

Breakthrough!

How the 10 Greatest Discoveries
in Medicine Saved Millions and
Changed Our View of the World

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Introduction

It's tempting to start right off with an apology for the word "breakthrough," a word that—depending on your point of view—can be as tedious as an overhyped headline or seductive as a brightly wrapped gift. Either way, it's hard to resist wondering, *What* breakthrough? A cure for cancer, an easy way to lose weight, the secret to living forever? But this isn't *that* kind of book, and apologies seem unnecessary when you're talking about the ten greatest breakthroughs in *all* of medicine. Sadly, none involve easy weight loss or living forever. However, all are arguably *more* important because they meet three essential criteria: 1) They saved, improved, or reduced suffering in millions of lives; 2) They changed the practice of medicine; and 3) They transformed our understanding of the world. That last item is too often overlooked. All medical "breakthroughs" profoundly impact health and how physicians work; far rarer are those that open our eyes to a fundamentally new way of seeing the world, giving new meaning to not only such questions as, Why do we get sick, and how do we die? but also, How are we put together and what connects us to the rest of nature?

Each of these ten breakthroughs came at a time in history when they struck humanity like a thunderbolt—a jolt of awakening followed by a palpable rise in human consciousness. *What?* Illness is caused by natural forces and *not* evil spirits or angry gods? Inhaling certain gases can take away pain and *not* kill the patient? A machine can take pictures of the *inside* of your body? We often take it for granted today, but at one time, millions of people couldn't believe what they were hearing. They *refused* to believe it. Until they finally did. And then the world would never be the same.

Critics often have a field day with top ten lists. Motives are immediately suspect, every selection second-guessed, many "better" alternatives offered. But objectivity tends to crumble when one tries to measure how much any one discovery has impacted suffering, illness, and death. Nevertheless, one valid criticism is that top ten lists are overly simplistic. In

our celebrity-obsessed times, the spotlight's glare on a handful of superstars too often blinds us to the many individuals who helped pave the way. Yet what often makes a great discovery most fascinating is understanding the many smaller steps that often made the final "leap" possible. This book celebrates these steps and shows how—milestone by milestone—they led to ten final breakthrough discoveries.

Don't embark on these journeys expecting tales of calculating genius and easy success. In fact, the greatest breakthroughs in medicine represent a wildly unpredictable collage of human stories and emotion. Even if you're not surprised to learn how many discoveries relied on one individual's dogged persistence despite failure and repeated rejection, you may be shocked to learn how many discoveries resulted from sheer dumb luck, if not divine intervention. The number of "coincidences" that led to Alexander Fleming's discovery of penicillin might tempt some atheists to reconsider their assumptions. Also surprising is how many individuals had no idea their work would one day lead to a major breakthrough. One example is Swiss physician Friedrich Miescher, who discovered DNA in 1869—more than 70 years before scientists would figure out its role in heredity.

But though ignorance in the pursuit of truth is forgivable, it's harder to sympathize with those throughout history who ridiculed a discovery because fear and rigid thinking prevented them from letting go of outdated beliefs and tradition. The examples are many: from the rejection of the pioneering work in germ theory by John Snow and Jacob Semmelweis in the early 1800s to the dismissal of Gregor Mendel's laws of genetics in the 1860s when—despite ten years of hard work—one eminent scientist snorted that Mendel's work had "really just begun." No doubt, many of the greatest discoveries in medicine were made by courageous individuals who dared shake the foundations of a long-held, and usually wrong, view of the world. And no surprise that, once the discovery was finally accepted and solid footing regained, the world found itself in a very different place.

* * *

And yet the nagging question remains: why *these* ten breakthroughs and *these* rankings? If you have other ideas and some free time on your hands, you could try creating your own list by, for example, typing "medical breakthrough" into Google. However, you might want to set aside

the morning to narrow down your choices from the *2.1 million* hits that came up in one search conducted in 2009. Fortunately, my task was simplified by a 2006 poll conducted by the *British Medical Journal (BMJ)* in which readers were asked to submit their nominations for the greatest medical breakthrough since 1840 (the year the *BMJ* was first published). After receiving more than 11,000 responses, votes were narrowed down to a final 15.

Entries that did *not* make the *BMJ*'s final 15 ranged from the disingenuous (plastic, the iron bedstead, the tampon, Viagra, and the welfare state) to the sincere (blood tests, the defibrillator, clot-busting drugs, insulin, nurses, and caring for the terminally ill). However, the final 15 had a curious feel of being both idiosyncratic *and* (mostly) right: 1) sanitation (clean water and sewage disposal); 2) antibiotics; 3) anesthesia; 4) vaccines; 5) discovery of DNA structure; 6) germ theory; 7) oral contraceptives; 8) evidence-based medicine; 9) medical imaging (such as X-rays); 10) computers; 11) oral rehydration therapy (replacement of fluids lost through vomiting and diarrhea); 12) risks of smoking; 13) immunology; 14) chlorpromazine (first antipsychotic drug); and 15) tissue culture.

The *BMJ*'s top 15 is fine but hardly the final word. Another list published in 1999 by the Centers for Disease Control and Prevention's publication *Morbidity and Mortality Weekly Report (MMWR)* offered an interesting twist with its "Ten Great Public Health Achievements" in the United States from 1900 to 1999. The *MMWR* did not rank its selections but shared some similar items with the *BMJ* list (vaccines and "control of infectious diseases"), while offering some other valid entries, including improvements in motor vehicle and work place safety, safer and healthier foods, declines from heart disease and stroke, and recognition of tobacco use as a hazard.

