – justifiably at the time- that only by thoroughly palpating the organ during a laparotomy could one come to discover the deeply-embedded nodules of cancer. This view was substantiated by many early reports on diagnostic larparoscopy which reported that the scope could not sufficiently illuminate certain areas of the liver and had therefore been unable to detect deeply-embedded nodules.

Kalk was deeply disturbed by the high fatality rates associated with these blind biopsies and especially wanted to help alleviate this devastating outcome for what was supposed to be a simple procedure. With his numerous refinements and inventions, Kalk became one of the first ever to introduce a safe and accurate method of endoscopic liver, gallbladder and kidney biopsies. Because Kalk was able to broaden the scope's usefulness, the result was that the entire field was re-invigorated. As a result too, it moved surgeons that much closer to abandoning forever exploratory laparotomies.

One of First to Obtain Substantial Clinical Experience with the Endoscope
Kalk stood out not only for his visionary inventions, but for his world renowned expertise as a gastroenterologist in general. During his long career an entirely new category of virtuoso had to be defined to keep up with the pace of his clinical success. Patients from all over the world flocked to see him, turning the hospital in which he practiced - the Stadtkrankenhaus - into one of the most well regarded in all of Germany.

Combining his virtuoso clinical skill, along with his technical acumen, Kalk became one of the few who achieved substantial and consistent clinical success. By 1939, he published what was at the time one of the largest series of successful laparoscopic surgeries, reporting on 2000 laparoscopic procedures, all of which were performed under local anesthesia and apparently without a single mortality. This was in fact an astonishing achievement, since at the time others were experiencing mortality rates for taking biopsies in the range of 2-5%. This fact alone establishes Kalk as one of laparoscopy's true virtuosos.
Besides biopsies, Kalk's worked on some of the most advanced therapeutic laparoscopic interventions the world had seen at the time. By 1934, he had applied to laparoscopy the latest radiological technologies by attaching radiological cathodes to the endoscope to treat gall bladder and liver disease
In the end, Kalk put routine, safe and accurate laparoscopic diagnosis of liver, kidney and gallbladder disease on the map as a finally safe and accessible modality that would help potentially millions to avoid the devastation of laparotomies. With his brilliant innovations and clinical precedence in place, laparoscopists finally were able to consistently and reliably perform a multitude of laparoscopic procedures, including finally those in the operative category.

Etiologies Uncovered - Kalk Helps Discover Virus as Cause of Hepatitis
Kalk's work with laparoscopy helped improve the etiologic and differential diagnosis of disease states in another way too. With the new ability to gain access to biopsies in a much safer manner, physicians could now have a chance to conduct greater levels of research. In just this manner, Kalk helped discover through his numerous case studies of liver biopsies that hepatitis was caused by a viral infection. He therefore also goes down in history for his substantial contributions to hepatic research.

Some Areas of Contestation
There are essentially no negative reports about Kalk, which is certainly a refreshing change, given all the intense disputes we've covered so far. The slightest hint of doubt was expressed by Benedict, an American laparoscopist whom we will review shortly.

He alludes to Kalk's description of laparoscopy's safety record as being a matter that could stand for greater qualification. In one of Kalk's first articles, he had made the claim that laparoscopy was essentially "without danger," though not ignoring its potential for serious complications such bowel perforations and insufflation complications, Kalk had come to this conclusion after performing 100 examinations in which there had been "no damage."

However, Benedict qualified this statement by pointing out that there were many contraindications that must be observed with great care. Of course, Benedict reports this in 1937, which naturally provided him with an unfair vantage point to Kalk's 1929 preliminary report on the matter. Even so, these comments provide some important insight into the sorts of dialogues that were taking place in laparoscopy's formative years. Just as is true today, not all practitioners brought to the table the same clinical or surgical skill. Perhaps in Kalk's gifted hands, he achieved a level of success that may have been unattainable for others. There may also have been subtle differences in technique that developed between European and American laparoscopists.

The other issue causing for some degree of uncertainty relates to Kalk's report of performing 2000 procedures without mortality. Due to issues of translation, we were not able to verify these reports with the level of precision we would have liked. While we definitely do not wish to cast doubt where none may be warranted, we do know that laparoscopy even in modern times has the potential to cause some degree of mortality. In addition, since laparoscopy at the time was still burdened by ineffective technologies in lighting and electro-cautery especially, it seems fair to say that this one particular area could stand to be researched more fully. Perhaps the next generation of historians will be able to gain a better understanding.

Conclusion Kalk
Without qualification, Kalk's work was unprecedented for the times. Kalk is described as being the first to make laparoscopy a useful, practical and safe procedure. Indeed, Kalk became the singular force behind laparoscopy's

dramatic expansion and acceptance experienced throughout the world during the next several decades. Physicians from several different countries continued to cite his first 1929 article for years to come. It was Kalk more than anyone who became the decisive voice in steering Europeans away from the culdoscopic technique that had temporarily supplanted laparoscopy in America during the 1940s-1960s. For this reason, Europeans had a distinct lead in laparoscopic development until the 1960s.

Perhaps of most lasting value, his technical and clinical insights impacted the lives of potentially millions by offering to the world for the first time a safer way to perform diagnostic laparoscopies, a change which directly and dramatically reduced mortality rates for what were supposed to be routine diagnostic procedures. He was also a tireless researcher and prolific writer who wrote more than just about any other laparoscopists in his lifetime, publishing by the end of his career over one hundred articles. Kalk continued his clinical practice and research well into the 1950s, working ceaselessly to perfect various procedures. This was the case, even though he apparently almost “didn’t make it out alive [during] the Stalingrad invasion of Russia of 1943.”

In 1949 he was appointed chief of the Department of Internal Medicine of Kassel's hospital called "Stadtkrankenhaus," making it, as one German researcher pointed out “one of the most interesting places to be in for hepatologists and laparoscopically working internists.” During the 1950s Kalk was still innovating and began collaborating with Karl Storz to develop still more instruments. Later, Kalk eagerly tried out the latest technologies and was one of the earliest to use the Optical Esophagoscope Universal developed by Storz. The world lost a truly gifted physician, inventor, and visionary when Heinz Kalk died in 1973.

Veress Needle
In 1937, the Hungarian physician, Janos Veress developed a needle that was a major advance for laparoscopy. Indeed, today we still use that same Veress needle of 1937, virtually unchanged.

Its main purpose was to perform therapeutic pneumothorax to treat patients suffering from tuberculosis. However, laparoscopists quickly realized its potential as a safer method for creating pneumoperitoneum. The most striking safety feature was spring-loaded obturator that allowed safe insertion and insufflation of the peritoneal cavity. Amazingly, it had multiple talents and could be used for draining ascites and evacuating fluid and air from the chest as well. Veress eventually reported his use with it in over 2000 cases. He originally did not suggest that it be used for laparoscopy. Though Goertze and others invented similar needles almost twenty years earlier, the design improvements, added functionality and especially the enhanced safety make Veress’ contribution the innovation that changed everything for the better.

THE AMERICANS - 1930s

John Caroll Ruddock - 1891-1961
"Laparotomies for diagnostic should be condemned"
-John Ruddock

John Ruddock, an American internist from Los Angeles, was light years ahead of his time when he made this bold proclamation concerning exploratory laparotomies. The year was 1934, just when the popular 1910s fervor over laparoscopy as a new modality was beginning to visibly wane. Ruddock, with his outstanding and far-reaching contributions, was just the outsized catalyst that the 1930s needed to help revitalize the very life of laparoscopy. Today, Ruddock is considered by many to have been the principle driving force behind laparoscopy's progress and acceptance in the United States during the 1930s and beyond.

Ruddock became the singular force responsible for advancing early operative laparoscopy in a time when American physicians still regarded it as fraught with unpredictable and unacceptable levels of complications. Indeed, one source explains the influence of Ruddock succinctly, stating "Before the Second World War there were two centers of laparoscopy in the world: Germany (Kalk) and the United States (Ruddock)."

With Ruddock's meticulous attention to both the technical side of things, as well as matters of technique, he was able to work out many of the laparoscope's main flaws. In this way, he became one of the first American pioneers to report on a significant amount of procedures, performing in his lifetime an incredible 5000 [1] laparoscopies, all with low levels of morbidity and mortality. He was also was one of the most vocal and influential advocates for laparoscopy, and continued to promote its use throughout his lifetime.

The timing was not exactly perfect for Ruddock to work with the laparoscope. You will recall that in 1925, Case came out with a most damning report, detailing laparoscopy's most unbecoming features of insufflation embolism, bowel perforations, not to mention the hideous reality of its horrendous illumination.

Laparotomies Really Begin to Get Scrutinized
Like Kelling almost 30 years earlier, Ruddock also recognized that laparoscopy's role as a diagnostic surgical technology was "many times superior to laparotomy." He also understood that the problems of visualization stood as the most limiting factor. There were many technical reasons for this shortcoming, stemming from both the light source itself, as well as from the optical systems. The problem also related to the fact that there were no custom-made scopes specific to laparoscopy at this time. Rather, the instruments on the market were all essentially modified versions of cystoscopes, which had optics and other features designed with the contours of a urethra entry point and environment in mind. To this problem Ruddock set his energies and in 1934 he devised an optic system that has been described as one of the most sophisticated and crucial innovations of this pre-Hopkins era.

Ruddock was not afraid to seek out experts and learned a great deal from European endoscopists, particularly from “thoracoscopists” who had discovered better optics for viewing the chest cavity more clearly. At this time, the work of Kalk was widely known by American laparoscopists and so it is likely that Ruddock drew inspiration from his work. As well, he gained insight into electro-cautery from American urologists whose work in this area especially had been on the cutting edge. Drawing from all of these different elements and in collaboration with ACMI, Ruddock modified a McCarthy cystoscope and developed an optical system that allowed for a greater viewing area of the abdominal cavity to be captured. Referred to as a “*foreblique visual system*,” this innovation brilliantly solved a problem that turned out to be a matter of only a few degrees. Although Ruddock is not exactly the first to invent this type of optics system– Kremer and Kalk introduced their versions in 1927 and 1929 respectively– still Ruddock deserves credit for recognizing these disparate technologies and bringing them together into one *smooth operating unit*. Ruddock realized that a 45-degree indirect viewing angle was far superior for laparoscopes than the standard 90-degree angle found in the optics of cystoscopes. In 1937 Ruddock also attached an ACMI photographing unit to his laparoscope, becoming one of the earliest to experiment with laparoscopic photography.

From the Brink of Extinction: Bringing Operative Laparoscopy Back to Life

The other most important feature that Ruddock added was the built-in biopsy forceps which were capable of both cutting and coagulating. In other words, Ruddock offered for the laparoscopists an instrument capable of performing simple operations, albeit mostly with biopsies in mind. Some histories under-emphasize this point about Ruddock, portraying Ruddock as one who performed only diagnostics. This is definitely not the case, as he went on to perform what in those days were the most sophisticated- and just about only existing- operative procedures of the times: lyses of adhesions, draining of ovarian cysts, and taking biopsies.

The operating component of his system featured built-in biopsy forceps equipped with the newly available bipolar electro-cautery units, derived from the Stern-McCarthy cystoscope. While this detail alone may not seem impressive at first, recall that in later decades, many American laparoscopists actually forgot about the superior safety features relating to bipolar systems. The biopsy forceps were equipped with the telescopic unit, so that the biopsies could be taken under direct vision. Air could be introduced into the shaft of the scope at any time for air irrigation.

His procedures were performed using insufflation methods established by Kelling and improved with the Veress needle.

The pre-op with the patient was remarkably reminiscent of modern methods. The patient was prepared as if for laparotomy, including fasting stomach, empty bladder, and preliminary sedation with barbiturates and morphine. The same midline just below the umbilicus was the site of the trocar puncture. The most

astonishing difference is that only local anesthesia was used (novocaine injected into the abdominal area), something difficult to contemplate today. Regular atmospheric air was used to provide the insufflation. During this time, patients were carefully selected. Just like today, those having pulmonary or cardiac disease were cited as not good candidates.

Like Jacobaeus, Ruddock's operative procedures were modest in scale, at least as viewed from our modern perspective. His main operative accomplishments were in the taking of biopsies. Yet, this was no small matter in those days. As you will recall, prior to the perfection of electro-cautery technologies, biopsies had actually been a procedure burdened with great risk of mortality due to hemorrhaging. "Bleeders" such as the liver, kidney, stomach, and pancreas were essentially off limits due to the added difficulties associated with inadequate illumination. For this reason, surgeons were especially reluctant to switch from their tried and true diagnostic laparotomies, with its known risks, to the unknowable territory of a new, unproven technique. Ruddock himself ultimately advised against doing kidney and pancreatic biopsies since he described these regions as nearly impossible to visualize adequately. This is somewhat different than the experience of Kalk, who did end up pushing the scope into this region. Yet, this may simply speak to the difference in comfort levels that they had for risk, with Ruddock apparently the more conservative of the two.

Ruddock named his device the *peritoneoscope* and went on to describe his success with its use in his first series of 200 patients in 1934.

Later in 1937, he was able to report initially on over 500 cases, which dealt with biopsies, as well as a broad range of conditions such as bladder diseases, draining of ascites, lysis of adhesions, and other lesions of the abdomen such as neoplasms of the stomach and colon. Ultimately Ruddock reported on a grand total of 500 cases by the end of his career, a publication which became widely disseminated and influential in the United States.

It is even more impressive to look back on Ruddock, situated as he was in the 1930s, before fiber optics, before Hopkins, and realize just how much risk he assumed in re-investigating and establishing even more operative procedures. In retrospect we can see that his work in this respect marked a crucial turning point for laparoscopy in America, for not even *diagnostic* laparoscopy had gained enough credibility to hold sway to any significant degree. As for operative laparoscopy, for all intents and purposes, in the United States it essentially remained a procedure practiced by precious few. Only a few clinics scattered throughout the world had begun experimenting with operative laparoscopy.

This was the reality, despite all the achievements in operative laparoscopy so famously achieved by the American pioneers Orndoff and Bernheim from just the previous decade. For this reason Ruddock stands out as one of the most important pioneers in the American history of endoscopy especially, for having the vision and courage to push the laparoscope's usage closer toward operative

procedures- in both the upper and lower abdomen- in an era when not even diagnostic laparoscopy had been entirely welcomed.

Re-Establishing the Scope's Superiority in Diagnostics
Ruddock also provided even more evidence of the scope's superior diagnostic capabilities (compared to other non-invasive ways). He became one of the first to take careful measurements to show just how much the laparoscope improved diagnostic accuracy.

He found this particularly true in diagnosing stomach carcinomas, a fact which turned out to be a critical turning point for laparoscopy. Using the laparoscope to make diagnoses of the stomach region had actually been achieved by very few. Other prominent pioneers had found difficulty to access, including Jacobaeaus, Kalk, Beling, and many others. In this instance especially, Ruddock was definitely well ahead of his time.

Ruddock's statistics on stomach diagnostics in particular are simply breathtaking for the times. Aided by the laparoscope, he reported a diagnostic accuracy rate of 91.7%, compared to just 63.9% achieved without its use (in other words, using other methods that internists generally relied upon, including clinical observations).

At that time metastasis of stomach cancer was considered completely inoperable. Exploratory laparotomy that found metastasis was always seen as a wasted and unnecessary procedure after the fact, one which unnecessarily precipitated death, or at the least, diminished the quality of the patient's precious remaining life. Ruddock's statistics revealed a 6% mortality rate after laparotomy for those patients with stomach cancer, with only a 25% chance that it would prove to be operable. Therefore, being able to determine metastasis beforehand was an essential tool to help avoid unnecessary laparotomies. That way, the patient at least had a chance to convalesce rather than be plunged into more pain and suffering without even a curative aspect to it. We feel retrospective sadness in knowing that these life-saving results were never fully recognized in Ruddock's era, or indeed for many years thereafter.

Ruddock differed from Kalk on the usefulness of laparoscopy in stomach cancer. Kalk believed its diagnostic value was quite limited, since (in 1929) not much could be seen.

Ruddock also raised an interesting point when he mentioned the diagnostic x-ray, which his experience revealed to have an impressive 95% accuracy rate when it came to diagnosing stomach carcinomas in particular. Yet it was that 5% that he was after, as well as what he referred to as that "extra level" of confidence which visual confirmation provided which made the scope such an indispensable tool. By providing such superb statistics and careful clinical analysis, Ruddock became one of the first to gain the necessary clinical evidence which ultimately helped drive diagnostic laparotomies into long overdue obsolescence.

As for diagnosing carcinomas of the liver, Ruddock found his laparoscopic technique achieved up to a 90% degree of accuracy. For all diagnostic procedures combined, Ruddock determined the clinical accuracy of laparoscopy to be 93.6% overall.

Ruddock Proceeds with Caution
It seems Ruddock was fully aware that new technologies could attract suspicion and scorn. To this element, Ruddock offered reassurance, stating in 1937 that the "peritoscope will not and cannot replace a laparotomy." Still, he mentioned that this method was better than laparotomies, which had the prolonged hospitalization and discomfort and costs.

Some Shortcomings
Criticisms aobut Ruddock were certainly difficult to come by; where were the full scale academic brawls of the Nitze-Leiter lore? Don't worry; we've got plenty reserved for the 1990s. Yet, for this era, it seems there was indeed a kinder, gentler nation of endoscopists. All the same, the excellent research of Litniski found a most telling comment by Ruddock that keenly exposes his great misunderstanding concerning insufflation. In his 1934 article, Ruddock stated that "it is not easy to measure the quantity of air used, as the abdominal cavity is not sensitive to inflammation." This state of oblivion with respect to insufflation was not the sole province of Ruddock or his contemporaries. Indeed the physiological understandings of insufflation would not be fully worked out until many decades later.

As for the number of procedures, based on Ruddock's original article from 1951, we confirm that he was at that time working on a large series of patients that had reached a total of 5000 by that time.

As for uncovering morbidity and mortality rates from over eighty years ago, it is probably safe to say that we will never be able to assert anything at this point with much confidence. In general, medical articles of this era are a bit notorious for their lack of clarity when it comes to mortality rates. For endoscopy, this was no exception. Therefore, we proceed with caution in this area. What we do know for certain is that Ruddock did experience one mortality in his first series of 500 patients, stemming from taking a biopsy of a carcinomatous nodule in the liver. He reflected that he believes this could have been avoided if he had more thoroughly coagulated the biopsy site. We also know he reported eight puncture wounds of the bowel, also from his first 500 cases.

Another way to gain insight into issues concerning complications rates is by reviewing what others reported about laparoscopic mortality rates in general for the time. One of the best articles for shedding light into this subject was written by Beling in 1939, who plainly admits that mortalities were occurring, stemming from in particular that notorious nemesis of laparoscopy; bowel perforations. Mention of complications arising from insufflation and electro-cautery was nearly non-existent at this time since such technologies were still too new to be have been understood fully in the first place.

Conclusion Ruddock
Ruddock's careful studies that revealed laparoscopy's superior diagnostic value resulted in a resurgence of trust and popularity for the discipline, a fact that certainly had a direct impact on the lives of many patients. Yet more than that, Ruddock's early work in pushing the scope into the operative domain turned out to be that one crucial factor absolutely necessary to lift operative endoscopy off the ground. Indeed, later reports from 1939 for example, speak of the era's recent flurry of activity in laparoscopic methods, which was partially attributed to Ruddock's success.

Perhaps just as significantly, Ruddock worked tirelessly to advocate for the laparoscope and was described by one source as the most "vocal proponent of laparoscopy in North America." However, the reason for his fervor always centered around improving the lives of his patients, whom he wished to protect from the trauma of exploratory laparotomies. With this in mind, Ruddock made a plea to internists and surgeons to work more cooperatively toward this ultimate goal of bringing minimally invasive care to patients.

Though Ruddock's career was temporarily suspended with the events of World War II in 1941 because of his recruitment as an army medical surgeon, after the war he continued to work on advancing laparoscopy. In fact, he published one of his most excellent works on the subject after the war, in 1951, with his widely acclaimed article entitled "Peritoneoscopy: A critical Clinical Review."

Carl Fervers – The First Operative Gynecological Laparoscopy
Many credible sources including Kurt Semm's articles on the subject, name Carl Fervers, an American gynecologist and general surgeon, as the first to perform an actual, truly operative laparoscopic procedure, with his successful laparoscopic lysis of adhesions. The groundbreaking work of taking biopsies, while requiring some operative elements, ultimately was not as close to an operative procedure as was the lysis of adhesions.

The procedure was made possible by the recent improvements made to electro-cauterizing endoscopes, most notably the Stern-McCarthy bipolar system introduced in 1926 by Max Stern. Fervers quickly understood the potential that this improved electro-cautery had for gynecologic laparoscopy. Using a modified-cystoscope equipped at the distal end with the electro-cautery component, Fervers became the first ever to cut and divide intra-abdominal adhesions by applying the coagulating tip of the scope to the adhesions.

Though mentioned less often, in that same year Fervers also is the earliest Americans to report on performing a liver biopsy laparoscopically, just before Ruddock. In his article Fervers expressed concern about the "audible explosions and flashes of light" caused by the combination of the electro-cautery equipment with the atmospheric air (oxygen) which the abdominal cavity had been filled with. This is a great snapshot of just what sorts of troubles had to be endured to get laparoscopy off the ground! With the adverse affect, Fervers was quick to look for a solution and suggested using CO_2 instead.

It wasn’t long before others heard of his work and attempted their own experiments with the new modality. From approximately this point on in fact, the application of electro-cautery in laparoscopy became a mainstay of the 20th century.

Conclusion Fervers
Fervers' work was absolutely groundbreaking. Prior to this time, operative endoscopy had been essentially the exclusive domain of endo-urologists. In this way, Ferver’s recognized that the time was ripe to move forward and like a true pioneer, despite the lack of precedents, he leaped forward and took that tenuous but extraordinary first step which finally startled gynecological laparoscopy out of its great slumber and toward its phase of awakening evolution. Though there is an unfortunate paltry supply of information about Fervers in the literature, his work nevertheless deserves a prominent place in laparoscopy’s great halls of fame.

Early 20th Century Gynecologic Laparoscopists - 1930s
It is said that the early 1930s saw the first round of activity from gynecologic laparoscopists. This was the first decade in which the American Board of OB-Gyn’s came into existence, established since 1930.

In Benedict’s own review of the literature of this time period, he found that the laparoscope had been so far used in the following conditions: liver diseases, including cancers, ascites, neoplasms of the stomach and colon, and female pelvic diseases including uterine tumors, ovarian tumors ectopic pregnancies. Benedict noted that this surge in interest had been influenced by Ruddock.

By the 1930s there were some sophisticated operations performed using hysteroscopy as well. R. Segund in 1934 developed a hysteroscope to overcome the issue of over distending the uterus by using a smaller caliber input device than for the output.

Moving away from the last few overviews concerning the work of internists, we now highlight the progress achieved by our early brethren practicing some of the earliest documented instances of gynecologic laparoscopy performed in the modern abdominal entry with insufflation.

Robert Hope
Another working in early gynecologic laparoscopy was Robert Hope, who was one of the first Americans to apply the laparoscope to gynecology and was one of the most influential in the field. In 1936, he published what was apparently the first gynecologic report on the use of the laparoscope to secure a definitive diagnosis of an ectopic pregnancy, reporting that his method had a high rate of accuracy.

As for the current day’s drawbacks, Hope added a great deal of insight into what was frustrating his efforts. He mentioned that bleeding caused several problems for the laparoscopists, including the fact that one couldn’t be sure where it was coming from, but also because the blood diminished the view that one could

obtain from the scope. For these reasons, Hope reported that if the abdomen bled, the procedure must be converted immediately to a laparotomy. At the time too, a ruptured cyst required laparotomy.

Hope was also attempting to advance operative gynecologic laparoscopy, attempting especially to achieve the laparoscopic sterilization. His work in this area over the years has been overshadowed by others who were able to achieve laparoscopic tubal ligations before he did. However, Hope's contributions for American laparoscopy were still influential and were important for its continued acceptance and development.

Edward Benedict
In the late 1930s, Edward Benedict of Boston was considered one of the leading endoscopists in the United States. Like many other exceptionally talented physician-inventors, he contributed substantially to a number of endoscopic disciplines, including gynecologic laparoscopy and esophagoscopy.

Benedict's First Endoscopic Work - Gastroscopy, Esophagoscopy
Benedict became so enamored with the scope that he actually quit working in general surgery to dedicate himself entirely to endoscopy. At this time, German endoscopists had been much more accepting and active in gastroscopy and esophagoscopy. However, there was a small group of American pioneers whose dedication to the discipline led to important innovations early on, of whom Benedict became the most renowned. In 1933, at the Massachusetts General Hospital, Benedict, working with the lead endoscopists, Chester Jones, conducted what were described as the first American trials using the Wolf-Schindler gastroscope (developed in Germany). Using this instrument, Benedict and Jones performed a gastroscopy for the first time on April 6, 1933. Apparently with just this first experience, Benedict was hooked. He gave up general surgery and dedicated himself to all types of endoscopy, including laparoscopy. After achieving over 75 patient trials, he ultimately found the gastroscope (with the assistance of x-ray technologies too) to be most useful with diagnosing stomach tumors, gastritis, and gastric ulcers.

Turning Point for Gastroscopy – Benedict's 1948 Operating Gastroscope
Prior to the late 1940s, gastroenterologists relied mostly surgical means to obtain biopsies. Others had attempted to incorporate a biopsy component to the early scopes, with the efforts of Bruce Kenamore in 1940 as one of the most notable attempts. It was Benedict though who was able to get all the components to work smoothly together. In 1948 he introduced his operating gastroscope, which included biopsy forceps and a suction tube. Benedict tried to overcome the shortcomings of Kenamore's device, but found the only way to do so was to increase the diameter of the instrument, which ultimately was the downfall of his device. Widening the size to 14 mm, it was substantially wider than the 11 mm scopes that Schindler had deemed to be the maximum size for comfort. For this reason, the patients were less able to tolerate the device, which often triggered the choking response. Nevertheless, Benedict really believed that

internists had to do more than just peer into the stomach. He fervently believed that obtaining biopsies was the only way physicians could obtain a definitive diagnosis and argued that the advantage of obtaining a more definitive diagnosis far outweighed its technical shortcomings.

In fact, during the early 1950s, Benedict's opinions on this matter of biopsies set off an intense debate amongst gastroenterologists, with the new Benedict school of thought saying that it would be completely irresponsible not to take biopsies in every patient. Prior to his work, gastric biopsies were reserved predominantly to differentiate between diffuse carcinomas and lymphomas. In general though, biopsies were not taken for every presenting patient. With Benedict's influence though, slowly others began to see the importance of taking biopsies as a routine part of their practice. Benedict's device was one of the few on the market to offer the operating feature and, of this group; his was the instrument of choice into the 1960s. Ultimately though, it was not widely used due to the intolerance by patients and misgivings of physicians. Eventually time would prove Benedict's theoretical arguments about the need to take biopsies in every patient to be absolutely correct. However, he wasn't able to push the idea further until the advent of fiber optics made smaller, flexible scopes possible.

Gynecologic Laparoscopy

By at least 1937, Benedict had also applied the scope to other disciplines, working in both the upper and lower abdominal regions. Like so many others of the era, Benedict had been inspired in part by the work of Kalk. In 1937, Benedict published one of the most detailed reports on laparoscopy to be found in the literature. In this article, he (or his group) had already performed a total of 48 laparoscopies [2]. One of his most successful cases in this series involved one of the earliest instances of operative gynecologic laparoscopy, in which he was able to aspirate a large ovarian cyst of an 85 year-old woman.

His general techniques were similar to those prevailing at the time, such as the use of two trocar sites, atmospheric air to insufflate the abdomen, and relying only on local anesthesia in conjunction with sedative drugs.

Benedict Establishes Contraindications for Laparoscopy

Benedict did suffer the loss of one of his patients, which was described as stemming from insufflation complications, along with the inability of this particular patient (with terminal lung cancer) to tolerate the use of sedative drugs administered pre-operatively. It seems with this early experience of adversity, Benedict became especially insistent on determining contraindications more carefully. This sentiment can be discerned when he gently calls into question the remarks by Kalk, who had reported laparoscopy as being essentially "without danger." Perhaps he was unfamiliar with other articles by Kalk, which came out later giving more detailed indications. In any case, Benedict became one of the first American laparoscopists to give exquisitely defined information about what he believed to be the contraindications of laparoscopy. Benedict mentions many that are no doubt familiar to us today, including the presence of

abdominal adhesions and patients with pulmonary or cardiac concerns. In those days before antibiotic use, an inflamed pelvis was also described by Benedict as being a contraindication.

Benedict was careful to explain instances in which the laparoscope failed to diagnose accurately. He gave excellent detail about the difficulties of properly diagnosing carcinomas of the liver, reporting that in case a cancerous liver was overlooked because its surface appeared normal, but that upon palpation nodules were discovered. Later with laparotomy it was discovered that there was a very subtle bulging of the liver as well.

Conclusion Benedict
Benedict was among America's small group of trailblazing endoscopists whose numerous contributions were crucial for getting the field out of the shadows and into a real practicable form. Benedict also performed some of the earliest work in operative gynecologic laparoscopy in America. As well, Benedict's clinical work was light years ahead of his time, especially with respect to the care in which he noted contraindications. He was also one of the first Americans to begin experimenting with gastroscopy, which he recognized early on held tremendous value for the field of gastroenterology. Benedict's advocacy of laparoscopy and gastroscopy was crucial for getting the field off the ground at this early stage. Few were willing to take on a new modality so misunderstood as endoscopy, especially when exploratory laparotomies had by this time become a wide-spread accepted practice. In fact, many in the late 1930s were beginning to grow suspicious of laparoscopy and by the 1940s, Americans had switched almost exclusively to culdoscopy. For these reasons alone, Benedict must be considered one of endoscopy's irrefutable pioneers, in similar league as Orndoff, Bernheim and other American endoscopists of the early 20th century.

C. Abbot Beling, Newark, New Jersey, Newark City Hospital
"Miracles were wrongly hoped for in situations where the use of the peritoneoscope was not indicated"

The American internist, C. Abbot Beling of Newark, New Jersey, proved himself to be one of the most accomplished pioneers of his day, achieving for laparoscopy some of the most crucial milestones. On par with such famous pioneers as Kalk, Ruddock, and the French pioneers already reviewed, Beling also achieved tremendous success in the area of liver biopsies. In one of the most exciting firsts of laparoscopy, Beling was among the earliest to successfully remove a small section of the liver laparoscopically.

We have derived most of the information on Beling directly from his two articles on the subject of laparoscopy, published back to back in the years 1938 and 1939, respectively. In both articles, Beling provides exquisite detail of what he believes to be the benefits of laparoscopy, giving highlights of his case studies to support his views. He viewed the laparoscope to be most effective in making definitive diagnoses of tuberculosis peritonitis and in taking biopsies. Most crucially, Beling wrote his articles specifically as a comparative piece, giving us a

rare, side-by-side comparison between diagnostic laparoscopy and diagnostic laparotomy, one of the first series of articles of their kind. He also compares laparoscopy to the traditional non-invasive diagnostic techniques that internists generally fell back upon before calling in “the surgeons.” For instance, Beling notes that before laparoscopy making a definitive diagnosis of tuberculosis peritonitis could only be determined laparotomically.

As far as traditional clinical diagnoses went, Beling found that the clinical accuracy in diagnosing ascites was “low” (lower than in laparoscopy) in the old method using paracentesis. Specifically he stated that the laparoscope got out more liquid and supposed the discomfort level of the patient to be about the same. He noted as well that the views obtained by the scope had presented “unexpected discoveries” which had not been readily apparent clinically, concluding that the laparoscope’s efficacy as a clinical tool was simply “incontrovertible.”

Liver Biopsies

We hold special affection for any pioneer in these early years that recognized the importance of abolishing forever the disconcerting practice of exploratory laparotomies. Beling made a special effort to address this issue, noting that his research indicated that up to firstly that one third of patients with pre-existing cancers would die as a result of exploratory laparotomies. For these patients especially, Beling advocated for the use of the laparoscope, so that terminal patients would not be subjected to unnecessary pain and suffering caused by pointless laparotomies. The early confirmation of these conditions, although inoperable at the time, at least allowed the patients to experience more comforting and less invasive palliative care. He found that the laparoscope excelled most in the diagnosis of inoperable liver carcinomas, but that the pancreas and parts of the stomach were still inaccessible.

Contraindications

Perhaps the best article for the history of endoscopy at this time came from Beling, who gave one of the most exhaustive lists of contraindications for the lap found, even above and beyond what Benedict had published in his 1937 article.

Like Benedict and Orndoff from just a few years before, Beling was also one of the earliest to report extensively on the important contraindications to laparoscopic use, giving an even longer list than Benedict had. Beling listed a total of nine main contraindications, including “the presence of acute inflammatory disease of the abdominal cavity, pneumonia, pulmonary abscess, disease of the thorax, intestinal obstruction of the small or large intestine, acute perforation, heart failure, and extensive adhesions.” One of the most striking aspects of his 1939 list was that extensive adhesions and operative scars were actually contraindicated. This is interesting to take notice of, since there were early accounts of the laparoscope being used to cut adhesions, including even in Jacobaues’ time. This qualification therefore is useful in order to understand more clearly the outer limits that the early pioneers were facing when it came to

operative procedures. Operative scars and adhesions were in fact contraindicated. He even mentioned bullet and stab wounds as not being good candidates.

Why the Laparoscope Was Not Fully Accepted in Beling's Time
Beling's two articles, published as they were back to back, provide for a medical historian a dream come true: they reflect an abrupt change of attitude- within the same physician- concerning the newly adopted laparoscope.

In his first 1938 article Beling expressed excitement about the excellent diagnostic results afforded by the laparoscope, and even lamented on the lack of interest in the procedure. For instance, he used the word "astonishment" to express his incredulity that paracentesis continued to be performed more than laparoscopies. On this point he writes, "this cannot be defended as a necessary procedure because peritoneoscopy (laparoscopy) accomplishes the same purpose with as much ease and with more information." From this article we see that Beling was a strong advocate of laparoscopy who didn't mince words when he urged all physicians to take note of its diagnostic and therapeutic advantages (i.e., the draining of ascites and tuberculosis fluid).

Apparently this reticence in 1938 had been caused by what Beling characterized as misconceptions surrounding our once loveable lap. Beling believed at that time (and later too) that this circumspection most likely stemmed from misunderstandings about its contraindications. Beling attempted to address this issue by reiterating all the known contraindications for its use.

In the next article however, there is a completely different tone. Something strange has happened which caused Beling to reflect on a number of new yet contradictory concerns, ranging from, on the one hand, over-enthusiasm and injudicious use of the scope, then by turns another lamentation about why the scope was not fully accepted, then back again with warnings not to rely too much on laparoscopy just because it gave such excellent visuals, and finally returning again to laparoscopy's serious limitations. It was quite tricky to understand just precisely what he meant and the contexts of all these paradoxical strands of thought; here is our best effort to sort out the confusion.

Beling's Second Article - 1939
The second article overall focused on what the laparoscope "could and could not accomplish," a direct response to address what had apparently been "miracle" stories circulating during this time. In 1938 Benedict had also referred to a "recent revival" of interest in laparoscopy, which he attributed partially to the influence of Ruddock. Another physician comments on this phenomenon sweeping the times, stating that "Miracles were wrongly hoped for in situations where the use of the peritoneoscope was not indicated. This led to the condemnation of the peritoneoscope, rather than the faulty judgment of the doctor-operator." Indeed, it seemed the laparoscope's reputation had actually exceeded itself in this case!

Something spectacular must have occurred to have made such a dramatic shift in Beling's perspective. From our search, we found the most likely sources of this renewed sense of enthusiasm for the lap- and the attendant calls for temperance- came possibly from news of Hoff and Neefl, the German team who in 1938 presented the world's first color photographs made during an endoscopic procedure.

In order to qualify these so-called miracle stories, Beling warned physicians that they should not do laparoscopies routinely or in the place of other thorough clinical examinations. To this point he stated that just because the laparoscope was so accurate in diagnosis, there was "no excuse for incomplete investigation," (which apparently meant other clinical investigations, not necessarily exploratory laparotomies). Notice the paradox to this statement, which on the one hand speaks to the laparoscope's uncanny diagnostic abilities, yet which belies the nervousness so many physicians feel when technologies begin to supplant traditional methods. Beling went on to report that he believed the scope was being "injudiciously used" due to poor understanding of its contraindications. For the second article, a substantially broadened list of contraindications was reported.

This new, expanded list mentioned that laparoscopy was not safe or useful for the following procedures:

"The amount of posterior fixations of the stomach can not be determined with the peritoneoscope. Except under unusual circumstances the peritoneoscope is not indicated for neoplasm of the colon or rectum. Furthermore, the peritoneoscope does not lend itself to the diagnosis of pancreas disease and removal of ovarian cysts."

The indications for using the laparoscope were cited as:

"Tuberculosis peritonitis, ectopic pregnancy, non-inflammatory disease of any of the organs within the greater sac of the peritoneal cavity, excluding however the contents and borders of the lesser sac, and excluding the pancreas, the kidney and other retroperitoneal structures, with still further exceptions; masses of the peritoneum, suspected neoplasm or anomaly of pelvic organs, including endometriosis, ascites of non-cardiac origin, splenomegaly or hepatomegaly."

Beling did acknowledge that the overall safety of laparoscopy specifically had been well established by that time, mentioning several large studies on the matter, such as Ruddock's report on 500 cases. Beling wanted to add an additional layer of safety on the matter, since there were also apparently reports of mishaps and mortalities with the procedure as well. Beling did his best to form a clinical opinion based on clinical rather than mythical data. In the process, he provided one of the most balanced reports of the times.

Conclusion Beling

Beling's brilliant clinical work, exceptionally thorough research, and dedication

to accurate reporting were simply breathtaking examples of a truly gifted physician, setting him in a league of his own during this experimental phase of laparoscopy. Of most importance, he did his best to convince physicians everywhere to abandon the practice of exploratory laparotomies.