While the *BMJ* and CDC lists influenced my selection of the top ten breakthroughs, both had limitations, such as excluding medical breakthroughs before 1840 (a decision Hippocrates and a few others might take issue with). In addition, it seemed more interesting and relevant to morph the *BMJ*'s "discovery of chlorpromazine" into the more inclusive "Medicines for the Mind." As described in Chapter 9, this breakthrough covers one of the most remarkable ten-year periods in the history of medicine: From 1948 through the 1950s, scientists discovered drugs for the four most important mental disorders to afflict the human race: schizophrenia, manic-depression, depression, and anxiety.

Another question likely to arise when considering the “top ten” of anything is: What’s *that* doing there? For example, many people associate “medical breakthroughs” with various technological marvels (MRI imaging, lasers, artificial body parts), surgical feats (organ transplants, tumor removal, angioplasty), or miracle drugs (aspirin, chemotherapy, cholesterol lowering agents). Yet, while one can point to numerous examples in each of these categories, none rank among the top ten when the previously mentioned criteria are considered. In fact, it’s interesting to note that two of the *BMJ*’s top 15 rankings are decidedly *low-tech*: sanitation (#1) and oral rehydration therapy (#11). Yet both are clearly high-yield in terms of lives saved. It’s estimated, for example, that over the last 25 years, oral rehydration therapy has saved the lives of some 50 *million* children in developing countries.

Along the same lines, others may argue *against* some of the breakthroughs included here, such as the rediscovery of alternative medicine. I’m thinking of one former editor of the *New England Journal of Medicine* who declined to review this book in part because “There is no such thing as ‘alternative medicine’—only medical methods that work and those that don’t.” I understand the point but respectfully disagree. There are many ways of addressing the pros and cons of alternative medicine—some of which I hope are reasonably covered in Chapter 10, “A Return to Tradition.” However, when all factors are considered from a larger perspective—a very large canvas that covers pretty much all of human history—I stand by its inclusion.

The first and easiest explanation for including alternative medicine is to point to the partnerships now forming between alternative medicine and scientific medicine and the recent birth of a new philosophy of healing that draws on the best practices of *both* traditions. This new and rapidly developing field, called “integrative medicine,” is now supported by many practitioners in both alternative and scientific medicine. A second point is that even lacking the methodology of scientific medicine, alternative medicine has had a remarkably positive effect on the health and spirits of millions of people who don’t necessarily subscribe (or prescribe) to a purely Western scientific model of health and disease. But a third and perhaps more important point is that taking a closed-minded view toward nonconventional approaches to medicine has an uncomfortable feel to it, a queasy reminder of lessons learned throughout the

history of medicine, as taught to us by those who rejected William Harvey's theory of circulation, the value of René Laennec's stethoscope, Edward Jenner's vaccine for smallpox, the theory that germs can cause disease, Mendel's laws of genetics, the value of ether in surgery, the idea that penicillin can stop bacterial infections, that...

Well, you get the point.

* * *

Perhaps the best thing about the top ten breakthroughs in medicine is the stories they reveal about people from all walks of life—physicians, scientists, patients, and ordinary folk. The stories cover a wide range of emotion, from the disbelief and awe of witnessing a deep secret of nature suddenly revealed, to the relief and joy of discovering a new tool that saves patients from pain and certain death. But always, they are the stories of how the human spirit pushes the boundaries of knowledge in new and surprising ways, such as:

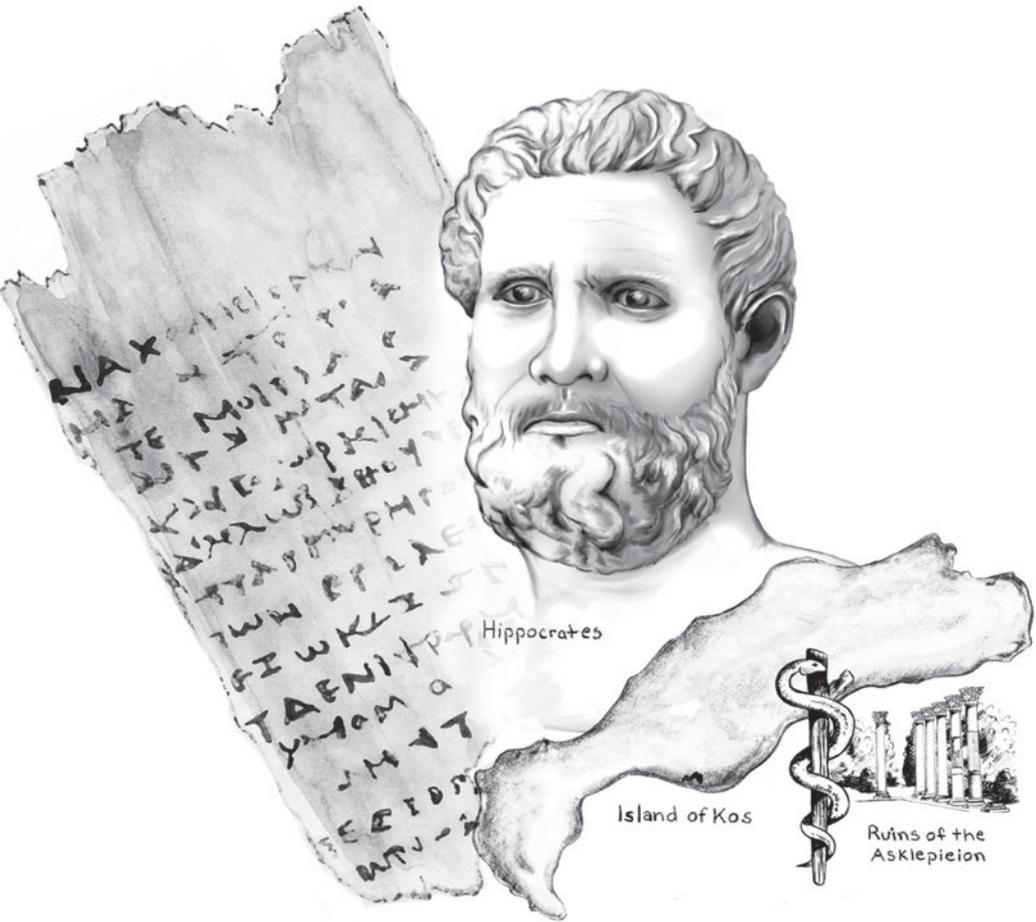
- Hippocrates, who invented clinical medicine with his painfully detailed observations of patients like the boy from Meliboea, who died a slow and agonizing death “as a result of drunkenness and much sexual indulgence.”
- Physician Ignaz Semmelweis, who returned from vacation to learn that he'd lost his close friend to a disease that was supposed to only affect women and who was subsequently struck by an insight that would save countless lives.
- The youths in the early 1800s who inhaled experimental gases and indulged in “frolics” and “jags,” unaware that their experiences would help pave the way to the discovery of anesthesia.
- Farmer Benjamin Jesty who, 20 years before Edward Jenner “discovered” vaccines, led his family into a cow pasture and vaccinated them against small pox based on a hunch and an old wives' tale.