Beling demonstrated his great vision as well when he spoke of the day where he hoped ultimately the successful marriage of diagnostic and operative surgery could be realized, so that operations like the removal of ovarian cysts could be diagnosed and then removed, all in one sitting with the laparoscope. Amazingly too, Beling recognized a problem that afflicted our modern times too; issues of re-training. Beling pointed out that "the need for doctors to essentially retrain themselves" was one of the most daunting impediments standing in the way of the laparoscope's further acceptance. Overall, Beling wins our trust as one of the most meticulous and forthright of practitioners, whose many balanced but astute insights into laparoscopic matters proved to be years ahead of his time.

Beling and the other newly converted laparoscopists of this era did just about everything they could to take the scope this far, to the outer edges of simple operative procedures. In the end though, there wasn't a pioneer around in 1939– or 1949 for that matter- who could squeeze any more progress out of our exhausted laparoscope at this time, for the underlying limitations still were rooted in those same damning duo of dilemmas we've been kvetching about since page one: poor lighting and inadequate optics.

Gastroscopy, Esophagoscopy, Laryngoscopy 1930s
Despite the impressive progress in endoscopy in general, for gastroscopy in particular, there was the added difficulty of working with the extreme angles and reflections necessary to get the light source to make it all the way down to the nether regions of the stomach. The diagnostic and especially surgical limitations of working on a mirror image were constraining. However, in 1932 the desperately needed turning point was finally achieved by Rudolf Schindler, one of endoscopy's most gifted and significant pioneers of the 20t century. His introduction of a semi-flexible instrument- which actually worked- had been an idea in progress since the time of Nitze and Leiter from the 1880s. This semi-flexible gastroscope, manufactured by the Wolf Company, originally featured a phenomenal 48 lenses, which was the secret behind its ability to overcome for the most part the difficulty of transmitting the illumination down to the nether regions of the stomach. This feature significantly decreased the risk of perforations. As well, the stomach's distal area could now be viewed in up to 80% of patients, a substantial improvement over the rigid scopes which had only a rate of 30%. Schindler's contributions are significant in other areas as well, with dozens of other inventions to his name. He was also a prolific writer, producing over 170 manuscripts and five books. With such an outstanding record of innovation and contribution to endoscopy, Schindler has been called "The Father of Gastroscopy."

Conclusion Part IV - 1939

By the end of the 1930s, many operative laparoscopic procedures had finally been achieved in numerous and repeated clinical settings, as opposed to isolated times such as had been the case just 30 years earlier when Kelling was starting off. In the following years, laparoscopy became a somewhat accepted diagnostic procedure.

However problems started to arise as more adopted its use. Rising death rates caused by endoscopy-gone-wrong were now an inextricable part of the scenery and had to be immediately attended to. The same conditions that give rise to high complications were affecting our early 20th century counterparts: lack of adequate training inexperience, and improper technique or instrumentation.

New endoscopic technologies were also fairly limited during this time, with difficulties with light sources and 19th century lens technologies still the only technologies being used, despite the fact that microscopy technology had been improving significantly. In fact, the work of the German electrical engineer Ernst Ruska, who invented the electron microscope, was introduced in this decade, in 1931. For the first time, viruses could be viewed at up to 1 million times larger than prior light microscopes. However, this level of magnification technology wouldn't trickle down to the laparoscope for a while, but this invention did at least facilitate the accuracy of biopsies and gave more reason to do laparoscopies, knowing that the biopsies obtained could now really be understood more fully.

Modlin sums up this year of 1939 quite well when he states: "Despite the fact that laparotomy was a dangerous procedure, its use as a diagnostic tool was widespread, and there was little impetus for surgeons to develop an alternative. Thus, regardless of the unique clinical possibilities that could have evolved from the development of laparoscopy, its widespread use was not embraced by the medical community."

Notes

1. There are many discrepancies in the record concerning the exact total, with values ranging from as low as 500, to a high of 5000. The most credible sources cite 2500 as the overall figure.
2. From Benedict's own description of these cases, it is not clear whether he performed these 48 procedures himself, or whether he was referring to the number of cases that the group from his hospital in aggregate had performed.

PART V) 1940s –1960s: POST-WWII

CHAPTER 17. 1940'S

Introduction

"OK Einstein, so what's the speed of dark?"
-Steven Wright

This period in time was indeed one characterized by "the speed of dark," as the catastrophic events of World War II unfurled, leaving in its wake the deaths of nearly 50 million people worldwide. Naturally, for the medical community there were abrupt disruptions too, with many volunteering or recruited to serve as battlefield medics.

Despite the unspeakable devastations taking place, dedicated physicians from around the world still kept their patients the central focus of their lives. In fact, this era witnessed some of laparoscopy's greatest pioneers, who carried on down the path which the 1930s generation of Kalk, Ruddock, and others had so firmly secured.

Gynecological Endoscopy

For gynecological laparoscopy, a striking divergence takes place between European and North American development. In this decade, we witness the beginning of a new trend in America, the rise of culdoscopy, while in Europe and elsewhere, the true laparoscopic approach remains the most popular. The next generation- Palmer, Decker, Power and Barnes, WB Normant for hysteroscopy, and many more– proved to be so influential, that their work would continue to shape the development of gynecological endoscopy for the next twenty years.

1940s Laparoscopy Stage Setting

We begin here where we left off in 1939, which was a time when the literature about laparoscopy was paradoxically lamenting its lack of broad acceptance on the one hand, while calling for practitioners to curb their enthusiasm on the other.

The calls for temperance were apparently the result of unexpectedly high rates of complications, such as cases of air embolism, which were more prevalent in a time before electronic monitoring systems. Such unpredictable complications may have been the crucial factor which led US physicians to adopt the alternative approach of culdoscopy, which required no insufflation or general anesthesia, which meant that it could be performed without the need for a hospital. This new endoscopic approach was advanced by Decker, whose 1944 article introduced the idea, along with his positive experiences with it. Laparoscopy couldn't have been that entrenched at this time because culdoscopy easily displaced it within a decade of Decker's 1944 debut. In fact, so popular was this new method that it essentially brought laparoscopy into a state of near extinction. Advances in other imaging technologies just emerging at this time, such as radiology and ultrasound, also helped to curtail interest.

Unfortunately too, economic concerns exert more influence over medicine than we would like to believe. This has been particularly true with laparoscopy, which required insufflation, expensive optics, general anesthesia (with some exceptions in its development) and a multitude of auxiliary instrumentation. During times of trouble, such as during the Great Depression and now, in the middle of World War II, such factors may have been perceived as rather exorbitant investments of time, money, and additional training to boot. Other forms of endoscopy (which didn't need insufflation) continued to thrive and develop, especially endo-urology and gastro-esophagoscopy.

Whatever the causes were, what we do know is that between the 1939 peak in interest and until as late as 1966, there was a considerable decline in publications associated with laparoscopy, marking a distinct 25-year gap in its development in America.

Preface to Palmer

Ultimately, since the use of laparoscopic application in gynecology became less prevalent in the US, naturally technological developments specific for the laparoscope stagnated somewhat in the US. We therefore return to Europe, where the next great influx of innovation occurred.

Some of the biggest events in the beginning of the 1940s that helped our next generation of pioneers include the 1941 introduction of Brubaker and Holinger's proximally placed magnesium flash bulb. This technology, with its brighter light, allowed for the first motion pictures of endoscopic surgeries to be achieved, with Brubaker and Holinger presenting in 1945 the world's first ever motion picture of a live bronchoscopy. This was apparently the first or one of the first times that a proximally placed light had been reintroduced into endoscopy, the last time having been in Nitze's time of the late 19th and early 20th century. The Brubaker system however was apparently not broadly adopted for routine use due to its extreme bulkiness and excess heat from the lighting.

Palmer (1904-1985)

How do we begin to tell the story of one of the 20th century's greatest pioneers whose brilliant works shaped nearly thirty years of laparoscopic history? It is indeed an impossible task to attempt to capture all the visionary luster of Raoul Palmer, the Swedish-born French gynecologist whose laparoscopic legacy reaches near sainthood for those of us who were fortunate enough to have known him. At a loss for words, others refer to the phenomenon of Raoul Palmer as simply "the Palmer era." Simply put, he was the man responsible for transforming just about every aspect of gynecologic laparoscopy and became one of the strongest influences in reviving and maintaining interest in gynecological laparoscopy. From his insightful change to the deep Trendenlenberg position, to his more accurate methods for monitoring the intra-abdominal pressure, Palmer changed laparoscopy from an occasionally performed technique to an absolutely indispensable means of obtaining invaluable diagnostic and therapeutic results.

Palmer's 1947 publication led to wide spread acceptance of laparoscopy in ob-gyn medicine, which launched a renaissance of discovery for Europe.

His summarized list of groundbreaking grand slams includes, for a start, being one of the fathers of gynecologic laparoscopy. Palmer earned this title by racking up an unwieldy list of accomplishments, including but definitely not limited to: bringing gynecological laparoscopy back to life in both Europe and America; the first to suggest safer methods and monitoring of insufflation; the first laparoscopic retrieval of ovocyte [1], the first to make true headway into achieving operative gynecologic procedures on a routine basis; and the first film of a live gynecological laparoscopic procedure [2].

To retrace these brilliant milestones in more detail, we begin with the year 1929, when Palmer began his medical career. In 1934 he was appointed head of gynaecological research at the Faculty of Medicine in Paris, and later in 1938 began working at Hospital Broca in Paris. He started his career as a demonstrator in the gynecology department, specializing as a fertility surgeon. Early on, Palmer was performing laparotomies for fertility concerns. An excellent account of these early years was retold by Manhes, who described the scene of Palmer's formative years as follows:

"He immediately understood how imperfect and absolutely arbitrary was the way of diagnosing feminine pathologies, and saw instantly what a brilliant future there would be for laparoscopy. It inspired him with a belief to continue with dogged perseverance despite the criticism and sarcasm of his peers, to discover, design and invent new equipment and above all to create a 'SCHOOL' in his Faculty, where he trained innumerable disciples from all over the world."

In other words, he was bothered that prior to the operation, he had no insight into the amount of lesions or locations of adhesions. This led him to devise his own procedure, dubbed "preoperative exploratory coelioscopy" beginning in 1943. It is amazing to think that Palmer was able to accomplish anything during this time, for he was situated right in the middle of World War II– in Paris- during the German occupation of France.

It was during this early 1940s period that Palmer also discovered the benefits of placing his patients in the deep Trendelenburg position and "mobilizing the uterus by means of a cannula inserted into it." Like others before him, Palmer experimented with different techniques and technologies, even adopting briefly Decker's culdoscopic procedure. However, having found that method quite inadequate for visualizing the pelvic organs, Palmer eventually discovered that the deep Trendelenburg position provided not only the greatest margin of safety for his patients, but also allowed much greater visualization of the pelvic organs. The position itself also acted as a natural means of insufflation by filling the pelvic with air.

Using the combination of these novel features, Palmer established his optimal pre-operative staging, which eventually led in the early 1960s to his performing

operative procedures that had rarely been achieved, including most impressively the retrieval of ovocytes sometime in the year 1961 (some sources cite 1958) and tubal ligations beginning in 1962. Indeed, Palmer was one of the most influential pioneers in the area of laparoscopic sterilization. He contributed to the literature, and worked continuously toward improving the technique, using monopolar instrumentation at first, before bipolar methods had been perfected. Other operative procedures performed by Palmer in this manner include the electro-coagulate the uterine horns, draining of cysts, and lysis adhesions.

Palmer is also considered the first laparoscopists to recognize the critical importance of monitoring and controlling the pressure from insufflation. Kurt Semm drew considerable inspiration from Palmer's work. Indeed, the physiological aspects of intra-abdominal pressure were so poorly understood, that the details were not really worked out until the 1960s. Prior to Palmer's discovery, many patients were dying from air embolism caused by insufflation complications. Therefore, Palmer's ability to accurately define the maximum units of tolerable pressure (25 mm Hg) was a much-needed improvement that made laparoscopies finally a much safer and more predictable surgical method. He also noted that this level had to be continuously maintained and monitored throughout the entire procedure, and that the speed of the insufflation should be limited to 400-500 cc per minute. No one before him came even close to making these discoveries [3]. Finally, he recognized the superiority of CO2 for insufflation and switched to that medium instead of the commonly used atmospheric oxygen.

Palmer also changed the approach of laparoscopy from the upper to lower abdomen. At first glance, this appeared to be a minor change, yet it turned out to increase safety by making bowel and major vessel perforations less likely. This was because, in combination with the deep T position, the bowel and other viscera fell forward toward the upper abdomen. In this way, the laparoscopist was able to make the trocar and veress needle entries with a greater degree of safety built in.

Palmer's 1947 publication detailing these innovations and their use in his first 250 cases turned out to be a tremendous sensation throughout Europe and was highly influential in helping to get laparoscopy accepted into gynecological practices.

Palmer - 1950s

It seems one by one, Palmer began systematically addressing the laparoscope's every last flaw, from minor annoyances to major impediments. The ovaries for a gynecologic laparoscopist were in the category of major; as in major impossibility. Like the pancreas to internists, the delicate (and sacred) ovarian ducts were deemed early on as too fragile for most forms of laparoscopic intervention, with the exception that some were able to drain ovarian cysts from time to time. Yet in 1958, Palmer made one of the most crucial breakthroughs for operative laparoscopy by introducing his specially designed forceps equipped

with an electro-cautery component which could safely take ovarian biopsies. While there had been other forceps invented by this time, such as those by Ruddock, none had been designed with the delicate ovaries in mind. This instrument was later used by Palmer to perform tubal ligations, another breakthrough for the times (notwithstanding though Bosch's introduction to this nearly two decades earlier). The forceps invention was said to have brought "immediate fame" to Palmer, apparently "in the US especially." In this way, Palmer became among the few to have pushed the boundaries of what was thought possible for gynecologic operative laparoscopy.

First Ever to View a Human Ovocyte Laparoscopically
One of the most spectacular moments in laparoscopic history has got to be 1961, the year in which Palmer along with his colleague, R. Klein, became the first to laparoscopically view and retrieve an ovocyte in a living patient, which was later used for performing some of the earliest attempts at vitro fertilization. Steptoe in fact mentions being highly influenced by Palmer's work in this field.

This achievement was a remarkable feat for the times and represented one of laparoscopy's most critical turning points. Though Steptoe and Edwards received more attention for their efforts in retrieving a human ovocytes (because it resulted in the birth of Louise Brown), it is impressive to ponder that Palmer had achieved the necessary first step of retrieval for IVF purposes almost fifteen years earlier.

During the 1950s, many technological advances were made which Palmer was quick to adapt. Palmer cited the most important one as being the 1952 introduction of the quartz rods lighting, commenting "Laparoscopy became a practical method only when the illumination became 100 times more potent…this was first achieved in France with the Fourestier-Vulmiere instrumentation…"

Using this new light source, Palmer became one of the first to adapt the film and photographic technologies for use with the laparoscope, making his first color movie film of a live pelvic surgery in 1955. Palmer was also inventing and modifying new scopes, with one of his most impressive being a 5 mm scope, presented in 1957, which was one of the smallest in the market and which came equipped with the most powerful lens system available.

Conclusion Palmer - Palmer Helps Revitalize Laparoscopy in America
Palmer influenced not only his own generation, but also the next generation of endoscopists after him, including those who would be leaders of the 1960s-1980s eras, such as Behrman, Melvin Cohen, Manhes, Richard Fikentscher, Patrick Steptoe, Robert Neuwirth, Jacques Rioux, and Victor Gomel. Each of these gynecologists visited Palmer in France and returned to their hometowns to help promote laparoscopic development in the US, Canada, and beyond. One source cites Cohen's visit to Palmer in 1966 (and then subsequently sharing the technique with North Americans via demonstrations and publications) as being one of the most influential factors in revitalizing laparoscopy in America, which had been supplanted by culdoscopy at the time. His long-list of technical

breakthroughs were unprecedented for the times. As well, Palmer was a prolific researcher, publishing in his lifetime over 800 articles and several books. Perhaps of most importance, Palmer is remembered as a beloved teacher and mentor whose generous spirit and genuine love of teaching ultimately served to indirectly influence the entire field of minimally invasive surgery.

DECKER

Introduction to Decker

By 1939, we have in America a confused and paradoxical picture of laparoscopy, with some pockets of exceptional progress, surrounded by other regions where the method was viewed with great circumspection– and misunderstanding.

Albert Decker and the Introduction of Culdoscopy

This hesitation in adopting laparoscopy– however so slight– left a wide opening for alternative diagnostics to be considered. This was indeed the perfect moment for Albert Decker to advance a new approach.

During the early part of Decker's career at the Knickerbocker and Governor Hospital in New York, Decker had been taught the laparoscopic method for diagnosing the abdominal cavity. He worked with the technique for ten years, but eventually gave it up by 1938, even though he knew of Ruddock's work and favorable results with it. The motivation behind Decker's innovation stemmed from his concern about deaths and complications arising from insufflation and general anesthesia mishaps when performing laparoscopies. The general anesthesia was apparently his greatest concern, and since laparoscopy required its use, he needed to think of an alternative. He therefore conceived of a different approach for visualizing the lower abdominal cavity with introduction to an approach similar to Ott's from 1901. This is interesting commentary, since the earliest 1930s reports about laparoscopy specifically mentioned that many of the physicians were using only local anesthesia. Perhaps sometime between 1928 and 1938, general anesthesia may have become the preferred method once it had been made safer.

At first it was difficult to gain proper visualization in the vaginal route due to the presence of the intestines. In order to overcome this problem Decker came up with various innovations, first experimenting with various positions, settling eventually on the knee-chest position, which then became one of the most popular methods in the US for the next 20 years. Incidentally, knee-chest positioning had been used as early as 1893, with French urologists and Howard Kelly being some of the earliest to use it in cystoscopic procedures.

Next, he designed his own scope, called the Decker Culdoscope, which was specialized for the vaginal technique. This instrument was essentially a modified laparoscope, which also utilized an optics component and trocar.

After World War II, Decker focused on promoting his technique to the world and began publishing several articles throughout the 1944-1952 time period. Even after his first publication on the subject in 1944, Decker's work was fairly swiftly

adopted throughout the US, and for a brief time too in Europe. By 1949, Decker's procedure had become well known enough to warrant an editorial review in *The Lancet*, which gave the procedure a very positive rating, concluding that:

"…when one considers the frequency of errors in clinical diagnosis, the number of unnecessary laparotomies performed, and the temptation to radical surgery that exposure of the abdominal viscera presents, even the most conservative gynecologists will acknowledge that culdoscopy offers considerable advantages."

Decker also followed up with extensive publications on the method and was able to extend the use beyond diagnostic and into more therapeutic uses, including aspiration of cysts. Later, Decker published a well-regarded textbook in 1952, titled "Culdoscopy: A New Technique in Gynecologic and Obstetric Diagnosis." From all these threads of influence, Decker almost single-handedly changed the landscape of endoscopy in America. For the next twenty years his culdoscopic method dominated gynecologic endoscopy, nearly rendering laparoscopy extinct in America.

One of the First Motion Pictures of a Gynecologic Endoscopic Procedure
For a modern audience of gynecological laparoscopists, it's tempting to skip the chapter on Decker and get back to the *real deal*. However, one of Decker's groundbreaking achievements deserves our utmost attention; he became one of the earliest ever to produce live films of a gynecologic endoscopic procedure (in his case, a culdoscopic film). Dubbed *cine culdoscopy*, Decker attached a motion picture apparatus to his cystoscope and was able to capture some live films through the culdoscopic incision. In the end, he abandoned further work on the matter because the additional lights required had generated too much heat, causing tissue burns. Still, there are film archives of his work available today for viewing. Decker often worked together with his colleague Cherry and much of Decker's work is reported as team of "Decker and Cherry." Unfortunately for Decker's legacy, his brilliant work in this area often gets overshadowed by the more prominent laparoscopic pioneers of this era.

Whether he intended to or not, Decker had actually started a revolution within a revolution. The culdoscopic approach, as it became known, would dominate American gynecology for more than two decades, with its peak during approximately 1950-1970, and fading out only in the late 1960s and early 1970s, when irrefutable evidence about the laparoscopic approach (now equipped with better technologies of course) began re-entering the literature and practices everywhere.

OTHER INNOVATIONS

Hysteroscopy
WB Normant (1943-1957) is considered the "father of American hysteroscopy." He contributed greatly to the literature and expressed several controversial opinions, including saying that D&C was a blind procedure and therefore should only be done hysteroscopically.

Notes

1. There are conflicting reports on both if Palmer was able to actually achieve this, and if so, in which precise year.
2. We make a distinction here between Decker's first film, which was made via culdoscopy and not laparoscopy.
3. Kelling's work on matters of insufflation were so far off the mark, that we don't mention them here.

CHAPTER 18. 1950'S

Introduction

The great tragedy of science - the slaying of a beautiful hypothesis by an ugly fact.
-Thomas Huxley

Huxley's quote is apropos because, in the first year of this new decade the "ugly fact" about endoscopy was that the light source was still almost no better than Kelling's time. However, dramatic changes were just over the horizon.

Diagnostic Laparoscopy Definitely Established

Despite the paltry lighting situation in the starting year of 1950, Ruddock reported in 1951 that "peritoneoscopy (laparoscopy) is now a definitely established diagnostic procedure and has been widely accepted throughout the world as another endoscopic method of examining body cavities" and that "It is now accepted as a safe diagnostic procedure in lieu of exploratory laparotomy in selected cases for a definite purpose." Notice the use of the qualifying phrase "in selected cases for a definite purpose," an indication that there were still some limitations to its application.

Gynecological Laparoscopists 1940s-1960s

Some of the earliest to take advantages of these new technologies were gynecological laparoscopists! Other events affecting our field include the founding of ACOG in 1951, with Dr. Woodward Beacham of New Orleans as its first president. Palmer in Paris was still leading the way in the 1950s, as were many other French laparoscopists including Soulas, Dubois de Montreynaud, and Troyer. Cohen was already working on cutting edge technologies and had introduced one of the earliest motion picture and photographing unit.

Frangenheim

The development of gynecologic laparoscopy was characterized by sharp fits and staggered starts throughout much of formative years. The 1950s was no exception to this great revolution that did not come gently into being.

Indeed, by the late 1950s, laparoscopy needed a new generation of pioneers to help push its progress to the next level. Germany and the world received just such a pioneer in Hans Frangenheim of Wuppertal, who ended up becoming the most crucial force for advancing laparoscopy and keeping it alive as it faced a phase of indifference during this 1950s time period. Many have stated that this era's broad interest and acceptance of laparoscopy was due largely to Frangenheim's influence.

A Contrarian from the Start

For a time culdoscopy had influenced even the German school of thought in the matter. During the earlier part of Frangenheim's career, many of his colleagues were in favor of this approach. However, Frangenheim was just not convinced and was deeply dissatisfied with the method. Despite criticism from those around

him, Frangenheim made the switch to an abdominal approach and never looked back.

Frangenheim was deeply influenced by the published works of both Kalk and Palmer, and sought out their friendship and mentorship throughout his life. Frangenheim met with Palmer in 1955, which began a lifelong friendship between the two.

Frangenheim's first article on his laparoscopic experience was published in 1958, in which he reported on over 350 laparoscopic examinations. As a fertility specialist, Frangenheim used the laparoscope to perform some of the world's most groundbreaking organ-preserving, operative laparoscopic procedures, which were designed to preserve fertility. With his unique innovations in technique for operative procedures especially, Frangenheim made it clear that laparotomies could in fact be avoided in many cases.

Aside from his extensive research and publications, Frangenheim was also especially influential in bringing about technological advances specific to laparoscopy. He constructed an improved CO2 insufflator, and later became one of the first to adapt quartz rod technologies and later fiber optics. And many today still recall the moment when they first saw Frangenheim' motion pictures of live laparoscopies, among the few to be introduced in the 1950s.

The First Textbook on Gynecologic Laparoscopy
In 1958, within the same year as his first publication Frangenheim also published one of the first textbooks on gynecological laparoscopy. Semm referred to this work as one of the most influential of the times, especially in German-speaking regions.

Conclusion
Semm, Cohen, and many other pioneers regard Frangenheim's work as the most important and influential of the times, in the same league as Palmer and Kalk. His contributions to operative laparoscopy were especially groundbreaking, as were his extensive publications and seminal textbook. Frangenheim's influence came at the most important time in the laparoscope's life, when doubt and distrust about the procedure was just reaching a crescendo. Through his exceptional surgical skill, technical innovations, publications, and advocacy, Frangenheim became the central catalyst in revitalizing worldwide interest during laparoscopy's second awakening.

Motion Pictures 1950s:
The World's First Live Birth in Motion Picture- Mori and Yamadori
The stunning 1950s endoscopic revolution, fueled by the introduction of fiber optics remains utterly incommunicable. How does one succinctly describe something that overturned every last drop of technology for the endoscope, bringing in its wake an entirely new order of things? To give just a small glimpse into this phenomenal era, imagine the sound of jaws dropping when the world's first live birth was captured by the newly motion picture outfitted fiber optic

endoscopes. This is just what Mori and Yamadori must have heard when they presented their endoscopic first to the world. Using a glass fiber hysteroscope, Mori and Yamadori were the first to capture on film the birth of a human being. The author's brief description on their achievement went as follows:

"The original production of the glassfibre hysteroscope and a study on the intrauterine observation of the human fetus… and the beginning of delivery by means of hysteroscopy and it's recording on the film."

This involved placing a movie camera on the inner side of the uterus wall so that views of the fetus during late pregnancy could be captured.

Eventually there was a beautiful deluge of innovation. TV and film technologies were utilized in surgery with more frequency after World War II. In 1950, Japanese pioneers from Hayashida Hospital, Uji, Fukami and Suginara, developed one of the earliest endoscopic cameras, the gastrocamera, while in 1953 Cohen and Guterman introduced their Cameron cavicamera, which was capable of filming and photography. Later, some of the most sensational moments in endoscopy's history came with the debuts of the world's first television and color film broadcasts by French pioneers; Palmer's 1955 color film debut of the first live laparoscopy; and in the same year the world's first ever television broadcasts of live bronchoscopies, achieved separately by the French bronchoscopists, Soulas and Dubois de Montreynaud. Within a few years, Frangenheim of Germany would produce his famous 1958 color film of a gynecologic laparoscopic surgery, a feat which would reverberate throughout the world of gynecologic laparoscopists for years to come. By 1959, closed circuit televisions had been experimentally introduced to the repertoire of endoscopic tools, though again it must be emphasized that these early examples were exceptions rather than the rule.

CHAPTER 19. 1960'S

Introduction

Last season's fruit is eaten. And the full-fed beast shall kick the empty pail. For last year's words belong to last year's language and next year's words await another voice.
-TS Elliot

There are no words left to describe the 1960s; everything important has been said or sung. The voice of a new language reverberated through the air, awakening a dream for the world where human rights would finally reign free. As for the revolution that was about to hit endoscopy, the great 1950s technological coup that was fiber optics was without doubt the most important catalyst. Yet technology alone can't talk or walk; it needed the great vision of men and women who saw the great potential it represented and brought it into living color. To these pioneers, we turn now, which brings us precisely to 1960, the year in which so many extraordinary things were achieved that we can only touch upon some of the most salient moments.

Gynecologic Laparoscopy

Gynecologic laparoscopy had been growing steadily since the beginning of the 20th century. By this time however, endoscopy needed a new generation of pioneers to help force progress in the field to the next level. Building off of the earlier work by the previous decade's pioneers, such as Frangenheim and Palmer, and Albano and Cittadini of Italy, the next generation had a great body of experience from which to draw. We start the decade off with the incomprehensibly brilliant, Kurt Semm.

Semm Introduction

Being charged with the task of summarizing Kurt Semm's extraordinary life in only a short space is practically cruel and unusual punishment since such a feat is essentially a sheer impossibility; Semm's breathtaking achievements simply fall outside the grasp of language. Indeed, others have found themselves at a loss for meaningful words too and have resorted to mythical terms to describe his work, designating Semm "the Magician from Kiel." What we can say for certain is that Kurt Semm goes down in history as one of the most critically-acclaimed fathers of laparoscopy, one of the most influential the world has ever seen.

The full scope of his contributions can barely fit into any one category, but his main works fall into the category of outstanding engineering inventions and unprecedented firsts in advanced operative laparoscopy. His most intangible legacy– courageous advocacy of laparoscopy– is perhaps the most unforgettable essence of Semm, and is the part which will live on in our hearts forever.

EARLY EXPERIENCES

Germany 1956–1961 – Series of Bans on Laparoscopic Instruments

1961 proved to be a critical moment in Germany, as the laparoscopy experienced

a great fall from grace when the German Federal medical institutions actually enacted a total ban on its use, proclaiming it to be a “prohibitively hazardous procedure.” The problems had started earlier in 1956 when Germany’s VDE prohibited use of distal electronic flash devices in laparoscopes for reasons of safety. Later, the ban extended to all laparoscopic devices with electronic components (which meant all of them at this stage).

With improvements to the component technologies of the laparoscope, a lifting of the ban in 1964 temporarily eased the use of the laparoscope back into Germany, although the damage to its reputation had been done; for the next several years, in a sort of unspoken manner, it was confined back to its role as an almost exclusively diagnostic procedure.

The moment of Semm’s arrival onto the scene was therefore complicated by these undercurrents of tension. Even so, the time frame of 1965 onward is considered as the great turning point for laparoscopy’s slow journey back into a place of acceptance. Semm’s role in making this underdog story transform into that of a hero’s was absolutely critical.

Enter Semm, 1965:
Hot on the heels of a temporary German ban on the laparoscope in 1961, Kurt Semm would rise in the medical field as one of its most vocal and unwavering supporters. Despite the extraordinary – and life-saving– innovations he advanced, many tried to discredit the outcome of his work.

Part of the reason for the German ban on laparoscopy had related to complications arising from both faulty insufflators, as well as from the monopolar electro-cautery units used in early generation laparoscopic tubal ligations. It was Semm’s personal mission to address both of these serious flaws in the laparoscope’s design.

1966 – Automatic Insufflator
In Semm’s view, laparoscopy was not accepted by many due especially to the uncontrollable and unpredictable complications associated with insufflation. His design principles were inspired in part by the outstanding work of Palmer on this very issue. After numerous rounds of tinkering, his experience with this device was published in 1966. Semm’s CO2-pneu machine was an electronic insufflator which facilitated complex procedures’ technical resemblance to general surgery, which made creating a distended abdomen much more precise and safe. It also was capable of monitoring intra-abdominal pressures with an unprecedented degree of precision. Ultimately, this translated into safer laparoscopy, which helped reduce instances of bowel perforations and retroperitoneal vascular injuries.

Many of the early American pioneers in the 1960s, including Cohen, adapted Semm’s instrument into their own practices and thereafter were able to perform significantly safer and less cumbersome procedures. Many believe that this

particular innovation, introduced at this most critical time of 1966, was very influential in getting laparoscopy accepted and reestablished in America.

New Thermo-Coagulator

As for the problem of tissue burning during laparoscopic sterilization, Semm took a most thorough approach, investigating every aspect of the dilemma. After an extended period of experiment and analysis, Semm reported on a new method to the AAGL in New Orleans in 1973. The defining feature of Semm's device was that it produced a constant low current (aka, radio currents, thermal). Radio frequency waves such as this had been used in endoscopic surgeries in some cases as early as the 1910s. This type of current was later re-introduced to endoscopy by most notably, Max Stern in 1926. Based on some of these earlier design principles, Semm made significant improvements and customized the device for tubal ligations. The current was 140 degrees and there would be localized and controlled application; he claimed to have performed nearly 300 procedures using this new style. It also was able to coagulate hemostasis at 100 degrees Celsius. This innovation was said to have revolutionized laparoscopic surgery by virtually eliminating thermal injuries. In 1967 Semm reported his own series of successful laparoscopic tubal ligations, which generated a great deal of interest in the subject finally too in the United States.

For Semm, this was but a start. He became a staunch supporter and promoter of thermo-coagulation, not only publishing a number of articles in both English and German on the subject, but devoting much of his text, *Pelviscopy and Hysteroscopy*, to it as well.

At this juncture, Semm's demonstrated great confidence, a symbol to the reality he already could envision for laparoscopy. In the text *From Laparoscopy to Pelviscopy*, Semm announced: "The procedures presented in this operative manual are just the beginning of this new surgical era and will stimulate the development of numerous variations."

In 1973, Semm made for another crucial turning point: the development of extracorporeal and intracorporeal knots, the first glimpse of advanced operative laparoscopy's future suture. The specific invention here was the loop applicator, a Roeder Loop into a 5 mm trocar, and within a year of its introduction, Semm had incorporated its use as a routine procedure in his clinic.

An inventive outpour ensued from Semm, with the following inventions: an aqua-purator, which switches back and forth between aspiration and insufflation of physiologic saline solution, the high-volume irrigation/aspiration system; a perfected EndoLoop applicator; and a tissue morcellator, capable of morcellating large fibroids for the first time laparoscopically.

Despite the increased level of safety that all of Semm's inventions ultimately brought to laparoscopy, accolades for his work were far from unanimous. For many surgeons, there is nothing more aggravating and offensive than a colleague who is not only prolific but also boisterous. Once more, Semm's "new surgical

era” would require a vast kennel of old dogs to learn new tricks. Indeed, general surgeons in particular were appalled at the idea of a gynecologist teaching “real” surgeons how to operate.

Although Semm was essentially not recognized in his own land, on the other side of the Atlantic, both American physicians and instrument makers valued his inventions for their simple application, clinical value, and safety.

Unfortunately, as this technique became more popular the rise in complications also increased. The need for better tools and better teaching was at hand. To meet this need Jordan M. Phillips founded the American Association of Gynecological Laparoscopists in 1971.

First Time Ever - Advanced Operative Procedures
Semm was the first pioneer to truly establish advanced operative laparoscopy. Semm adapted numerous surgical procedures to laparoscopic techniques, including tubal sterilization, salpingostomy, oophorectomy, salpingolysis, and tumor reduction therapy. Semm even popularized laparoscopic procedures outside of gynecology, such as omental adhesiolysis, bowel suturing, tumor biopsy and staging.

Almost Removed from the German Physician Society
By far, his greatest and most well-known “first ever” for advanced operative laparoscopy was the first completely laparoscopic removal of the appendix, performed by Semm on September 12, 1980, in Kiel.
The description of his technique was as follows:

“The technique, recommended only for non-acute cases, consisted of an extracorporeal ligation of the mesoappendix with endoscopic ligation of the appendix with a pretied loop. The appendix was transected across its base with electrocautery. Laparoscopy subsequently became a practical and popular technique for the evaluation and treatment of right lower quadrant pain in females, utilized by general and gynecologic surgeons alike."

No one could believe this was possible at the time and as a result, Semm was unable to publish his surgical breakthrough in the hostile environment within the community of general surgeons in Germany. In fact, those who did not personally witness the work of the “Magician of Kiel,” accused Semm of pathological hoaxing. The seemingly superhuman quantity of operations Semm claimed to have performed insulted the intelligence of a great majority in the medical community. The open disgust extended to Frangenheim himself, a predecessor that Semm naturally had studied and admired. In true full scale academic brawl formality, Frangenheim published extensively against Semm and his methods, and Semm gladly responded in print and speech as well. Worse still, many apparently requested his banishment from the German Physician’s Society.

Indeed, the media had a field day with this feud. Personal altercations between the two men were published in widely read medical journals. The laparoscopic

world was entrenched in heated and all too personal rivalry. With Frangheim's influence, countless Semm writing's were categorically denied publication. Again, media and the forces behind it were inappropriately interfering with medical progress and subsequent discussion (However, to his detractors' credit, they were at least mainly motivated by the belief that Semm's claims and instructions were dangerous).

Strong willed and not afraid to fight for what he knew was right, Semm stood his ground and forced a reckoning with what ultimately would become the greatest revolution in 20th century surgical history; that of the minimally invasive movement. Throughout his entire career, at one point or another, Semm had to fight skepticism in order to promote laparoscopic surgery as a method of lessening pain and trauma in infertility patients.

Conclusion Semm – Lifetime of Advocacy
Semm's gifts were legendary and he lives on today in the sense that now all endoscopists are converts to advanced operative endoscopy, which became a reality through his visionary force and passionate advocacy. Even when the naysayers were practically beating down the doors of the OR to halt laparoscopy's progress, Semm was there, defending at the trenches until the very last moment. Indeed, at the close of the 1970s, it was clear that operative laparoscopy had past the point of return from its humble origins as a diagnostic device; for this profound transformation an incalculable degree of credit goes to Kurt Semm.

1964 – First International Symposium of Gynecological Endoscopists
A true turning point for laparoscopy was the inauguration of the first world congress specifically in its honor. The 1964 first International Symposium of Gynecological Endoscopists, held in Italy, was said to have touched off a brilliant renaissance throughout the world, with the participants returning to their home countries transfixed with the dream of a new horizon.

OTHER PIONEERS OF THE 1960s
The Legacy of Karl Storz - Engineering Endoscopic Magic
The story of minimally invasive surgery is utterly incomplete without mentioning the substantial contributions from Dr. Karl Storz, one of its most outstanding pioneers. Inventor, entrepreneur, engineer, and so much more, it would take more than one lifetime for anyone to come close to achieving the life works of Dr. Karl Storz. His business acumen and technical savvy are the stuff of legends, which, combined with his humility and charismatic personality, set in motion many firsts and turning points for the minimally invasive movement. With Storz' pioneering insight, he changed endoscopy forever with such groundbreaking firsts as cold light technology, the production of the Hopkins rod lens, and extracorporeal light systems for video applications, just to name a few. Add these facts to the over 400 patents realized by Storz in his lifetime, along with over 1700 employees across the world now producing 7000 products, and one

begins to realize that the title “instrument maker” does little to capture the depth and breadth of his life works.