It's often moving to read the stories of people who couldn't imagine how their efforts and suffering would one day impact millions of lives and change our view of the world. Ironically, we're just as much in the dark today every time we learn of a new discovery, whether in the news or among the two million hits that come up in a Google search. No one can say which will stand as a true breakthrough two years, much less two

centuries, from now. Quite possibly, it will be tomorrow's discovery of a new cancer cure, easy weight loss, or infinite longevity. In the meantime, here are ten that we *know* have stood the test of time. Without them, we might not have the luxury of such speculation—or perhaps of having been born at all.

The World's First Physician: 1

HIPPOCRATES AND THE
DISCOVERY OF MEDICINE



The Greek island of Kos, located in the crystal clear waters of the Aegean Sea and bordered by 70 miles of golden beaches, might be one of the best spots on the planet to fall ill—or to simply remain well.

Part of a 12-island archipelago, Kos is 200 miles southeast of Athens and just a few miles off the southwest coast of Turkey. Long, narrow, and verdant with lush foliage, the island is flat except for two low mountains along its southern coast. But it is in the town of Kos, an ancient village on the northeastern coast of the island, where the magic and medicine of this island begin.

It is tempting to speculate that the legendary history of Kos arises from its nurturing rich soil and abundant groundwater: Visitors entering the village are greeted by a lush landscape of tall palms, cypresses, pine trees, jasmines and, for an added splash of color, the bright reds, pinks, and oranges of the hibiscus. But if you want to locate the true pulse of Kos and its 2,500-year-old legacy, you must continue your journey...

First, face west and walk two and a half miles out of the village. There, amidst more lush landscape, you will approach a sloping site. Hiking up this slope, you pass an extensive complex of ancient ruins that rise around you in a series of terraces. Put aside your curiosity and continue to climb. Before long, you will arrive at a pinnacle. Gazing out from this high point, you stop flat in your tracks: The world has split apart.

Spread out before you is a breathtaking view of the Aegean seacoast. Inhaling the fresh coastal air, you feel the stirrings of the true spirit of this small island, the mystery of where two worlds meet. One, the “inner” world, is simply you: the tightly wrapped sac of blood and bone, emotion and mind, which is your body. The other “outer” world is merely every other thing in the physical universe surrounding you.

If you ponder for a moment the possibility that two such worlds not only exist, but co-exist in a place we may not yet fully understand, then congratulations. You have finally begun to arrive, physically and metaphysically, on the island of Kos. For this is the place where, in the view of the world’s first “rational physician,” all life, death, health, and disease—and hence the practice of medicine and healing itself—begins.

* * *

This ancient site is known as the Asklepieion, the generic Greek word for any “healing temple.” But the Asklepieion of Kos is a temple like no other. Although today a crumbling ruin of broken walls, roofless chambers, and lonely columns supporting only air, in its heyday this was a

bustling center of healing. Here patients in all stages of sickness and injury sought the best treatment they could find.

If you were suffering from disease or injury and arrived here in the fifth century BC, over the course of days and weeks you would have progressively ascended each of the four terraces that scale these grounds, each level dedicated to a different stage of diagnosis, counseling, and healing. Apart from simple relaxation, your treatment might have included bathing in large pools, being massaged with perfumes, oils, and ointments, following a regimen of mental and physical exercise, receiving diet counseling, herbs and other oral drugs, and commiseration with the ancient spirits.

Oh, and one more thing. If you happened to check in sometime between 490 and 377 BC, you might have received one more benefit: a visit from the world's "first" physician, a man not only credited with inventing the practice of medicine, but whose insights have remained influential for well over two thousand years.

* * *

Most of us have a distinct yet vague impression of who Hippocrates was. The phrase "Father of Medicine" often (and accurately) jumps to mind. And of course, there is the Hippocratic Oath, which we know has something to do with doctors behaving nicely. On the other hand, it should be noted that Hippocrates bears no connection to the similar-sounding "hypocrisy." Though also Greek in origin, hypocrisy is from *hypokrisis*, which means "playing a part" or, as commonly used today, someone who is a phony.

Which Hippocrates certainly was not.