From the Beginning - Humility and Hard Work

To think that the making of such a remarkable man began in such a small town as Tuttlingen, Germany, tucked away off the upper Danube valley, is quite heartening for all of us small town folk. Today of course, Tuttlingen now holds special preeminence as one of the leading medical engineering centers of the world. Yet at the start of Storz’ career, France, and other larger cities of Germany, such as Leipzig, were considered the leaders in the field of medical engineering. Yet, such daunting details were no match for Storz’ immense inner drive. From the very beginning, he was impassioned with the idea of excellence in his craft, understanding early on that he was not just dealing with a commercial enterprise, but rather, that every detail was integral to the very life and health of millions of patients everywhere. Even as a young apprentice, Storz made a practice of studying cover to cover the instrument catalogues of competitors, in an attempt to gain insight into the shortcomings of the current technologies so that he could then improve upon them. Later, when running his own company, Storz’ unwavering commitment to quality continued to be apparent in every nuance of his work. When asked in a 1996 interview about the initial phase of rapid growth his family-run business experienced, Storz demonstrated this commitment to perfection over profit when he explained that “At no time during that phase did we expand to the detriment of quality however.” He even made the difficult decision to “turn away potential business” if it meant that quality would suffer. And later, when referring to his practice of loaning instruments out without charge, he stated again that “Money was never allowed to be the first consideration. That was our guiding principle. The instruments had to be there to help the physicians to do their job. The rest then followed on its own accord.”

“The Optimal Fulfillment of Customers’ Needs” – The Storz Motto

And the rest that followed was indeed spectacular. From a purely business perspective, the tenets of sound management that Storz established from the earliest moments of his life reflect a level of wisdom and leadership that would serve as an exemplary case study for today’s young MBA students to follow. The tremendous and long-standing success of his family company, which today continues its tradition of excellence as led by his daughter, Sybill Storz and her son, Karl Christian Storz, can be traced back to several of Storz’ original guiding principles. Though it might sound cliché today, Storz truly put into practice the philosophy of *customer first*. This was no empty promise however. What this meant in practice was that Storz committed his time, energy, and resources to meet face to face with physicians from all over the world, flying all over the world attending their conferences, congresses, and of course, the operating room. Today this may seem a commonplace practice. However, during Storz’ time, instrument makers rarely took on this responsibility, instead leaving the investigation of physician’s needs up to middlemen or “dealers” as Storz

described them. With remarkable acumen and unshakable conviction, Storz rejected this model of doing business. He recognized early on that being in touch with the physicians directly would help him understand what their needs and concerns were. And being a highly sensitive and astute learner, he was able to grasp the finest nuances communicated to him, illuminating for him the core of even the most difficult technical problems, which naturally helped him come up with innovative solutions.

The second guiding principle that Storz followed throughout his life was extraordinary level of personal integrity and generosity of spirit. These qualities permeated his every business dealing, and were especially apparent in the way he respected and nurtured his many employees. Long before it was fashionable to do so, he recognized his employees as being the most integral part of the company success. As a testament to this spirit of generosity, by the late 1990s, many of his employees had been with him for up to thirty years. Well ahead of the times, Storz offered his employees training, ergonomic factories, and insisted on keeping their manufacturing jobs right in Tuttlingen, even during the times when so many others were outsourcing to areas where labor costs were cheaper. When asked about the pressures pertaining to *profit margins*, he responded with his usual steadfastness of character by stating that as "a conscientious manufacturer," there was simply "no room for the phrase 'a quick profit' in a medical instruments company." Driven by such a values-centric business model helps to explain the level of trust, respect, and admiration he earned throughout the years from those with whom he worked. This legacy carries on today, as the name Storz is synonymous with unmatched quality and integrity.

The third quality embodied in Storz' business philosophy was his strong commitment to continued research and development. This was one of the main driving forces behind his ability to be the first to market in the cutting-edge technologies that were so rapidly developing during the 1950s-1970s. He often referred to his commitment to research and development as one rooted in humility, which allows one to keep an open mind and therefore continue to learn and improve. One of the best examples of this was his early recognition and promotion of Harold Hopkin's rod lens optical system. Several of the top instrument makers of the day actually turned down the now famous Hopkins' telescope. Yet, in the first meeting with Hopkins and in viewing the early prototype, Storz immediately knew that this new technology would revolutionize endoscopy and commenced immediately with a licensing agreement and production.

Finally, one of the most essential ingredients to a successful enterprise is passion. And for Storz, this was indeed one of his most endearing of traits. It was this quality especially that kept him going during the difficult times right after the Second World War when he was just getting started. Down to the tiniest detail, Storz was enthralled with all aspects of his work, from the great wonders of medicine, to optics and lighting and employee satisfaction. Upon viewing the image presented from one of his newly minted Hopkins endoscopes, he recalls

saying to his employees in his playful banter “Anyone who isn’t pleased with an image like that must be lacking in something.”

Prescience Personified

It is easy to get carried away with Storz’ incredible talent at business leadership and forget to mention his remarkable gifts of ingenuity and technical expertise. Yet, behind the scenes of the everyday operations was also a man keenly active in analyzing and engineering solutions to the technical shortcomings that plagued endoscopy in its early days. Naturally, with over 400 patents, in this brief précis, we can only touch upon the very tip of his tremendous intellectual outpourings. However, his invention of what is called “cold light” stands out as one of endoscopy’s most profound and revolutionizing contributions. Alone, this one technology reshaped the entire landscape of endoscopy and pushed it toward its true potential as an operative force. Without the cold light, the development of video technologies would have been significantly delayed.

His insight into the problem was certainly no accident. He understood from the very beginning of his career that the lack of intense (but cold) light was hindering the ability of endoscopists to move beyond simple diagnostics and into the realm of operative use. Just in understanding that endoscopy had the potential to move into an operative role was a unique accomplishment in and of itself, for many surgeons at the time were staunchly opposed to this idea in principle. Nevertheless, Storz was quick to grasp the significance of endoscopy’s potential, and was especially excited about the bundling of endoscopes with the latest television, film, and photographic technologies that were exploding onto the scene in the late 1950s. With the introduction of fiber optics, which was a technology initially recruited to transmit only images, Storz realized that the fiber bundles could also be used to transmit the long-sought cold, yet intensely bright, light source. Using the existing technologies of quartz rods to magnify the light sources of his specially designed extracorporeal flash systems, Storz engineered the first working endoscope bundled with both his Hopkins lens and the re-engineered fiber optics bundles, all of which in the aggregate permitted the most astonishing precise images ever achieved at that time.

And thus the cold light revolution was born. This one innovation enabled for the first time film and photographs to finally be captured which were actually of high resolution and therefore of clinical value. Many films and photographs had been made prior to Storz’ discovery, but because the light sources had been either too hot or too weak, the consequent poor resolution of the images captured simply rendered these nascent technologies mere novelties. As well, patient safety was vastly improved, since the now reliable extracorporeal light source could finally replace other systems which had simultaneously generated too much heat and/or too little light, all of which contributed to less accurate diagnoses and more chance for complications. Storz’ invention stands out as one of endoscopy’s greatest innovations, which in turn helped launch endoscopy’s migration from mere diagnostics to its stately form as an operative application.

Conclusion
Storz always acknowledged the role his family played, particularly his father, in shaping his strength of character, which ultimately served as the foundation for his life of integrity and success. In one of his last interviews in 1996, Storz expressed with tremendous pride just what great joy he felt in keeping that tradition alive by having his daughters by his side who today keep alive the shining legacy of his exemplary life. Storz' deep dedication to his employees also lives on in the form of the University Vocational training program that he and his family built right there in Tuttlingen, so that not only his local German brethren, but international students as well, could continue to prosper and feel pride in being a part of such a unique and profound heritage.

More 1960s Pioneers and Developments
The broad acceptance of lap at this time was also influenced a great deal by many others in Europe, including Albano and Cittadini of Italy, who began their trailblazing work in the 1960s, and published a very influential article in 1967 and in 1972, published their textbook which became well known in Europe. Albano and Cittadini were present at the first International Symposium of Gynecological endoscopists held in Italy in 1964. Thoyer-Rozat of France was one of the world's most influential laparoscopists throughout the 1960s and 1970s, with well-known publications and also one of the earliest textbooks for gynecological laparoscopy; Steptoe was also already working in the 1960s on techniques that would soon mesmerize the world. In 1967 Steptoe published the first textbook on laparoscopy written in English. It was widely disseminated and was another key factor that influenced Americans to defect from their culdoscopic ways.

AMERICAN GYNECOLOGICAL LAPAROSCOPISTS
Cohen and the American Re-Awakening - Back on the Saddle Again
The reintroduction of laparoscopy into the United States was said to have occurred sometime in either 1967, a year marking the resurrection from near extinction during the near twenty-year reign of culdoscopy. It was a true underdog moment of triumph and stands as one of the greatest turning points in American laparoscopic history. There, at the helm of this great second renaissance was Melvin Cohen, a gynecologist hailing from the Chicago School of Medicine, whose lifetime of innovations, advocacy, and clinical earned him the title as one of the fathers of the American laparoscopy movement.

Cohen's tireless advocacy of laparoscopy began with his seminal 1967 report, considered one of the most well-articulated and well-circulated articles comparing culdoscopy to laparoscopy. The results of his exhaustive studies between the two approaches were absolutely striking and exposed a great deal of culdoscopy's inherent limitations, leading Cohen to conclude that laparoscopy was without question the safer and superior approach for all gynecological procedures. This was a stunning upset for culdoscopy, which had enjoyed an unquestioned lead for so long.

One of First to Combine Television, Film to Endoscopy in the 1950s
Although best known for his brilliant clinical work and reintroduction of laparoscopy in the 1960s, Cohen had actually been on the cutting edge of things as early as the 1950s. In fact, Cohen was one of the earliest to be involved in expanding the use of television and video for endoscopic applications. In 1953, Cohen and Guteman introduced one of the earliest photographic and motion picture systems to be applied to endoscopes. Called the “Cameron” and also the “cavicamera,” these innovations were brilliantly conceived and highly influential in multiple endoscopic fields.

The Famous Visit to Palmer in 1966
Cohen’s journey in rediscovering laparoscopy began when he visited Palmer at Hospital Broca in 1966. Still, after just one visit to Palmer in 1966, Cohen was hooked. Within one year of that life-changing meeting, he published his groundbreaking 1967 article.

Revolution in Rewind
“When we first saw the beautiful view of the total pelvis and abdomen, afforded by laparoscopy we thought we had "died and gone to heaven."
-Raymond Reilly, Brigham Young University, 1972

For Cohen, the several years it took to convince gynecologists of the laparoscope’s value must have felt like a revolution gone awry. The process of winning converts was definitely not a swift one. It was so clear to him, so clear to what seemed like all of Europe, it must have been nearly maddening to experience the great indifference the Americans were expressing. He tried in vain to get gynecologists to see that laparoscopy provided better results that culdoscopy.

The Great Defections
There were some converts beginning to surface in the late 1960s. The experience of Ronn Batt of Buffalo, New York, provides an excellent example of how some gynecologists really did *get* it and made almost immediate changes to their practices to accommodate laparoscopy. Batt had engaged in training in operative culdoscopy between 1966-1969, and had as a handy saying back then “have culdoscope, will travel.” Yet, after discovering Steptoe’s textbook on laparoscopy, which came out in 1967, and after additional training sessions in laparoscopy with Jan Behrman at the University of Michigan, Batt almost immediately switched over (or shall we say back?) to laparoscopy by the end of 1969; a transition of only a couple of years after seeing the publications, demonstrations, and textbooks.

Fear and Siegler
Alvin Siegler, in 1969, practicing in Brooklyn, New York, also reports on the very positive results he obtained with using laparoscopy to perform 114 successful diagnostic and operative laparoscopies, 44 of which were tubal ligations. He also mentioned that laparoscopy had not yet gained “wide acceptance” in America, despite what he strongly believed to be a clearly superior procedure than any

other method. Like Batt, Siegler also refers to European works as being influential in his adopting the technique, mentioning in particular Steptoe, Sjovall, and Thoyer-Rozat. Siegler also notes how easy it is to obtain excellent photographs using the laparoscopic approach. As a convert, Siegler's perspective is interesting to note during this time when rekindled belief about laparoscopy was just beginning to trickle in.

Yet, the quick transitions of Batt, Fear and Siegler appeared to be rather unique. There were deep thickets of culdoscopy hold-outs well into the 1970s. One of the best comments to illustrate this comes from Raymond Reilly of Brigham Young University, who recalled his first experience with laparoscopy, which took place only in 1972, with the memorable remarks: "When we first saw the beautiful view of the total pelvis and abdomen afforded by laparoscopy we thought we had died and gone to heaven."

This delay in adopting new (or even in this case re-introduced) technologies is not too surprising actually. Firstly, adopting laparoscopy meant that gynecologists had to have access to operating rooms in fully-equipped hospital settings. Culdoscopy on the other hand, was a method that had been performed without general anesthesia or insufflation, attractive features for those in private practice who may not have had access to hospital privileges. The innovation by Clyman's improvements to the culdoscope, along with his advances in operative culdoscopy also helped to reinvigorate interest in the procedure. Clyman in fact was part of a small but influential group of leading culdoscopists, which included himself and Decker, as well as Balin and Willson, and Telinde, whose collective publications were widely respected.

As for other hindrances to accepting the new method, there was also the issue of re-training, which most established physicians are loathe to undertake, given the enormous disruptions it was perceived to have on one's practice. In short, it wasn't looking like a clear-cut victory for the lap, even as late as 1972.

Conclusion Cohen
Of course, we all know the happy ending to this particular tale. In the end, Cohen's advocacy and work was not in vain. His clinical experiences with laparoscopy translated into a series of well-regarded studies and textbooks, all of which eventually did serve to change the hearts and minds of the Americans. At the end of the day, it is clear that Melvin Cohen became one of the most influential catalysts for putting laparoscopy back in the American saddle.

Robert E. Fear, Capt, MC, USAF
"It is accepted by the patient far more often than exploratory laparotomy and, especially culdoscopy."
-Fear, 1968, comparing laparoscopy to both laparotomy and culdoscopy

This great reawakening was also catalyzed by others in the United States who were in the same camp as Cohen in noting the baffling phenomenon of the decided disinterest in the laparoscopic method. Fear addresses this problem

head-on in the first paragraph of his article on the subject, published in 1968. There are no minced words here, and you can almost hear his exasperated tone when he states:

“The Laparoscope is a precise diagnostic tool which should have a much more prominent place in American gynecology than it has at the present time. With modern optical systems, high intensity fiber-optic light sources, and convenient means of inducing and maintinga pneumoperitoneum, the instrument represents a precise, safe and acceptable a means of evaluating the gynecologic patient as is available today.”

One of the most interesting aspects about this article by Fear is that, for one of the first times in the century, the patient’s perspective about these varying options is brought into the dialogue, stating, again with a bit of a rhetorical whip to it:

“It is accepted by the patient far more often than exploratory laparotomy and, especially culdoscopy.”

In the final analysis, Fear does get to see the brilliant rebirth of laparoscopy, although we would still have to wait several more years for its true moment in the sun.

PART VI) 1970 – PRESENT: ADVANCED OPERATIVE VIDEOLAPAROSCOPY

CHAPTER 20. 1970'S

Introduction

"When we first saw the beautiful view of the total pelvis and abdomen afforded by laparoscopy we thought we had died and gone to heaven."
-Raymond Reilly, Brigham Young University, 1972

Here we are again, pivoting upon an unmistakable turning point, where all the stars seemed aligned just so, just in favor for all things endoscopic. The momentum for the endoscope was simply brilliant. All manner of technology poured forth specific to the endoscope, a consequence of not only the great success of the late 1960s fiber optics revolution, but also the result of the outstanding innovations generated by that peerless class of 1960s pioneers who continued working their magic deep into the '70s and beyond. The laparoscopic retrieval of oocytes, tubal ligations, the first successful endoscopic removal of polyps from the entire colon, and so many more gynecological operative procedures were being routinely performed by this time. Some statistics report that even as early as 1971 between 6 or 7 million laparoscopies were being performed each year in the USA alone.

From the technological side, the gadgetry coming down the pike was nothing short of gorgeous genius: Hopkins lens, fiber optics (this time perfected), glitch-less bipolar generators, beaming lasers, and Semm's CO_2-automatic insufflator, just to name a few. TV cameras for documenting and teaching were now a fairly standard operating room companion and working to improve the outstanding visualization problems associated with these new technologies were a world class team of experts from companies like Storz, Olympus, ACMI, and Philips. It was as if we had left earth and had gone to endoscope heaven, where the prevailing law of physics dictated that all laparoscopic operative procedures were possible and a laparotomy turned out to be some mythological creature concocted by the ancients.

Stopping Just Short of True Operative Procedures (Exception Tubals)

Indeed, it seemed every imaginable ingredient was there for the offering. Yet, strangely, a peculiar reticence concerning operative endoscopy still weighed upon the times. Or perhaps more accurately, the idea simply had still not ripened enough to fall off the diagnostic tree. This holding back seems strangely familiar, no? We experienced this same anticlimactic disappointment in the 1930s, when the same on-the-verge feeling reached a great pinnacle, only to fall back upon a comfortable plateau. If there ever was one, the moment was exactly now, when ostensibly the laparoscope should have and could have bound from its shackles to take off toward its crowning glory– operative video endoscopy.

And you the reader, nearly defeated by the burden of hanging on for so long, waiting in exquisite impatience for the redemptive moment to unfold, for *The Conclusion* to come. Alas, it was not to be. We have to wait for what seems like

an interminable time span of another ten years before that one grand moment arose.

A Stairway to Heaven
But don't give up just yet, exhausted reader! Put the saddle back on, for there is still a glorious story to be told for this decade poised just before the great leap forward, one characterized by a good many great minds making great medical moments happen– with great music in the backdrop, even, to make the journey all the more pleasant. This was the era when the accumulation of knowledge, technology and clinical success for endoscopy had accreted to a point of no return, where one could see the hopeful future set atop the helm of an inevitable horizon.

1970s Influential Events in Gynecological Laparoscopy's Return to Forefront
The dual technical breakthroughs of both fiber optics and the Hopkins lens revolutionized endoscopy. Even though both of these technologies were invented in the 1950s, they did not become fully incorporated into all endososcopic instrumentation until the late 1960s and early 1970s. Once they did finally trickle down, laparoscopy changed almost overnight. The new levels of visualization and illumination were simply phenomenal and these two technologies alone were the most crucial that endoscopy ever received in its entire history. Finally the laparoscopist could see clear and color-true images, with a breathtaking 3-D like field of vision with a depth of field never before imagined. Just as importantly, with the new "cold light" the risk of thermal injuries to the abdominal organs by incandescent light was eliminated. With these new miracle technologies now in place, diagnostic laparoscopy could truly and finally transform into its brighter and bigger future of advanced operative laparoscopy.

The 1970s Superstar – Laparoscopic Sterilizations
For gynecological laparoscopists, the early part of the 1970s was a time marked by great paradoxical events. On the one hand, by the mid-1970s training in laparoscopy had been added to "all major gynecologic residency programs" in Europe, with America following soon thereafter. Yet, the transition away from culdoscopy was still not complete. The success of laparoscopic tubal ligations was probably one of the most important factors to help precipitate the final closure to the culdosscopy era.