Who was Hippocrates, and how did earn the mantle of "Father of Medicine" as well as credit for the "Invention of Medicine"?

Perhaps one measure of an individual's greatness is when the question is not so much how their "breakthrough" compares to another, but rather, *which* of their many breakthroughs one should select to make the comparison. For Hippocrates, the list is substantial and includes being the first physician to

- Recognize that diseases have natural causes, rather than their arising from supernatural or evil forces
- Invent "clinical medicine" and the "doctor-patient relationship"

- Create an oath of conduct that has remained influential for 2,500 years
- Elevate the practice of medicine to an honored profession, rather than a conventional trade like plumbing or roof repair
- Achieve many other medical breakthroughs, including recognizing that thoughts and emotions arise in the brain rather than the heart

And yet...

* * *

Some time around 440 BC a young physician eager for knowledge crossed the narrow body of water separating his island home from what we know today as southwestern Turkey. Reaching land, he made his way 50 miles north to an area known as Ionia. Entering the city of Miletus, he met with the well-known philosopher Anaxagoras. Famed for introducing philosophy to the Athenians, Anaxagoras was also the first person to recognize that the moon's brightness is due to reflected light from the sun. The ensuing conversation must have been interesting. On the one hand, Hippocrates was a reputed descendent of Asklepius, the god of healing and son of Apollo. On the other hand, Anaxagoras was likely unimpressed by religious tradition: In 450 BC he had been imprisoned for insisting that the sun was not a god. While this outrageous claim may have raised the hackles of any other healer from Kos, more likely it set a twinkle in the eye of young Hippocrates. And an invitation to sit down for a chat...

* * *

And yet among the many “firsts” commonly attributed to Hippocrates, one breakthrough at the core of his teachings is often forgotten or overlooked today. Perhaps this lapse is due to its paradoxical nature, the fact that it both opposes yet resonates with the way medicine is often practiced today. What was this additional breakthrough? Before answering, we need to learn more about this man and his place in history.

The making of the man: 19 generations of healers and 3 first-rate legends

In today's high-tech world of CAT, MRI, PET, SPECT, and other cryptic visions, of the increasing specialization and molecularization of medicine, of all manner of pharmacopeia from the fitful to the fatal, we put a certain amount of trust in the rituals of modern medicine. We are comforted by hospital rooms where patients are anchored to their sanitized beds by the wires and tubes of modern technology. If for some reason then, you were to succumb to an illness and wake up in the fifth century BC in a dim, oil-lamp-lit chamber to the sound of a priest moaning incantations over your hurting body, chances are you would be overcome by a distinct lack of confidence, if not terror.

Hippocrates may well have felt the same.

Yet, born on Kos in 460 BC, this was the world in which he was raised. Like many doctors today, Hippocrates came from a line of physicians who had been practicing “medicine” for generations. For starters, he was trained in medicine by his father, Heracleides, his grandfather, and other famous teachers of the time. But this is being too modest. In fact, his family also claimed that the tradition of medicine had been in their lineage for no less than 19 generations, dating back to Asklepieios, the demi-god of healing. Deities aside, Hippocrates' early view of medicine was probably influenced by a long, long ancestry of religious healers and priests.

If you're thinking that claiming to be the nineteenth-generation descendent of the god of healing on your medical school application might strain the limits of credulity—or, conversely, that it might be just the edge you need for acceptance—several caveats are in order. First, surprisingly few undisputed details are known about the life of Hippocrates. Although a large body of writings attributed to Hippocrates have survived—some 60 works collectively known as the *Corpus Hippocraticum*, or simply Hippocratic Corpus—there is considerable debate as to which are genuine works of Hippocrates versus the embellishments of the many admirers who expanded on his school of thought decades and even centuries after his death. Nevertheless, by comparing and analyzing the documents, historians have patched together a reasonably credible account of Hippocrates and his accomplishments.

To be honest, three of the most colorful stories about Hippocrates are probably rooted as much in legend as they are truth. But even if only partly true, they provide insight into the man Hippocrates may well have been, a man whose reputation was sufficiently formidable to spread beyond his own small island to the distant lands of his own enemies.

The first and perhaps best known story is set in 430 BC during the Peloponnesian War. Shortly after being destroyed by the Spartans, a plague broke out in the city of Athens. Hippocrates and his followers traveled to Athens to help. Observing that the only people not affected by the plague were iron smiths, Hippocrates made an astute deduction: Their resistance must somehow be related to the dry, hot atmosphere in which they worked. He promptly wrote up his prescription. The citizens of Athens were to light fires in every home to dry the atmosphere, to burn corpses, and to boil all water before consumption. The plague retreated, and Athens was saved.

The second story is often cited to highlight Hippocrates' remarkable diagnostic skills, which ranged from the physical to the psychiatric. Shortly after the Athenian plague, King Perdiccas of Macedonia, aware of Hippocrates' growing reputation, requested the physician's help when no other doctor could diagnose his vexing symptoms. Hippocrates agreed and traveled to Macedonia to see the king. During the examination, Perdiccas blushed whenever a beautiful girl named Phila—who was his father's concubine—was nearby. Hippocrates took note. Upon further inquiry, he learned that Perdiccas had grown up with Phila and dreamed of one day marrying her. This dream was shattered when his father took the girl as his concubine. However, the recent death of his father reawakened Perdiccas' conflicted feelings of love for Phila, causing him to fall ill. After subsequent counseling by Hippocrates, the king was cured.

The third story, a testament to Hippocrates' loyalty, took place when Greece was at war with Persia. By this time, Hippocrates' reputation was so great that Artaxerxes, the enemy king of Persia, requested that Hippocrates travel to Persia to save its citizens from a plague. Despite the king's offer of gifts and wealth "equal to his own," Hippocrates politely declined. Although sympathetic, it was against his scruples to assist the enemy of his country. The king gracefully responded with a vow to destroy the island of Kos—a threat that was put to rest, figuratively and literally, when the king suffered a stroke and died.

Legends aside, our investigation into the invention of medicine may be better served by looking at the achievements of Hippocrates as documented in the more scholarly writings of the Corpus. While historians continue to debate the authenticity of even these documents, said caveats having been acknowledged, we can venture into the territory where Hippocrates' "Invention of Medicine" can be attributed to six major milestones.

And yet...

* * *

While there is no record of the conversation between Hippocrates and Anaxagoras in that ancient city of Miletus, it's not hard to imagine that the young physician was beginning to question the medical tradition of his own family, with its lineage of demi-gods, superstitions, and priest healers. It wasn't that Hippocrates completely rejected their theocratic approach; he simply felt that in medicine and health, other truths were to be found. Thus, the reputation of Anaxagoras and his philosophy, which had reached even the small island of Kos, brought Hippocrates here to question and learn. Settling down in the shade of a tree outside the city, Hippocrates proffered a simple invitation. "You know of my background and tradition, Anaxagoras. Now tell me of yours..."

Milestone #1

Getting real: diseases have natural causes

"[Epilepsy] appears to me to be nowise more divine nor more sacred than other diseases... Men regard its cause as divine from ignorance and wonder."

—*Hippocrates, On the Sacred Disease, 420-350 BC*

Until the time of Hippocrates, the most commonly accepted explanation for the cause of essentially all illness was refreshingly simple: Punishment. Having been found guilty of some misbehavior or moral failure, the gods or evil spirits exacted their justice through sickness. Your

redemption, or “treatment” as we call it today, might include a visit to a nearby temple of Asklepieios, where the local priests attempted to cure your malady with incantations, prayers, or sacrifice.

At some point early in his career, Hippocrates changed the rules. Distancing himself from the Asklepiian priests and their theocratic approach to healing, Hippocrates insisted that diseases were caused by natural forces and not the gods. No statement better summarizes his view than the frequently quoted passage from one of the books attributed to Hippocrates, *On the Sacred Disease*. The title of this book—the first to be written about epilepsy—references the belief at the time that seizures were caused by the “sacred” hand of a displeased god.

Hippocrates begged to differ:

“It appears to me to be nowise more divine nor more sacred than other diseases, but has a natural cause like other affections. Men regard its nature and cause as divine from ignorance and wonder, because it is not at all like other diseases. And this notion of its divinity is kept up by their inability to comprehend it... Those who first referred this disease to the gods appear to me to have been just such persons as the conjurers and charlatans... Such persons, then, using divinity as a pretext and screen of their own inability to afford any assistance, have given out that the disease is sacred...”

In this and similar writings, we hear in the voice of Hippocrates not only the adamancy of his view that disease arises from natural causes, but the exasperation, if not contempt, he holds for the “charlatans” who would claim otherwise. Thus with such statements, and nothing more than his own mortal powers, Hippocrates wrestled disease from the supernatural and placed it squarely in the world of the rational and natural.

Milestone #2

It's the patient, stupid: the creation of clinical medicine

“His symptoms were shivering, nausea, insomnia, and lack of thirst... He was delirious, but calm, well-behaved and silent.”

—*Hippocrates*, *Epidemics 3*, 420-350 BC

The term “clinical medicine” embodies much of what we now like to think any good doctor practices. It includes everything from taking a detailed patient history, to performing a careful physical examination and recording of symptoms, to diagnosis, treatment, and an honest assessment of the patient’s response to that treatment. Prior to Hippocrates, the practitioners of medicine were not especially concerned with such details. Rather than focusing on the pains and woes of individual patients, early Greek physicians tended to take a one-size-fits-all approach, in which patients were subjected to ritualistic, predetermined, and highly non-individualized treatments. In changing that approach, Hippocrates founded the art and science of clinical medicine.

How does one invent “clinical” medicine? Some say that Hippocrates developed his clinical insights through exposure to a long and curious tradition in the Asklepieion of Kos. For many years, patients recovering from illness would inscribe in the temple an account of the help they had received so that it might be useful for other patients. According to this story, Hippocrates took on the task of writing out these inscriptions and, armed with this body of knowledge, established the practice of clinical medicine.

More likely, the clinical skills developed by Hippocrates and his followers were earned through hard work over the course of many years and many interactions with many patients. One vivid and typical example of these skills, recorded in the book *Epidemics 3*, involves a youth in Meliboea who apparently was no icon of Greek virtue. According to Hippocrates, the youth “had been feverish for a long time as a result of drunkenness and much sexual indulgence... His symptoms were shivering, nausea, insomnia, and lack of thirst.” Although not for the squeamish, the subsequent description of the youth’s demise demonstrates a skill of clinical observation that could stand as a model for any medical student today:

“*First day*: There passed from his bowels a large quantity of solid stools with much fluid. During the following days he passed a large quantity of watery, greenish excrement. His urine was thin, sparse, and of bad color. His respiration was at long intervals and deep after a time. There was a flabby tension of the upper part of the abdomen extending laterally to both sides. Cardiac palpitation was continuous throughout... *Tenth day*: He was delirious, but calm, well-behaved and silent. Skin dry and taut; stools either copious and thin or bilious and greasy. *Fourteenth day*: All symptoms exacerbated. Delirious with much rambling speech. *Twentieth day*: Out of his mind; much tossing about. No urine passed; small amounts of fluid retained. *Twenty-fourth day*: Died.”