With the groundbreaking work by earlier pioneers such as Palmer, Frangenheim, Semm, Steptoe, Rioux and other, the use of laparoscopic tubal sterilizations had become fairly standardized within the first few years of the 1970s. In fact, most consider laparoscopic tubal ligations to have been the crucial development which initiated operative gynecological laparoscopy. By 1976, it was one of the most popular elective procedures in endoscopy, with reports showing that from 1971 to 1976, laparoscopic sterilizations increased from a mere 1% to an astonishing 60%. There was a heyday of new technologies and techniques in order to make the procedure safer and more reliable. In 1973 Rioux and Kleppinger introduced bipolar technique for sterilization because more cases of bowel injury were

reported with the use of monopolar. Their invention significantly decreased the amount of complications associated with electro-cautery. Jaroslav Hulka and George Clemens developed mechanical means of sterilization, using a spring-loaded clip for laparoscopic applications. Today, laparoscopic sterilization by occlusive method is now the most popular method of interval sterilization.

The Rise of Superstar Complications
To rise to the top, you must first get to the bottom of things.
-Robert C. Savage

There is perhaps no other dreaded word in the English vocabulary for laparoscopists than "complications." Yet, like any new medical discovery, complications will natural be an attendant part of the discovery process. A new breed of complications with the lap seemed to crop up with each new decade, as lap expanded into other fields and territories. One such complication which began to appear in the 1970s was sterilization problems, with growing mishaps involving tissue burns through unipolar. Semm reported that parallel to the rise in popularity of tubal ligations, in that same period, between 1971-1975, the failure rate of laparoscopic sterilizations (with mostly unipolar) reached as high as high 20% in Germany.

Bipolar - 1970s
Many were working feverishly to address the complication rates associated with tubal sterilizations, with bipolar and mechanical occlusion methods being the most important advances. Bipolar already had a long, though convoluted history. Some early forms of bipolar endoscopic instruments were available as early as the 1920s, especially in endo-urological devices. More modern forms were advanced as early as 1959 by Walz in Germany. Yet it took another almost 15 years for the technology to be adopted for tubal sterilizations. Until the mid-1970s, unipolar electrocoagulators continued to be used, especially in the US, despite a significant degree of complications arising from tissue burn. In 1973, bipolar technology was finally developed and adapted for use with laparoscopic surgery by three or four independent sources; Rioux and Cloutier in approximately 1974, Kleppinger, and Hirsch. A fourth pioneer named Stephen L. Corson has also been cited for contributing to the development of bipolar dividing forceps. Rioux was particularly upset about all the overlooked problems with the existing technologies. In an article on the subject he wrote, "The authors being unable to accept the indifference with which complications are reported, and realizing that they will happen in spite of all recommendations, developed a new instrument."

Rise of Organizations and Training Centers
Based on such an explosion of growth that occurred for gynecological laparoscopy, including concerns about the attendant rise in complications, it was indeed time for an organization to help guide the way. This is precisely what Jordan Philips believed was needed for gynecological laparoscopists and in 1972 he founded AAGL, which has now become one of the most prominent.

The first AAGL conference held in Las Vegas was a smash hit and served to drum up even more positive attention for laparoscopy. At this 1972 meeting, Frangeheim presented his video which laparoscopically captured an ovulation occurring, which became a pivotal moment for many in the audience who were witnessing these advances for the first time. ACOG President Keith Russell attended this meeting and gave a warm welcome to AAGL for its role as a vital new organization.

Hands-on training courses also blossomed, with Gomel and Rioux offering some of the earliest in 1970. Jan Berhman of University of Michigan was also involved in the earliest training courses, as was Semm with his introduction of the Pelvic-trainer in the early 1980s, which was an ingenious invention for accelerating the learning curve even more.

CHAPTER 21. THE FIGHT FOR REPRODUCTIVE RIGHTS

1970s: IVF, Medicine and Media, Edwards and Steptoe, Semm
Chapter by Dave Kostiuk

Progress is a nice word. But change is its motivator. And change has its enemies.
-Robert F. Kennedy

For better or worse, it is quite hard for any of us to picture life without television. Like many aspects of our world, this seemingly immortal medium is often both a blessing and a bane simultaneously. The same electronic box that transmits mindless brain candy from The Patridge Family to American Idol also gives us all-important information regarding wars, natural disasters, and political maneuverings. Television's broad spectrum of functionality is further complicated by corporations and other powers that be, which influence its purpose and content. Since its inception, the usefulness and uselessness of this medium has been a vast and never-clearing haze of gray.

However, innovations in media also spawned society's most in-depth patient awareness ever. Television, then printed media about television, and then electronic media about medicine and surgery, informed those in medical need with unprecedented degree of immediacy and accuracy. The virile ontogeny of the information superhighway increasingly empowered the patient with the ability to place surgeons under scrutiny, rather than just vice-versa. Instead of asking "when" and "how much," concerned individuals could now ask "why" and "how."

This phenomenon and its intricate relation to the history of laparocopy is somewhat comparable to the profound effect that television had on the Vietnam war, as broadcast images rendered the acutely negative aspects of war more palpable, visceral, and immediate, therefore infusing a whole generation with the desire and data to effectuate change.

1978 - Steptoe and Edwards
One of the best examples of laparoscopy living out this prophecy of media, patient-centric care is the story of the world's first IVF baby, achieved with the assistant of laparoscopic-assisted techniques. Perhaps too the 1970s, the post-civil rights decade, best exemplifies the medical field's simultaneously productive and counterproductive struggle with progress, ethics, and media. In the UK, the BBC was doing its utmost to destroy the careers and reputations of two men who would eventually prove to be the authors of one of medical sciences most amazing and culture-shifting feats.

Since 1967, Dr. Patrick Edwards and Dr. Patrick Steptoe of Oldham, Great Britain had been working towards creating options for women who couldn't conceive when they found themselves all but completely demonized by the media by 1969. The team's publication of their working experiments with in-vitro fertilization

created an immediate uproar within and without the medical community. As Kalk and Ruddock attest: "…the influential BBC produced a television program about cell fusion and in-vitro fertilization which opened with a picture of the atomic bomb explosion in Hiroshima." Not exactly fair and balanced coverage.

Consequently, church leaders and medical associations openly denounced in-vitro fertilization as a moral abomination. The perceived unnatural aspect of the work was further heightened by the presence of its chief tool: the still widely contentious use of the laparoscope for more advanced operative procedures. Steptoe and Edwards were forced to resort to soliciting private funding, as they had no other financial support for their efforts. Morale already low (though determination was high), the duo pressed on for the majority of the 1970s, experiencing one failure after the other until one fateful day in 1978.

But before we get to that, it is crucial to note the origins of this partnership. The laparoscope brought them together! In the words of Edwards himself: "I read about this chap Steptoe… [and] his work with something called a laparoscope… He was writing about how he had managed to reach the fallopian tubes. I thought, if he can do that, he can reach the ovaries." A melodramatic professional attraction from the start, colleagues had actually advised Edwards against working with Steptoe, who had already obtained medical infamy as a sort of radical nonconformist. Once the two men indeed joined forces, they attracted institutional hostility and dissent that was as professionally belittling as it was impulsively judgmental.

Edwards, the elder statesman of the duo, had already been thinking outside of the box for quite some time, showing interest in embroyo transplantation since 1958. The ball had already started rolling as far back as 1891, when English professor and physician Walter Heape successfully moved embroyos from an Angorian rabbit and placed them in the uterus of a Belgian rabbit, resulting in a litter of six rabbits. Much later, in 1959, M.C. Chang announced the very first successful birth following lab fertilization; this was the precedent "true in-vitro fertilization and subsequent enbroyo transfer to the uterus." A physiologist from Cambridge, Edwards had recently joined the fray at this juncture, making his best attempts to mature the eggs of Homo sapiens well into the next decade.

By the mid-sixties, Edwards had finally arrived at a stage where he could move from the realm of theory onto a stage of practical reality. He now knew he would have to acquire a partner who was skilled enough to retrieve human eggs to work with. Enter Patrick Steptoe, maverick gynecologist from Oldham General Hospital.

After they were ideologically ostracized from the respectable sciences and relegated to little or no funding for their work, the two pressed on for years despite constant disappointment and maddening frustration. Plenty of eggs and embryos from countless volunteer subjects moved back and forth with zero legitimate pregnancies. By 1977, Edwards was an approximate year away from retirement; ironically and admirably, he and Steptoe became more adamant and

determined than ever. They embarked upon a new program that involved monitoring the menstrual cycle and implanting an embryo into the uterus. Still, pregnancies wouldn't last more than a few weeks.

A married couple from Bristol would prove instrumental in tipping the scales in Edwards' and Steptoe's favor. Leslie Brown and her husband John were one of many couples who desperately wanted to remedy their disability to procreate. At age 29, Brown had an egg removed via laparoscope and replaced fertilized in Nov. of 1977. As Jennifer Rosenberg reports: "Previously, Drs. Steptoe and Edwards had waited until the fertilized egg had divided into 64 cells (about four or five days later). This time, however, they decided to place the fertilized egg back into Lesley's uterus after just two and a half days." Not only was she pregnant, but the pregnancy persisted.

Subsequently this pregnancy gave metaphorical birth to a shockingly high-level media frenzy. On one hand, Leslie Brown became an angelic symbol of hope to so-called barren women the world over. On the other, both physicians were deemed devils incarnate, wicked men doing wicked work. On this latter point Edwards recalled: "We were called everything under the sun– immoral, unethical, dehumanizing." Whether a story of heroes and heroines or a tale of moral depravity at its worst, it was indeed quite a story, one that print and especially visual media salivated to document.

Bribing became the journalistic rule of the day, reporters covertly slipping hospital workers payoffs as luxurious as 5000 pounds for inside information about Brown and other patients involved in in-vitro trial work. The media traffic became so disruptive and intense that Brown's residence was temporarily relocated to the home of Steptoe's daughter in Suffolk. During this 1977 turmoil, Edwards was quoted as saying: "Reporters began to circle the hospital grounds with long-range cameras, long-range recorders, every modern device of intrusion." Did the man say "modern device of intrusion?" The paradoxical irony is thick, as his partner Steptoe's detractors abhor him for his intrusive instrument, the laparoscope.

It was now time for the doctors to file complaints. Like too eager anthropologists studying a culture in a foreign land, the media was no longer just observing but influencing circumstances, quite negatively at that. Brown's health actually began to suffer, forcing Steptoe to file complaints with the health authority and the nation's medical journal. Moreover, thanks to the BBC Julie Brown and the doctors became the focal point of fanatics opposed to in-vitro; a bomb threat, luckily proven to be false, was phoned in to the maternity ward in July of 1978.

That same month, the ravenous media actually affected the character of the delivery. Police and extra security staff could barely keep a lid on all of the activity, and a little more than a week before the due date, Brown was showing distinct signs of high blood pressure. Steptoe opted for a nighttime C-section. It was July 25th, and he actually went so far as to feign departure for the day, walking out of the building around 5 pm. A few hours later, he returned and

slipped through a back entrance. Just before midnight, he delivered a healthy baby girl by the name of Louise Joy Brown, a blond just under six pounds.

Again, the now commonplace method of in-vitro fertilization, a godsend to so many couples otherwise incapable of conception, was physically possible thanks to the work of two brilliant pioneers using laparoscopy for what it had always been destined for; minimally invasive interventions. Laparoscopy, a subject that had been ignored for decades, had once again proven itself as safe and reliable throughout the course of Edwards' and Steptoe's work and studies. Like a King Arthur's sword in battle, the laparoscope was symbolically wielded as a weapon against societal oppression, in this case the fight to control a woman's body and her ability to exercise options in regards to it. The world was watching.

CHAPTER 22. NEZHAT & THE RISE OF ADVANCED OPERATIVE VIDEO-LAPAROSCOPY

Chapter by Barbara Page

Unreasonableness Redefined

The reasonable man adapts himself to the world; the unreasonable one persists in trying to adapt the world to himself. Therefore all progress depends on the unreasonable man.
-George Bernard Shaw

One of the greatest transformations within the history of surgery has been the paradigmatic shift away from open surgery and into the realm of operative video-laparoscopy, an approach which truly captured all that minimally invasive surgery was meant to mean. Many have described the advent of operative video-laparoscopy as a change to surgery as "revolutionary to this century as the development of anesthesia was to the last century."

Indeed, video-endoscopy is today the most common surgical procedure performed by gynecologists, colonoscopists, and gastroendoscopists. As for our own discipline, gynecologic laparoscopists were some of the earliest believers in the new way. By 1986, it was estimated that more than one million laparoscopic sterilizations were being performed in the U.S. alone. Today, gynecologic operative video-laparoscopy has freed millions of women from the era when debilitating, multiple laparotomies were the norm for even mild pelvic pathologies.

Nezhat and the Advent of Advanced Operative Video-Laparoscopy

However, getting to this point of general acceptance– a process which isn't even complete yet– actually took years of persistent insistence. Some have called video endoscopy "an overnight surgical sensation that was 75 years in the making."

To actually breathe life into video-laparoscopy, an entirely new way of operating had to be envisioned and accepted into the fold of convention. Yet, to convince an entire surgical discipline to re-learn how to perform surgery was no walk in the park. We all know, of course, that attempting to convince surgeons to do anything against their will is a headache in the making. But especially to force upon their heads a change so radical– that of shifting their sacred line of vision– was like courting a collision with catastrophe.

An outsized catalyst was needed to rend surgeons loose from the mighty clasp of custom. It was Camran Nezhat, considered the founding "father" of operative video-laparoscopy, who would use his visionary foresight and virtuoso surgical skill to bring this concept clamoring out of its dream-state and headlong into the realm of reality.

To achieve this, Nezhat rigged together video cameras intended for other uses and began operating off the monitor in the late 1970's, which then allowed him

to perform advanced procedures never before done by the laparoscope. By operating off the monitor, for the first time, laparoscopic treatment of extensive endometriosis involving extragenital organs was shown to be possible when Nezhat presented his work at the Annual Meeting of the American Fertility Society in 1985. A year later, his early clinical results on the subject were published in the *Journal of Fertility & Sterility* under the title "Laser Laparoscopy for the Treatment of Endometriosis." After demonstrating the safety and feasibility of performing these complicated surgeries laparoscopically, Nezhat predicted in this article that if such a complicated and extensive disease as endometriosis could be treated laparoscopically, then almost all other pathologies could be managed in that way too, as long as a body cavity existed or could be created.
Prior to this innovation of operating off the monitor, the old way of peering through the scope directly rather than a TV screen presented inherent disadvantages of back strain for the operating physician and poor visualization of the peritoneal structure due to use of one eye through a narrow aperture. Video-laseroscopy refined the laparoscopic process by empowering the surgeon with the capacity to operate in a vertical position, to observe an enhanced field of vision upon the video monitor, and a reduction of back-strain and eye-fatigue encountered while operating directly through the laparoscope.

When all was said and done, Nezhat's conceptual breakthrough would revolutionize modern abdominal and pelvic surgery, overturning in its wake almost 200 years of endoscopic tradition. Talk about rocking the boat; boy would there be dues to pay before this uber-idea could claim its place at the helm of the minimally invasive movement.

The Natural Order of Things?
Of course, today all of this may seem so natural, so evolutionarily inevitable, like the story of man walking upright. Yet, operative video-laparoscopy, a concept which now seems almost prosaic in its self-evident appeal, was not so obvious a solution during this late 1970s time period, nor was it an idea that came gently into being.

Looking back, one actually finds that the opposite was true. Rather, the birth of operative video-laparoscopy was more like a case of gravity defied. It was like suggesting a baseball player look the other way right when the ball is pitched; totally counter-intuitive.

To get a feel for just what Nezhat was up against in trying to convince the surgical world to believe in his ideas, let's take a quick trip back in time to review the status of operative laparoscopy as it stood in the 1970s, in terms of the types of procedures being performed, available technologies, and cultural mindsets which were hindering its development.

Marooned in Mediocrity: The Early 1970s Just Before Video-Laparoscopy
Powerful indeed is the empire of habit.
-Publilius Syrus, Maxim 305

Operative Procedures Achieved by the 1970s
The late 1970s skepticism concerning gynecologic operative laparoscopy is not so clearly spelled out in other historical accounts. Many have made the inaccurate claim that gynecologists had "fully embraced" laparoscopy as a standard modality by the 1970s. While there is a grain of truth in this with respect to diagnostic laparoscopy, for advanced operative procedures, the story was quite different. This can be established by reviewing the literature and textbooks of this era, where one can plainly see that operative laparoscopic procedures being performed were essentially no more advanced than those which had been introduced nearly fifty years earlier by endoscopy's early 20th century pioneers; draining cysts, lysis of adhesions, taking biopsies, electrocautery, and tubal ligations.

Aspiration of Ovarian Cysts – But Not Their Removal
The history of draining cysts laparoscopically serves as a perfect example to track these operative plateaus. As early as the 1920s, the American laparoscopic pioneers Ordnoff and Bernheim were some of the first to demonstrate how successful the "peritoneoscope" (aka laparoscope) was for this procedure. Jacobaeus was also able to drain ascites in the abdomen in the 1910s, a laparoscopic procedure similar in nature. Yet, over fifty years later, some of the most popular manuals and textbooks of the 1970s-1980s – Frangeheim's *Endoscopy and Gynecology*, TeLinde's *Operative Gynecology*, AAGL's *Manual of Endoscopy*, Hulka's *Textbook of Laparoscopy*, Baggish's *Atlas of Contract Hysteroscopy and Endoscopy*, Wheeless' *Atlas of Pelvic Surgery*- all specifically direct laparoscopists to focus only on aspiration as the standard practice. Surgical removal was made possible as a routine practice as a result of video-laparoscopy. Today of course clinical data demonstrates that up to 40% of these cysts do in fact refill, indicating therefore that surgical removal is the preferred standard.

Tubal Sterilizations
As for the endoscopic superstar of the 1970s- tubal sterilizations- it actually got its start back in 1936, when Boesch performed the world's first documented laparoscopic tubal sterilization using electro-cauterization [1]. Naturally, the technique has been perfected over the years. Yet by the 1970s, conceptually the procedure had not changed much from its 1930s debut.

Indeed, with the exception of contributions from the era's few virtuosos, such as Palmer, Semm & Mettler, Steptoe, Cohen, and Gomel, our entire discipline seemed stalled for what felt like was going to be forever at tubal sterilizations, as if it were the final frontier.

Blizok lokotok, da ne ukusish
Impossible, you might say! Fifty years without a new operative procedure? How could this be? After all, eye-popping technological advances were proliferating at an astonishing clip during this era; fiber optics, automatic insufflators, electronically controlled thermo-coagulators. Yet, here we were in the late 20th

century, with men and monkeys flying to the moon and back, while we laparoscopists were still stuck back at the farm, doing mainly routine diagnostics. It seemed to be a clear case of *Blizok lokotok, da ne ukusish*. This old Russian proverb, translated as “your elbow is close, yet you can’t bite it” was an apt description for the times, because on the one hand, with the new technologies enabling video-laparoscopy even more, we were so elbow-close to breaking through and past the old ways. Yet, paradoxically, we were so far away from the “bite” because, as Nezhat and other pioneering laparoscopists of this era soon discovered, confronting psychological resistance to change was the far more difficult task to overcome.

Another Conundrum

There was another conundrum to overcome; new surgical techniques had to be invented which could accommodate being done in the new closed, video-laparoscopic manner. Doing a procedure endoscopically that was actually designed to be done via laparotomy presented actually one of the most formidable problems. There were essentially no textbooks or protocols established yet which would have demonstrated how to make these procedures actually feasible laparoscopically. Some innovations were beginning to pour through the pipeline; Semm’s and Mettler’s extracorporeal Roeder’s loop was one such example. Yet these contributions still did not resolve the majority of the problems having to do with achieving more advanced procedures.