Through such clinical observation—with its focus on individual patients and their symptoms—Hippocrates raised medicine from the dusky gloom of demons and rituals into the bright light of keen observation and thought. And it made perfect sense in the world view that Hippocrates had begun to shape: if diseases had natural causes, why not look more closely at symptoms for clues as to what those causes might be? What’s more, this new focus on individual patients paved the way for another component that we now regard as essential to good medicine: the “doctor-patient relationship.”

Milestone #3

A code of ethics that stands the test of time

“I will use treatments for the benefit of the sick to the best of my ability and judgment; I will abstain from doing harm or wronging any man by it.”

—*Hippocrates, Oath, 420-350 BC*

Among all the known writings from Antiquity, the *Hippocratic Oath* is considered by some to be second in authority only to the *Bible*. Adopted as a code of behavior by physicians throughout history, the *Oath* continues to influence many physicians today and is still frequently cited in scholarly journals and the popular press as *the* code of ethics for the proper practice of medicine.

Contained in a single page of text, the *Oath* begins with the physician swearing, “by Apollo the physician, and Asklepius...and all the gods and goddesses as my witnesses” to uphold the *Oath* and its contract. In subsequent statements, the physician is bound to uphold a variety of ethical and behavioral standards, including:

- Holding my teacher “equally dear to my parents” and being willing to “impart a knowledge of the art to my own sons”
- “Not giving a lethal drug to anyone if I am asked”
- “Avoiding any voluntary act of impropriety or corruption, including the seduction of women or men, whether they are free men or slaves”
- Keeping secret “whatever I see or hear in the lives of my patients, whether in connection with my professional practice or not.”

Although some biographies suggest that Hippocrates required his apprentices to swear by an oath before he would accept them as students, the origin of the *Oath* as we know it today is unclear and may have been rewritten a number of times over the ages to suit the needs of different cultures. In any case, the *Oath* was hardly the last word by Hippocrates on ethics and the proper practice of medicine. For example, in the book *Epidemics*, he offers one of his best-known maxims—one that most patients today would be happy to remind their doctors of while being trundled into the operating room:

“Regarding diseases, make a practice of two things—to help or, at least, do no harm.”

Milestone #4 Acting the part: professionalizing the practice of medicine

“He must be clean in person, well-dressed, and anointed with fragrant perfumes that do not in any way cause suspicion...”

—*Hippocrates*, Physician, 420-350 BC

Living in the twenty-first century AD, it is difficult to imagine how healers in the fifth century BC conducted their daily business. However, it

seems reasonable to assume that between the priests and their incantations and various peripatetic healers with their non-FDA approved ointments, the practice of medicine was fairly loose by today's standards. In various books and writings, Hippocrates changed this, too. Raising the practice of medicine from a common trade to a profession with rigorous standards, he provided advice in virtually every arena of medicine.

For example, recognizing that not everyone is cut out for medical training, Hippocrates cautions in one book:

“Whoever is going to acquire truly an understanding of medicine must possess the following advantages: natural ability, instructions, a suitable place for study, tuition from childhood, industry, and time. First of all, natural ability is required, for, if nature is in opposition, all is in vain.”

In another text, he describes a range of physical and personality traits physicians need to possess to successfully practice medicine:

“The authority of a physician requires that he is of healthy complexion and plump as nature intended... Next, he must be clean in person, well-dressed, and anointed with fragrant perfumes that do not in any way cause suspicion.”

In another text, however, Hippocrates cautions against the perils of vanity:

“You must also shun luxurious headgear with a view to procuring patients, and elaborate perfume too.”

What's more, the physician must be mindful of demeanor and the appropriate boundaries of laughter. “In appearance he must have a thoughtful but not harsh countenance; for harshness seems to suggest stubbornness and misanthropy. But, on the other hand, the man of uncontrolled laughter and excessive cheerfulness is considered vulgar. Such a disposition must especially be avoided.”

And what patient today would not be reassured by Hippocrates' formula for bedside manner?

“When you enter a sick man's room...know what you must do before going in... On entering, be mindful of your manner of sitting, and your reserve, your decorum, authoritative demeanor, brevity of speech, your composure, your response to objections, and your self-possession in the face of troublesome occurrences.”

As for the occasional troublemaker, Hippocrates advises,

“It is necessary also to keep an eye on the patient’s faults. They often lie about taking the things prescribed [and] die through not taking disagreeable potions.”

Despite his stern advice, Hippocrates’ underlying goodwill is unmistakable:

“Give what encouragement is required cheerfully and calmly, diverting his attention from his own circumstances. On one occasion rebuke him harshly and strictly, on another console him with solicitude and attention.”

And finally, when it comes to the sensitive issue of billing, Hippocrates reveals a spirit both sympathetic...

“One ought not be concerned about fixing a fee. For I consider an anxiety of this sort harmful to a troubled patient. It is better to reproach patients whom you have saved than to extort money from those who are in a critical condition.”

and charitable...

“Have regard to your patient’s means or wealth. On occasion, give your services free, recalling the memory of an earlier debt of gratitude...”

Milestone #5 The enigmatic Corpus: 60 books and a wealth of medical firsts

“Men ought to know that the source of our pleasures, merriment, laughter, and amusements as well as our grief, pains, anxiety and tears is none other than the brain.”

—*Hippocrates*, On the Sacred Disease, 420-350 BC

Much of what we know of the medicine of Hippocrates comes from the Hippocratic Corpus, a collection of about 60 manuscripts that covers virtually every aspect of health, from the inner (mind and body), to the outer (environment), to where the two worlds meet (diet and breathing).