In short, what this meant was that each procedure normally done via laparotomy would have to be re-invented. This process was naturally one of trial and error, a factor which especially exposed Nezhat and other laparoscopic pioneers to some harsh criticism in the early days.

An Overview of the Times – TV, Video, and Light Source Technologies

As for the nature of endoscopic technologies, many precursors to video had been established for many years prior to the 1970s. Cinematography and television had actually been used modestly in a handful of surgical centers since roughly the late 1930s. By the 1950, Japanese pioneers from Hayashida Hospital, Uji, Fukami and Suginara, developed one of the earliest endoscopic cameras, the gastrocamera, while in 1953 Cohen and Guterman introduced their *Cameron cavicamera*.

Some of the most sensational moments in endoscopy’s history came with the debuts of the world’s first television and color film broadcasts by French pioneers; Palmer’s 1955 color film debut of the first live laparoscopy; and in the same year the world’s first ever television broadcasts of live bronchoscopies, achieved separately by the French bronchoscopists, Soulas and Dubois de Montreynaud. Within a few years, Frangenheim of Germany would produce his famous 1958 color film of a gynecologic laparoscopic surgery, a feat which would reverberate throughout the world of gynecologic laparoscopists for years to come.

By 1960, Inui, Berci, and others had either invented themselves or collaborated with industry to bring miniaturized video endo-cameras into endoscopy by the 1950s-1960s. However, all of these systems were definitely not designed with advanced operative video laparoscopy in mind. For instance, Berci's 1962 article was one of the earliest to mention both "TV" and endoscopy" in the title. While this article did an excellent job of delineating the latest TV technologies, nevertheless its singular focus was on the ways in which the new imaging technologies would enhance documentation and teaching capabilities; there is no mention of changing the *method* of performing endoscopic procedures, with the goal of advancing laparoscopy's operative potential.

Even as late as 1977, Berci revisited the role of TV and video devices –referred to back then as "teaching attachments"- as technologies to enhance teaching only. Figures 1 through 5 from this same 1977 article also clearly show that the latest in camera-equipped endoscopes were still designed to be utilized in the old way, with endoscopists peering awkwardly through the scope. A similar attachment, called a "multiple tube medical television camera," highlighted in a 1977 AAGL conference entitled "Endoscopy in Gynecology," also demonstrates this well-entrenched trend.

In other words, while some of the technological rudiments to support videolaparoscopy had been in existence for at least forty years in some cases, the most crucial missing link was not technological in nature, but rather was an issue of missing imagination. The conceptual idea of combining these technologies and using them in an entirely different way had been entirely overlooked until Nezhat's unique contribution.

A Paradox - Poor Resolution Almost Foils the Thought

All of this background review has missed one vital but paradoxical point; even with these newly emerging optic and video technologies, Nezhat's idea was actually still too advanced for the era's technologies to support. At the time of Nezhat's awakening to the magic of operating upright, operating off the monitor was barely feasible because the early generation optics and video systems (before digital was perfected) still did not produce the level of high pixel resolution that we have become accustomed to today. And despite the superior illumination afforded by the latest fiber optics and Hopkins lens systems, the quality of light had not advanced to a level where images could be efficiently split toward the monitor. As recently as 1977, Berci made a point to mention the inadequate nature of light sources, stating that "Illumination sources are in a chaotic state." These combined technical deficiencies meant that the images shown on the monitor were so grainy that, for most they proved to be indiscernible; definitely not clear enough to support the notion of operating off images. This is why so many were against the idea initially, since it was quite disorienting to view barely discernible images emanating from a low-resolution, two-dimensional screen positioned several feet away from both surgeon and patient!

Backlash to Laparoscopy for Second Time in the 20th Century

As if these obstacles were not enough, gynecologic laparoscopy in America was actually experiencing another season of discontent, just beginning to surface in the late 1970s [2]. Of course, as usual with the story of laparoscopy, this is completely paradoxical, for the discipline did experience some very dramatic leaps forward during this era, at least symbolically. For example, by the mid-1970s training in laparoscopy had been added to “all major gynecologic residency programs” in Europe. And by 1981, the American Board of Obstetricians and Gynecologists followed suit and made laparoscopic training a required component of U.S. residency programs. The number of procedures being performed annually also skyrocketed. By about 1973, some sources state that between six and seven million endoscopic procedures were being performed annually in the US alone [3]. Other reports show that from 1971 to 1976, laparoscopic sterilizations increased from a mere 1% to an astonishing 60%. Though such statistics on the quantity of surgical procedures are notoriously difficult to verify, based on our research these numbers appear to be reasonable estimates.

Yet at the end of the day, the majority of operative procedures were still limited to only simple tasks, a fact that translated to millions of female patients continuing to be subjected to multiple laparotomies for even mild cases of endometriosis. This stall in the progression toward more advanced procedures was in part caused by growing concerns over complication rates associated with outpatient laparoscopic sterilizations, a procedure which had rapidly grown in popularity in just a few short years.

A growing backlash toward all things laparoscopic developed in earnest and articles forewarning of high complication rates began to seep into the literature. One of the first such articles of this kind to gain national attention was published by the well-respected founder of the AAGL, Jordan Phillips, whose 1977 report outlining in stark detail the estimated complication rates associated with laparoscopic tubal sterilizations struck a raw nerve within surgical communities and served for a time to temper enthusiasm. Indeed, failed sterilizations became the second leading cause of lawsuits for ob-gyns in America, only after those associated with pregnancy complications [4].

Another example of the ambivalence over the scope’s role in more advanced operative procedures can be found in one of AAGL’s most memorable meetings, in which Semm had been invited to demonstrate the types of operative procedures he envisaged for his “pelviscopy.” “Kurt Semm’s pelviscopy presentation struck people in that meeting as going too far,” recalls Soderstrom, one of the founding members of AAGL. The title of this debate, called "Laparoscopy is replacing the clinical judgment of the gynecologist," also captured perfectly the unease about allowing the scope to advance beyond diagnostics.

Soon thereafter, urgent congressional hearings and other governmental advisory panels were being called into session to address concerns about the rapid technological changes affecting endoscopic medical devices in particular and medical technologies in general. Symbolic actions were taken against laparoscopy, beginning most conspicuously with the Congressional Health Device Act passed in 1976. Later, in 1981, the CDC in Atlanta issued a very strong public rebuke over patient deaths apparently linked to unipolar laparoscopic sterilization procedures [5]. Since the medical community tends to err on the side of caution, such adverse reports– whether exaggerated or not- were nearly the death-knell for laparoscopic innovation in those days.

The Frozen Tundra of Buffalo - This is Your Brain on Imagination
Necessity knows no law except to conquer.
-Publilius Syrus, Maxim 553

And thus it unfolded that, for the second time in the 20th century, interest in laparoscopy had soared to the heights of unfathomable popularity, only to plunge back down to earth once its inherent limitations were revealed after the veil had been lifted. An epoch tale indeed was in the making, as it seemed our laparoscope's once rising star of shiny, happy brilliance was on the verge of being reduced to a garish glare. The revivalist hey-day that American laparoscopists had so enjoyed during the 1965-1975 timeframe had been nearly neutralized by the end of the 1970s. In other words, the timing could not have been *worse* to introduce such a radically new concept as that of advanced operative video-laparoscopy!

All the same, Nezhat remained imperturbable. These heavy realities were no match for his hidden reserves of moxie; he boldly pushed past the raucous ramble of naysayers, forcing a reckoning with minimally invasive surgery as the new reality.

So, how did it all begin?

Amidst the frozen tundra that is Buffalo, New York in mid-winter, there was a kindling mind, ablaze with great visions that soon would take the surgical world by storm. But how did videolaparoscopy develop from the imagination of this young physician just starting his residency? And by the way, what audacity! How did he find the courage to disagree with senior surgeons– at risk to his own just-blooming career– and take on the entire surgical world?

Very gracefully, of course.

More than anything though, the *how* came from the *why*; Nezhat was driven to help ease the pain of his patients, who had been forced to endure 6 to 12 inch incisions into their abdomens for even the mildest of pathologies. In witnessing the extreme pain and suffering of his patients, their long convalescence, and the serious and numerous complications arising out of laparotomies, Nezhat believed that with just minor alterations almost all of this unnecessary suffering could be

averted. It seemed clear to Nezhat that one of the most significant hindrances was the positioning of the surgeon in relation to the scope. The whole contraption left him contorted in the most unnatural of positions; bent-over sideways, with an assistant blindly holding the scope and other instruments in place while the surgeon tried in vain to verbally direct its positioning.

He knew that if only he could find a way to circumvent the physical limitations posed by peering through the scope's singular eyepiece that the scope's surgical capabilities could then be extended into more advanced operative procedures. Practicing in the lab late at night, he realized that one might be able to perform surgery standing upright by watching the monitor.

With the concept now firmly in his head, Nezhat began the art of rigging together whatever equipment he could find to make this vision come true. Initially he operated directly off the monitor using a single tube camera by Medical Dynamics, model Synvision- with low light level.

Nezhat recounts those early days:

"Early on, vascular and neurosurgeons had had success using cameras for micro surgery. So, hoping to learn from their successes, I approached my colleagues in these disciplines. Their willingness to spend time demonstrating this technology was very fruitful. Of course, we ran into unusual logistical dilemmas trying to adapt this technology. Many strange configurations were attempted before achieving any degree of success. [Eventually though], we were able to convert an old camera used in their disciplines into an awkward but nevertheless functioning addition to the scope."- Camran Nezhat, Presidential Speech, September 2005, JSLS

Despite this precarious start, Nezhat was able to collaborate with other disciplines, a factor which became crucial in developing these ideas even further. Nezhat attributes this multi-disciplinary facet as having been a vital source of endless inspiration. Endometriosis especially led him to work with other specialties, since it commonly affects many different organs, especially the GI and GU tracks. The contributions of Dr. Earl Pennington, a pioneering colorectal surgeon, and Drs. Rottenberg and Green, both urologists, were especially noteworthy, as they guided Nezhat through very challenging procedures which had never been achieved laparoscopically before. Nezhat recalls, "Colorectal surgeon, Earl Pennington and urologist, Howard Rottenberg, were always at our side." Also, patients with endometriosis have high rates of endometriomas which sometimes can have the appearance of malignancy. Therefore, from the very beginning, contributions from colleagues in gynecologic oncology were of critical importance. In this area, the guidance of Drs. Benedict Benigno and Matthew Burrell was absolutely invaluable. Through their vision and willingness to share their expertise, a better understanding of how to recognize and manage malignancies laparoscopically was achieved.

As for new suturing methods, only a few modifications were needed. For the most part, Nezhat was able to convert the same microsurgical techniques for open surgeries as were taught by pioneers in treating endometriosis such as doctors Robert Frankling of Houston and Ron Batt of Buffalo. Prior to switching to video-laparoscopy, suturing laparoscopically was a feat extraordinarily difficult to achieve while hunched over the scope. In fact, this factor was one of the main hindrances which had made earlier attempts at operative laparoscopy so awkward, unsuccessful, and ultimately, unpopular.

Forever-scopy

Operative video-laparoscopy was certainly not without its flaws. And we wouldn't want to delude the reader by providing only the pretty pictures of its past. Indeed, one of its least attractive features initially was the extra time it took to perform some of the advanced procedures. As Nezhat recalled, "they used to call laparoscopy 'forever-scopy'." For instance, laparoscopic ectopic pregnancy surgeries were taking 4-5 hours initially, while Nezhat recalls that his first- and also the world's first- radical hysterectomy with paraeortic and pelvic lymphadenectomy by video-laparoscopy actually took seven hours. This added time factor wasn't helping to convince anyone that the video-laparoscopic method was better or safer than open. Of course, even some laparotomies took up to seven hours. But, the new method naturally was judged more harshly than classical standards.

Because of this time factor stemming from the very long learning curve, the effectiveness of video-laparoscopy was difficult to assess at first. Early reports showed laparoscopy to have higher complication rates than laparotomies, though these result were attributable mainly to inexperience.

Collaboration with Instrument Makers

In order to overcome these inherent deficiencies standing in the ways of the new technique, Nezhat began a fruitful relationship of collaboration with Karl Storz and other surgical instrument companies. Using those same old clunky cameras borrowed from the neuro and vascular surgeons, Nezhat was able to show the company representatives that operating off the monitor could in fact work. After hours in the OR, eventually Storz and other company reps were also convinced of the scope's greater potential and they began producing new cameras and light sources customized for operative video-laparoscopy.

These days, working together with companies in this fashion might be discouraged. Yet, without this early support and free-spirited exchange of ideas between engineers and surgeons, poor visualization and other technological hindrances certainly would have persisted as formidable conceptual and technological divides.

Delays in Publications

Despite collecting verifiable clinical proof to the safety and efficacy of video operative laparoscopy, at first no one would accept Nezhat's early manuscripts on the subject.

It took a few years, but finally his debut articles on these never-before-seen laparoscopic surgeries were published in 1986. From this point, Nezhat was able to continue to demonstrate– this time to a larger audience- that other complex surgeries were finally possible. Indeed, between the years of 1984-1989, Nezhat forced a reconsideration of all that was thought possible when he and his colleagues became the first to successfully perform such complex surgeries as: the first laparoscopic treatment of multi-organ, extensive, stage IV endometriosis, affecting the GI and GU, the first laparoscopic bowel surgery & resection with Pennington, the first laparoscopic ureter resection, ureterouretrostomy, with H. Rottenberg, and B. Green, the first laparoscopic radical hysterectomy with paraortic and pelvic node dissection with M. Burrell & B. Benigno, the first laparoscopic bladder resection with H. Rottenberg, the first laparoscopic vesicovaginal fistula repair with Batista, the first laparoscopic rectovaginal fistula repair with Basida, the first laparoscopic ovarian cystectomy in second and third trimester of pregnancy, the first laparoscopic-assisted surgery (laparoscopically assisted myomectomy), the first laparoscopic Burch procedure, the first laparoscopic treatment of ovarian remnant with E. Pennington and H. Rottenberg, the first laparoscopic sacral colpopexy, the first laparoscopic treatment of diaphragmatic endometriosis lesions with H. Brown, the first laparoscopic management of a leaking inferior mesenteric artery with C. Zarins, the first laparoscopic coronary reanastomosis in a porcine model, the first laparoscopic management of dermoid cyst.

Acceptance and publications on these firsts by Nezhat and his colleagues often faced numerous rejections and/or lagged three to five years after the initial procedures were performed, due to either resistance from journal editors to such new-fangled ideas, or for preference to publish the work of those in academia rather than those in private practice.

In any case, before the dawn of 1990, Nezhat and his colleagues had already performed laparoscopically practically all the major procedures involving the bowel, bladder, and ureter, which in the past had only been accomplished via laparotomy.

“Agony in the Garden” – The Era of Abject Antagonism
Scandal has ever been the doom of beauty.
-Book II, Properties

Like a rite of passage, the quintessential pioneer story wouldn’t be complete without an element of abject suffering to startle us out of our reverie. Like Semm, Muhe and others, Nezhat endured many years of doubt before his ideas became accepted. In terms of endoscopy’s long history, this was not surprising. There had always existed an element of resistance since the time of Bozzini, if not earlier. Resistance to operative video-laparoscopy was especially fierce for it forced surgeons- for the second time in the 20th century- to lose two vital sensory mechanisms: tactile and direct visualization. These changes seemed to be the tipping point which drove the final stake into ancient surgical practices,

bringing to the fore a 21st century approach which few were actually ready to embrace. Indeed, so suspect was the new surgical revolution that Nezhat and his brothers actually had their academic integrity called into question.

Even from just a few years ago, in 2002, a lay media frenzy went so far as to label Nezhat's work as "bizarre," "barbaric, and akin to "medical terrorism." Forced now to answer to this misinformed media frenzy, Stanford University was essentially left with no choice but to act in the most politically expedient manner by launching a highly publicized, formal investigation of Nezhat's work, issuing in the process a temporary suspension of his professorship to appease the public outcry [6]. After lengthy investigations– and to the surprise of no one in the know- Nezhat's work was found to be free of any misconduct whatsoever, cleared by the highest authorities from Stanford University, the U.S. State Supreme Court, and the California and Georgia State Medical Boards. How ironic it is today that, quietly, all the studies are pouring forth which confirm Nezhat's initial impressions of the advantages of operative video laparoscopy. Those same procedures pioneered by Nezhat and his team considered so controversial just a few years ago, are now encouraged to be performed by the most prestigious journals. A 2004 editorial from the New England Journal of Medicine states, "Surgeons must progress beyond the traditional techniques of cutting and sewing…to a future in which …minimal access to the abdominal cavity [is] only the beginning."

Conclusion

History may be servitude, history may be freedom.
–from "Little Gidding," TS Elliot

Sometimes history can become an unbearable weight. Operating off the monitor and inventing the accompanying advanced procedures were the crucial links which allowed our discipline to be set free from hundreds of years of history of peering directly through a tube, specula, or scope. By demonstrating the scope's boundless potential, Nezhat hit the groundbreaking grand slam that drove laparoscopy home toward its true operative potential.

Other Significant Pioneers and Events of the Late 1970s

John Wickman, a urologist, had been at the forefront of endoscopic discoveries since the 1970s. Wickman was using newly created lithotripter on kidney stones in '80/'81, and also performed the first removal of gallstones endoscopically in '86, using a nephroscope. Wickham is credited with coining the phrase*"minimally invasive surgery"* in 1983. Wickham was criticized greatly for what were considered "outrageous and nonsensical claims of a new surgical movement." Muhe of Germany and Mouret of France, 1985-1987, were the true pioneers for laparoscopic cholecystectomy in Europe M.A. Bruhaut of Clermont-Ferrand, and his team in France was on the cutting edge of operative laparoscopy for the 1970s. In 1979, Bruhat et al. used the CO2 laser for laparoscopy. Yona Tadir of Israel independently accomplished the same also in approximately the same time period. In 1980 Bruhat et al. also launched one of

laparoscopy's first prospective and comparative studies between microsurgery and laparoscopy for the treatment of tubo-peritoneal infertility. Their findings demonstrated that the laparoscopic method gave more advantages. Hubert Manhes worked with Bruhat early on, and came up with several new instruments and advanced operative procedures, including the conservative (laparoscopic) treatment of ectopic pregnancy as early as 1973. H.M. Hasson's 1971 introduction to "open laparoscopy," allowed for direct visualuation of trocar-entrance. Since introduction of the trocar was and still is one of the main chances for error, this feature allowed for less experienced surgeons to gain a sense of mastery over laparoscopy and mimicking the open method somewhat. Lisolette Mettler in 1976 reported on the laparoscopic diagnosis of stage IV endometriosis, which involved multiple organs. Henry Coutnay Clark was performing some of the earliest operative procedures from 1972 onwards in the Carribean and Canada, though many of his firsts were earlier unrecognized due to the controversy surrounding these new procedures. Victor Gomel reported good results with infertility patients undergoing corrective laparoscopic surgery.