Although the Corpus as we know it today dates back to 1526, a mere 500 years ago, accounting for its whereabouts in the preceding 2,000 years is a bit more problematic. Some historians believe that the manuscripts were initially assembled in the Great Library at Alexandria around 280 BC, possibly after they were recovered from the remains of the medical school library at Kos.

What *else* do we know about these manuscripts? On the perplexing side, their hodge-podge of mixed content, writing styles, chronology, and contradictory viewpoints suggests that they were written by multiple authors who lived before and after Hippocrates. On the other hand, though none of the writings can be definitively linked to Hippocrates, most were probably written around 420 BC to 350 BC, corresponding to his lifetime. Most intriguing, despite a pervasive lack of inner unity, the manuscripts share one crucial theme: a belief in rationality and a scorn for magic and superstition.

To get an idea of why historians are vexed in their attempts to make any generalizations about the Corpus, one needs only to consider the curious diversity of their titles, which include: *Nature of Man*; *Breaths*; *Nutriments*; *Aphorisms*; *Dentition*; *Airs, Waters, and Places*; *Affections*; *Joints*; *On Diseases*; *Decorum*; *Head Wounds*; *The Nature of the Child*; *Diseases of Women*, and so on. And the content ranges wildly in form and content, from a series of easily memorized sentences (*Dentition*), to insightful medical observations (*On the Sacred Disease*), to simple lists of ailments (*On Diseases*).

Nevertheless, from these texts we can gather that Hippocrates and his followers had a remarkably accurate understanding of anatomy—perhaps derived from their observations of war wounds and animal dissections—given that at the time, human dissections were deemed unacceptable, if not forbidden. True, at times the descriptions tended to lean a bit heavily on analogy and metaphor—for example, the eye was compared with a lantern and the stomach to an oven. But in other cases their anatomical and clinical observations were so accurate that they have earned the admiration of physicians and surgeons throughout history, up to and including the twenty-first century.

Some of the most fascinating observations from the Corpus come from facts that we take for granted today but were quantum leaps of insight at the time. One of the best examples is Hippocrates' descriptive assertion in *On the Sacred Disease* that thought and emotion arise from the brain and not the heart, as others believed at the time:

“Men ought to know that the source of our pleasures, merriment, laughter, and amusements, as well as our grief, pains, anxiety, and tears, is none other than the brain. It is by this organ that we think, see, hear, and distinguish between the ugly and the beautiful... By this same organ, too, we become mad or delirious, and are assailed by fears and panics, by insomnia and sleepwalking...”

Among the anatomical and clinical descriptions that continue to impress physicians today are those describing head injuries and joint deformities. For example, some claim that Hippocrates' treatise *On Injuries of the Head* helped set the stage for modern-day neurosurgery. The treatise begins with an impressively detailed discussion of the anatomy of the skull, including cranial structure, thickness, and shape, and differences in texture and softness between the skulls of adults and children. Hippocrates then describes six specific types of cranial trauma, including fissured fractures (caused when a weapon breaks the bone), depressed fractures, and wounds above cranial sutures. Other details reveal his clinical experience in treating head injuries, such as his description of certain cranial fractures that are “so fine that they cannot be discovered...during the period in which it would be of use to the patient.”

Similar details of medical acumen are seen in the manuscript *On Joints*, in which Hippocrates describes techniques for managing spinal diseases, including correction of curvatures of the spine and spinal injuries. Particularly interesting is the Hippocratic table, which was developed to treat spinal injuries. In fact, this table—to which patients were strapped so that physicians could apply pressure and thereby correct the deformity—is still in use today and is considered by many to be the forerunner of the modern orthopedic table.

But one of the most intriguing facets of Hippocrates' medicine was his view that to preserve health or cure disease, it was necessary to understand the nature of the body *and* its environment. In other words, the body had to be treated as a whole, not simply a collection of unrelated parts. This view, in turn, was closely related to the concept of balance. While Hippocratic writings describe balance in differing ways, the basic view was that good health arose when forces in the body were in balance, while disease occurred when internal or external forces upset this balance. The physician's goal in treating patients, therefore, was to identify and correct any imbalance.

One of Hippocrates' best-known—but medically inaccurate—theories arose from the concept of balance. According to this theory, four humors, or fluids, circulate in the body: phlegm, bile, black bile, and blood. A person's state of health or disease arises from the degree of balance or imbalance among these fluids, along with their relation to the four seasons (winter, spring, summer, and autumn) and the four elements of nature (air, water, fire, and earth).

Although humoral theory is notably absent from modern text books of human pathophysiology, it can be argued that within this view lies the metaphysical roots of something deeper than modern medicine can fully explain.

* * *

Acknowledging Hippocrates' invitation to discuss his philosophy, Anaxagoras nodded silently and picked up a stick. Slowly and deliberately he began to speak, sketching out his thoughts in the dirt with a series of circles and lines...

"Things in the one universe are not divided from each other, nor yet are they cut off..." He paused to see Hippocrates was following along.

Indeed he was.

"Thus also," continued the philosopher, "all things would be in everything...and all things would include a portion of everything... Nothing could be separated, nor yet could it come into being of itself, but as they were in the beginning so they are now, all things together..."

Milestone #6 Where the two worlds meet: a holistic approach to medicine

"It is necessary for a physician to know about nature, and be very eager to know, if he is going to perform any of his duties... what man is in relation to what he eats and drinks, and in relation to his habits generally, and what will be the effect of each upon each individual."

—*Hippocrates, Ancient Medicine, 420-350 BC*

It is not too great a leap to connect the philosophy of Anaxagoras with the holistic views that underlie much of Hippocratic medicine. According to

some accounts, it was not long after he met with Anaxagoras in the ancient city of Miletus and learned of the philosopher's theory of matter and infinity that Hippocrates developed his view that human health cannot be separated from the natural surroundings. Whether or not the story is true, it points to a fundamental insight that forms the core of Hippocratic medicine. It can be found in his specific prescriptions for disease, as well as his general theories on medicine and on staying healthy. It points to the importance of the inner world, a person's own body or "constitution," and the outer world, the environment. In so doing, it points also to a place where the two worlds meet.

And where do the two worlds meet? From the perspective of patients and the extent to which they have any control over their health, there are at least three places where the internal (their bodies) meets the external (the outside world): food (diet), physical movement (exercise), and air (breathing). Hippocrates frequently emphasizes all of these factors and more in discussing his holistic view of medicine. And of course, regardless of which factor he is discussing, the overall goal of good health is to use these factors to maintain or restore balance.

For example, regarding diet and exercise, Hippocrates advises in *Regimen I* that physicians must understand not only a patient's individual constitution, but also the role of diet and exercise in his or her life:

"He who is intending to write correctly about human regimen must first acquire knowledge and discernment of the nature of man as a whole...and the power possessed by all the food and drink of our diet... [But] eating alone cannot keep a man healthy if he does not also take exercise. For food and exercise, while possessing opposite qualities, contribute mutually to produce health."

In other writings, Hippocrates regards diet as indistinguishable from other treatments of the time, including bleeding and drugs. For example, the book *Regimen* lists the various qualities of different foods, while *Ancient Medicine* discusses the innumerable "powers" of food.

Hippocrates also writes often about the importance of air and breathing. In *Breaths 4*, he notes that "All activities of mankind are intermittent, for life is full of changes, but breathing alone is continuous for all mortal creatures as they exhale and inhale." In another writing, he adds, "It is air that supplies intelligence... For the whole body participates in intelligence in proportion to its participation in air.... When man draws in breath, the air first reaches the brain, and so is dispersed into

the rest of the body, having left in the brain its essence and whatever intelligence it possess.”

Although Hippocrates’ theories of the environment would strain the capacity of even twenty-first century technology to verify, the concepts nevertheless have an underlying ring of holistic truth. In addition to explaining that different seasons play a key role in health and disease, he also contends that different regions, warm and cold winds, the properties of water, and even the direction that a city faces are important considerations. In *Airs, Waters, and Places*, he writes:

“When a physician arrives at an unfamiliar city, he should consider its situations relative to the winds and the risings of the sun... He must consider as thoroughly as possible also the nature of the waters, whether the inhabitants drink water that is marshy and soft, or hard from high and rocky ground, or brackish and costive.”

Finally, it’s important to note that despite all we have said of Hippocrates’ rational approach to medicine and denunciation of supernatural forces as a cause of disease, he was no atheist. Whether out of respect for the family tradition of Asklepieion priests or from the same intuition that informed his other philosophies, Hippocrates also believed that a higher power was a necessary precondition for good health.

Thus, while few people today understand the full range of Hippocrates’ contributions to medicine, we should not forget that he is an original proponent of a uniquely holistic approach to medicine. In fact, this holism included what we now think of as both western *and* eastern medicine, with its acknowledgement of the importance of:

1. Rationale thinking and natural causes
2. The individual nature of health and illness
3. The role of diet, exercise, and environment
4. The value of ethics and compassion
5. A respect for a higher power

Hippocrates for yesterday, today...and tomorrow

“Patients are anonymous... Their recovery practiced in rooms similar to cockpits...”

—*Orfanos, 2007*

Although the physical form of Hippocrates disappeared from this world some 23 centuries ago, the body of his work—the collective writings and teachings for which we credit him the “Invention of Medicine”—remain alive and well in the twenty-first century. Medical students continue to cite his oath, physicians and surgeons continue to praise his anatomical and clinical insights, and many others continue to be inspired by his insights.

And yet...

To those who see little or no connection between ancient medicine and modern medicine of the twenty-first century, some would ask that you take a harder look at where we are today and where we may be heading. In a recent medical conference held on the island of Rhodes, Greece, a physician's opening lecture reviewed the history and accomplishments of Hippocrates. He then noted that after the flowering of Greek and Roman medicine and the transfer of this knowledge to the west in the middle ages by Arab scholars, the face of medicine began to change. Over the next four centuries, from the Renaissance to the urbanization, industrialization, and molecularization of medicine in the nineteenth and twentieth centuries, the field of medicine shifted from an emphasis on the routine and compassionate care of individual patients to an increasing focus on technology, economics, and business-oriented administration.

“Patients have become anonymous,” Constantin Orfanos noted in his 2006 address to the European Academy of Dermatology and Venereology. “Surgical interventions are procedures, to be honored as a brisk code number; emergencies and patient recoveries are practiced in rooms similar to cockpits for electronic cybernetics...”

To prevent the industrialization of medicine and its conversion into pure business, many now believe we need to look to the ancient past, to the healing tradition that arose long ago on a small island in the Aegean Sea. We might do well to revisit and reconsider the words and writings of

a man whose practice of medicine was truly holistic, encompassing not only rationality and clinical observation, but ethics, compassion, and even belief in a higher force.

Hippocrates would surely not discount the extraordinary advances made in medicine over the past four centuries. Rather, he might advise that we temper our relentless progress with the same philosophy that led him to the breakthrough that made modern medicine possible. He might suggest that we look a little deeper, seek the same place that he discovered and shared with his followers—that place where the inner and outer worlds meet, where health and disease are so precariously balanced.

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