CHAPTER 23. 1980'S

Introduction
Déjà vu all over again.
-William Keye regarding the 1980s

The 1980s represent what are arguably the most controversial years in laparoscopy's entire history. As developments in laparoscopy became more advanced and widespread, and with its popularity souring. Some of the earliest intense debates were revolving in particular about the increasing application of laparoscopy into more advanced operative procedures. By 1975 a huge heated debate had been brewing about whether or not the removal of ectopic pregnancies was indicated for laparoscopy and also tubal ligation by laparoscopy. Apparently there were some unexpected complications rates with the earliest procedures. As a result, laparoscopy was the target of intense scrutiny in the 1980s. In 1981, rules and requirements to perform laparoscopy were adopted by many hospitals and surgical societies. Meanwhile, the FDA got involved and in 1980 published safety standards for gynecological laparoscopy. The CDC also in 1981 reported about deaths from tubal ligations and made stern reprimands.

Yet, aside from these brewing debates about certain issues, the laparoscope was at the same time finally accepted as an important part of everyday practice. By this time the American Board of Obstetrics and Gynecology made laparoscopy training a required component of residency training.

Imaging diagnostic procedures were also beginning to work as complimentary components of endoscopic procedures. By 1981, surgeons could portray for instance bladder tumors via sonographic imagery with transurethral scanners. K. Matouschek was one of the first to do so.

As for attempting to grasp the various strands of endoscopic history in the 1980s, we divide the subject into two distinct periods: 1) before 1987 and 2) after 1987's laparoscopic cholecystectomy. Although Muhe actually was responsible for the true revolution in gall bladder surgery that began in this era, with his 1985 work, we still must use the year 1987 as a dividing point, due to the unfortunate lack of attention that Muhe's work received at the time.

Unfortunately at the same time in the early to late 1980's, there was significant resistance in the United States against operative laparoscopy. It took 5 years before Dr. Camran Nezhat was able to present his laparoscopic treatment of extensive endometriosis in 1985. This was at the combined Canadian and American Fertility Society in Toronto, Canada. His paper was finally published in 1986 in Fertility and Sterility. At that time he reported laparoscopic treatment of Stage IV Endometriosis. As Dr. Camran Nezhat was not able to publish his work, he started teaching operative laparoscopy on his own beginning September of 1983. Over the years, more than 10,000 physicians from all over the world have attended his workshops. In collaboration with colorectal surgeons and urologists

and GYN oncologists he was performing procedures far more challenging than cholecystectomies in the mid to late 1980's.

The 1980s
In the late 70s and early 80s operative laparoscopy for the mild pelvic pathology like ectopic pregnancy, ovarian cysts, oopherectomy, pregnancy, small myoma and adhesions were routinely performed by different surgeons world wide like Semm in Germany, Muhes and Bruhat and his group in France and Gomel in North America. Like the first introduction of laparoscopy in the form of looking through the scope directly, there was an equally exciting explosion of innovation following the introduction of operative video-laparoscopy.

1985 - Erich Muhe
Erich Muhe, of Erlangen, Germany, was years ahead of the pack when in 1985 he audaciously re-imagined a way to surgically remove diseased gallbladders. Using an instrument he designed himself, which he dubbed the "galloscope," and relying on the monitoring systems and other instrumentation from Semm's, Muhe completed the world's first ever completely laparoscopic removal of a gallbladder in less than two hours. By 1987, Muhe had performed almost 100 endoscopic laparoscopic cholestectomies, giving Muhe himself reason to call the procedure "magic."

However, that's not what the German Surgical Society thought. Muhe's 1986 presentation to the Congress detailing what he had achieved was met with great skepticism and even scorn. Indeed, his work was so misunderstood at this time it was called into question by German authorities, which eventually led to a full blown censure by the courts stemming from a lawsuit against him which alleged "improper surgical action." Muhe's work was then ignored for the next several years. It was only in 1992 that the German Surgical Society exonerated his work. The excellent and extensive research about Muhe by Litnski uncovered an excellent quote by the Congress' President from 1993, apologizing to Muhe:

"I am especially pleased that your pioneering effort received clear recognition at the Congress of German surgeons in Munich… this is without a doubt one of the greatest original achievements of German medicine in recent history."

Conclusion Muhe
Muhe's surgical skill was in the category of virtuoso. Yet his engineering genius was equally impressive. The scope he custom made especially for the gallbladder surgery had been improved considerably. It featured a laparoscopic opening of 30 mm and improved circular illumination. Muhe's technique different from Mouret's in the use of video cameras, which Muhe chose not to use at the time since that technology was in its developmental stages. There is some question in the record recently about whether Muhe or antoher laparoscopist named OD Lukichev of Russia was the first to perform a laparoscopic cholecystectomy. While Lukichev came close to achieving this procedure in 1983, ultimately he was not able to actually perform the entire operation laparoscopically. Therefore,

Muhe is still confirmed today as the first ever to laparoscopically remove the entire gallbladder.

Mouret
Mouret gained worldwide preeminence in 1987 by performing the first *video-assisted* laparoscopic cholecystectomy. The effects of this one day reverberated throughout the entire field of surgery, medicine, and beyond. In the aftermath of this revolution, not only had every single discipline of endoscopy been affected, but most astonishingly, the entire field of general surgery was transformed right down to its very core.

Indeed, we had arrived at *the* ultimate turning point in the history of laparosocopy. There is simply no other singular moment that encapsulates all that the minimally invasive movement had been leading toward all those years.

Mouret's surgery took place in Lyons, where a team of French surgeons had been working for some time on early laparoscopic development. Indeed, even before 1987, in 1983 Mouret had actually hit another milestone by becoming the second person in history (after Semm) to perform a laparoscopic appendectomy. And his earliest work began in the late 1960s and early 1970s with using the laparoscope for diagnostic gynecological procedures.

For the 1987 laparoscopic cholecystectomy Mouret used standardized instrumentation (for gynecological laparoscopy), rather than designing his own instrument as Muhe had. It is astonishing to think that Mouret's work was also not initially regarded as a crucial contribution, possibly as a consequence to his choosing not to publish, or perhaps because he was a private surgeon as opposed to one affiliated with a university.

Conclusion Mouret
The remarkable moment in laparoscopy history, brought to life by Mouret's dedication to the discipline, launched countless other developments since that time. Through years of friendly collaboration, the French team of laparoscopists from Bordeaux came to learn just about all there was to know about endoscopic affairs at the time and as Mouret himself would agree, this environment of exchange played a significant role in bringing about the events of 1987. And what appeared to unknowing eyes as something that came from out of nowhere, Mouret's achievement was actually the culmination of centuries of struggles to develop technologies which could catch up to the great idealism that had imagined for the world the minimally invasive philosophy.

The French Team
After Mouret's debut, his efforts as well as those of Dubois and Perissat led others to refer to them as the "the French connection." Apparently, it was not until the mid-1990s that these pioneers got the full recognition for what they had accomplished.

Francois Dubois
Dubois had been advocating the method referred to as mini-cholecystectomy, which had been popular in France since the early 1970s. Yet after hearing of Mouret's method, he contacted Mouret to start to learn as much as he could about the procedure. After practicing in the lab, Dubois performed his personal first laparoscopic cholecystectomy in 1988.

Jacques Perissat from Bordeaux, France
During the same time period as Dubois and Mouret, Perissat had his attention on the extracorporal shock wave lithotripsy that had been all the rage at the time, long before the laparoscopic cholecystectomy. At some point he decided to experiment with an intra-corporal method and choose the laparoscope to facilitate this new idea. Perissat had already been exposed to the work of Palmer and had gained clinical experience with Palmer's methods.

1988 - The Americans and Their First Laparoscopic Cholecystectomy
Within a year of Mouret's show-stopping surgery, a heightened pitch of promise was in the air for general surgeons. These moments represented unprecedented change for the medical community in general, causing a raucous swing-vote shift toward the minimally invasive mindset. It was like rock star fever had entered the operating theater. General surgeons flocked to weekend crash courses on operative videolaparoscopy, which had sprung up seemingly overnight. The year 1988 turned out to be the great flashpoint of change for American general surgeons. In 1988, the first US laparoscopic cholecystectomy was performed by J. Barry McKernan and Saye of Marietta, Georgia.

McKernan was Chief of Trauma surgery, and Saye was head of the Department of Obstetrics and Gynecology. Saye was also deeply influenced by seeing the work of Nezhat at post graduate endoscopic gynecology seminars and a live surgery demonstration in Atlanta where Nezhat presented a video presentation on his video laparoscopic treatment of extensive endometriosis. After these first moments of awakening, the rest is simply history. McKernan apparently purchased on his own credit the entire set of new instrumentation needed for his OR. Shortly after McKernan and Saye's first laparoscopic cholecystectomy, Eddie J. Reddick and Olsen (Nashville, Tennessee) performed theirs. Their work however was said to be more influential in popularizing and refining the procedure. Reddick and Olsen made significant new developments in technique, including a refined technique of laparoscopic cholangiography. Reddick earlier had been teaching courses in laser surgery. By the end of the 1980s, Dubois (Paris), Perissat (Bordeaux), and Nathanson and Cuschieri (Scotland) had performed laparoscopic cholecystectomy at their respective institutions.

Intro to Late 1980s
By the late 80s, the laparoscope was mainly a gynecologist's tool, and from this discipline, audaciously re-imagined innovations poured forth from a superstar slew of uber-surgeons, which kept the newsreels rolling about the new sci-fi surgery, which continued to keep the world enthralled. By the late 1980s, new

technologies were being developed which would allow for advanced operative procedures. Semm was spectacularly productive in the 1980s, introducing severeal new morcellators, which could morcelate fist-sized myomas. These developments continued to pave the way toward what was now the inevitable operative frontier. Nezhat and Semm were invited to a debate in Amsterdam, Holland in which Nezhat argued for operating on the monitor using video and Semm argued for operating directly through the laparoscope. This was a friendly debate which the then young turk Nezhat won against the established Semm.

CO2 Laser

A key element in this pioneering orchestra of surgical collaboration and operative technique is the CO2 laser beam. Bruhat et al. (1979) in France and Tadir et al. (1981) in Israel initially used the CO2 laser laparoscope. Later different surgeons across the world including Dan Martin, Bill Kelley, Jim Daniel in the U.S., Chris Sutton in England, Jack Donnes in Belgium and others were among the pioneers in Gynecology whom in their own countries used advanced laparoscopic operative techniques.

1989 - The Second International Symposium in Atlanta Georgia

The second international conference for endoscopic surgery, this time held in Atlanta, was described as a boat-rocking success and represented the moment in which, finally, general surgeons became convinced of operative laparoscopy as the future of surgery. As mentioned previously, before the introduction of laparoscopic cholecystectomy, gynecologists were performing some of the most advanced laparoscopic procedures. For example, in 1985, '86 and '89, Dr. Camran Nezhat and his colleagues reported laparoscopic treatment of Stage IV Endometriosis involving the bowel, bladder and ureters which he had been routinely performing for years. Through his collaboration with colorectal surgeons and urologists, he was able to reveal through seminars all over the U.S. and Europ,e years before the laparoscopic cholecystectomy, that even the most extensive pathology (including GI and GU resections) can be managed laparoscopically.

Conclusion 1980s

The 1980s was a time of great transition, which naturally causes a sense of disruption to the comforts of tradition. On the one hand, there was no question that laparoscopy was here to stay. By 1986 laparoscopies were in fact the most frequently performed procedure by Ob-Gyns in North America. Yet, simultaneously, some of the most heated debates began to simmer in the 1980s. Nothing elicited fiercer debating than whether to move laparoscopy into more advanced operations. It’s a debate that takes place even today. An example was the removal of ectopic pregnancies, which had been achieved by 1975. Despite the proof that they could be removed, even some of the most influential textbooks of the era did not advocate this method. For instance, Wheeless’ 1988 textbook advises the open method to remove ectopic pregnancies.

CHAPTER 24. 1990'S

Introduction

STOP…pretending you don't want me.
-On a t-shirt, somewhere in L.A.

The 1990's witnessed wide acceptance of laparoscopic surgery. This resulted in dramatic explosion of its applications: Patrick O'Regan and Nezhat, advanced the use of laparoscopic appendectomy. Edward Phillips and Jean Dulucq developed a peritoneal laparoscopic hernia repair. Videolaparoscopic nephrectomy was first reported in 1992 by Ralph Clayman and repair of the ureter by Gomel. Videolaparoscopic ureterouretrostomy, ureteroneocystatomy, and psosas-hitch procedures were reported by Nezhat. Bladder resection was reported by Nezhat in 1991. Dallemagne, in 1991, performed the first laparoscopic truncal vagotomy for treatment of peptic ulcer disease. Harry Reich reported on laparoscopic hysterectomy and Jack Donnez along with Harry Hasson and Tom Lyon on laparoscopic supracervical hysterectomy. Phillip Konick, Peter Mohr, David Redwine, Paul Devroy, Ivo Brosun, Jorge Keckstein Arnold Wattiez, Michele Nisolle, Shlomo Mashiah and Daniel Seidman were among physicians who reported about the laparoscopic management of extensive endometriosis. A large body of work on pelvic floor disorders was reported T. Vancaille, CY Lu and William Saye and others. Nezhat, Jacobs, Redwine, Wexler, and others, reported laparoscopically assisted colectomy. In 1992, Goh described the first laparoscopic Billroth II gastrectomy, adrenelectomy, and laparoscopic splenectomy Pelvic lymphadenectomy was reported first by Daniel Dargant, and Querlo in France and paraortic lymphadenectomy by Nezhat and Childers in this country. Nezhat and colleagues, in this country, and Cainis in Clearmont, France, first reported radical hysterectomy in the late 1980s and early 1990s; M.A. Pelosi introduced novel laparoscopic techniques of single port laparoscopy; GA Vilos advanced hysteroscopic techniques; Anton Langebrekke made significant contributions for advanced operative procedures; Jacques Donnez and Hasson performed one of the first laparoscopic supracervical hysterectomies.

Dazzling technological advances took center stage during this era. The first laparoscopic robotic procedures were performed by T. Falcone, J. Goldberg, A. Garcia-Ruiz, H. Margossian, L. Stevens, a procedure which was called "full robotic assistance for laparoscopic tubal anastomosis." In 1996, the first live telecast of laparoscopic surgery performed remotely via the internet was achieved (robotic telesurgery).

Society of Laparoendoscopic Surgeons (SLS) - 1990

The growing international popularization of endoscopic surgery raised the need for organized communication among those who were experts in their field and those who wanted to gain entry into the endoscopic fold.

Stop: There was someone out there optimistic enough to think he could convince surgeons from different disciplines to come together- in the same room?! Indeed, there are miracles in medicine after all and Team SLS proved it. It was Paul

Wetter, along with Janis Chinnock, and other colleagues, who envisioned with remarkable foresight the need for a multi-disciplinary approach to advance endoscopy even further.
Yet transforming this movie from someone's head into a living force is where grit and glory came into play. It would take the transmutation of Warren Buffett's business brain, spiked with a garnish of Gandhi, Picasso and Patrick Henry (for peaceful, artistic audacity) to get this baby off the ground. And it did. And it has served to inspire us ever since. And the un-believers stood stunned to tatters. Just ten years from its 1990 debut, SLS had achieved an international following of nearly 10,000 members, organized wildly popular conferences throughout the world, and launched the most widely circulating journal ever focusing exclusively on all things endoscopy.

Ultimately, this organizational innovation proved to be one of the most crucial factors for driving forward the collective success of endoscopic development in general, for it encouraged us to come together so that we could gain insight from one another as we embarked into the great unknown.

Backlash, 1990s Style
The mid-1990s witnessed another era of resistance, perhaps of a more virulent strain. The advanced operative procedures that were just coming into their own at this time were disparagingly referred to as "experimental surgery," which had no data to support their efficacy. An article written in 1994 sums up the concerns succinctly when the author stated:

"An increasing number of endoscopic procedures have been described in recent years, developed largely with the goal of providing less invasive and more cost-efficient surgical treatments than are currently available by more traditional approaches. However, this growing subspecialty of endoscopic surgery has largely been developed and advocated by a relatively limited number of vocal proponents, supported by an eager and aggressive medical instrumentation industry….But have they accomplished the goals of less invasiveness and more cost efficiency? More importantly, what happens when large numbers of less-skilled and less-experienced surgeons begin performing these procedures?" – D. Smith et al, A hospital review of advanced gynecologic endoscopic procedures, 1994

The point about less-experienced surgeons was not without merit in some respects. The training efforts couldn't always keep up with the rapid development of new procedures. One of the latest, laparoscopic-assisted vaginal hysterectomies, was the subject of especially heated debates. In this 1994 study, laparoscopic-assisted vaginal hysterectomies for instance were found to have up to a 60% complication rate. A prominent Wall Street Journal article in 1999 was published, highlighting the fact that "keyhole" surgery had backfired for heart surgery, sending another wave of incertitude to be unleashed concerning the laparoscope's perceived shortcomings.

After some of these and other negative reports came out, laparoscopy was on its heels, defense tips in tow. This became the moment in time when lap was deemed practically the antithesis of science and sanity, when it seemed that teams of frenetic forensic investigatiors would raid the literature hoping to catch a laparoscopy in the middle of a complication. The critics bemoaned that this so-called wild band of “free wheeling laparoscopists” were out loose, roving about looking for an opportunity to insert their tiny incisions.

Conclusion History of Laparoscopy
The dream of reason produces monsters; imagination deserted by reason creates impossible, useless thoughts. United with reason, imagination is the mother of all art and the source of all its beauty.
-Goya

It is rare that in our lives we can become the products- as well as pioneers on occasion– of a scientific movement that has come to be seen as one of the most important developments of 20th century medicine. This journey toward the new order of things, shifting as it did between peril and promise, was not a painless transformation.

Perhaps of even more lasting significance, the painful transformation from the old ways of open surgery to minimally invasive modalities set off an intense scientific and philosophical debate about just where the upper bounds- if any- of operative laparoscopy should end. It forced a reconsideration of the entire field of surgery, a change that called for every aspect of surgical methodologies to be thoroughly scrutinized. And it wasn’t just strictly the category of surgery that was reevaluated. Rather, questions arose having to do with a wide range of aspects concerning medicine, patient rights, and disease-states. New concepts relating to pain management for patients emerged as one of the most important changes to have come about due to the minimally invasive movement. As well, an eventual rethinking in expectations about surgical outcomes arose. Complications once considered unavoidable in the days of open surgery were suddenly reevaluated and revised in the minimally invasive era.

Still, as laparoscopists, our advocacy work to perfect and promote minimally invasive surgery is not done. There are still too many patients who are enduring needless open procedures. For example, in 1997 66.8% of hysterectomies performed in the U.S. were still done via laparotomy. Statistics from 2004 estimate that more than 7 million laparotomies(in all disciplines of surgery vs. 2.5 million laparoscopies) are performed for benign conditions in the US each year, with abdominal hysterectomies accounting for 500,000 of those cases, and another 500,000 accounting for unspecified cases (excluding the 1 million Cesarians).

Nevertheless, humankind is closer than ever to the ideal of performing the most advanced operative surgeries through the least traumatic incisions. For this reason, the nearly complete triumph of minimally invasive surgery has turned out to be one of the greatest achievements of 20th century medicine. More than

that, it transformed into one of the world’s most important human rights movements, a change which touched the lives of millions of patients who had suffered too long in the shadows of silence.