
REMEDIES
AND
RECIPES

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PHARMACY, the art of preparing and dispensing drugs, is a science rooted in herbalism and chemistry. The field of pharmacy has both influenced and advanced all fields of medicine, including urology. The way we practice the specialty of urology has evolved from the methods we once used to treat benign prostatic enlargement to the modern techniques we now use to help men with erectile dysfunction. Even surgery has become safer, due in part to the advances made by chemists and pharmacists who helped pioneer germ theory.

For centuries, humans of different cultures have believed that illness could be cured only with the help, ceremonies or prayers of their medicine man, mystic or monk. These men and women were wise beyond their years, spoke with deities and had the power to exorcize evil spirits. Doctor and druggist, physician and pharmacist all in one, these healers used elaborate ceremonies, special amulets or prayers to try to cure their patients. Although the power of prayer is not to be underestimated, cures could probably be attributed to the use of herbs during these ceremonies.

Knowledge of the mystic's craft including the secret knowledge of herbalism has been passed down through generations of oral tradition. For this reason, we cannot ascertain how or when man first discovered the power of plants in healing. Cave drawings in Lascaux, France, illustrate the practice of herbalism. Radiocarbon dating has shown that drawings in this Paleolithic cave represent the oldest depiction of man using plants for medicinal purposes; the drawings date back to at least 13,000 BC.

Herbalism is still practiced today, as is spiritual healing. According to the World Health Organization (WHO), about three-quarters of the world's population relies upon traditional remedies (mainly herbs) for the healthcare of its people.[1] Clearly, herbal remedies are still dominant in the modern world. Many of the drugs on which we rely today are derived from specific plant extracts known for centuries for their curative properties.

Our knowledge and basic understanding of herbal remedies has evolved and expanded over the past millennia. Each civilization has added something to our understanding of plants, roots, molds and spores—the natural elements from which we built the entire field of pharmacy—and each has contributed to the modern pharmacology from which we benefit today. The study of pharmacological history begins with the study of herbs and the early societies that used them.

Egyptian Pharmacy

EGYPTIAN PHARMACY

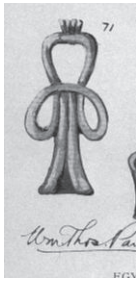
Ancient Egyptian civilization as we know it began in 3150 BC and ended when Egypt was conquered by—and became a province of—Rome in 31 BC.

During their reign, the Egyptians created more than 870 documented prescriptions. They were quite advanced in their pharmacological abilities. While most people might relate magic spells and incantations to Egyptian therapies, in reality, Egyptian prescriptions were often effective; 67 percent of ancient recipes could still be found in the *British Pharmaceutical Codex* of 1873.

Most of our knowledge of Egyptian medical and pharmaceutical practices comes from the *Ebers Papyrus* (named after Georg Ebers who purchased the scroll in 1873), a medical text written about 1550 BC. The 110-page scroll is based on older knowledge and contains about 700 remedies and "magical" formulas. The text suggests that the Egyptians probably had little knowledge of kidney function. The "treatise of the heart" states that the heart is the center of all vessels carrying bodily fluids, which included blood, tears, urine and semen. Another chapter covers mental disorders, including dementia and depression while other chapters discuss gynecological issues, such as pregnancy, contraception, injuries and tumors. To aid conception, a woman had to squat over a brazier or steamer and allow the smoke and vapors of frankincense or dates, beer or aloe to enter her. Contraception is also discussed in the *Ebers Papyrus* and descriptions of contraceptive devices include cotton soaked in a paste of dates and acacia bark or ground acacia, carob and dates with honey. To make the therapy most effective, crocodile dung was frequently added.

William P. Didusch Center for Urologic History. Donated by Michael Folmer. | Fossilized Crocodile Dung.

As in many civilizations, amulets were popular among Egyptians. One common amulet represented the girdle of Isis, who was worshiped throughout the Greco-Roman Empire as the ideal mother and wife, patron of nature and magic. This amulet was believed to stem the flow of blood during a miscarriage. Another amulet, picturing a hairy animal, protected against baldness.



Isis Amulet
Wellcome Library, London.
This amulet was believed to stem the flow of blood during a miscarriage.

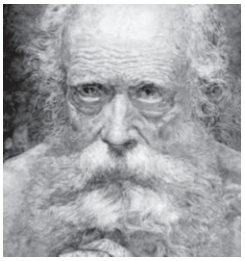
Egyptian medical knowledge was highly regarded by foreigners. In 800 BC, Greek author Homer wrote in the *Odyssey*, *"In Egypt, the men are more skilled in medicine than any of human kind."* Greek historian Herodotus and Roman philosopher Pliny the Elder both wrote about Egyptian medicine as well. The foundation of knowledge discovered by the Egyptians would ultimately become a base upon which other great medical scholars could build.

Ebers Papyrus.
By: Georg Ebers, c. 1875.
Wellcome Library, London.
The *Ebers Papyrus* includes a prescription for heating herbs on hot bricks so the asthma sufferer can inhale the fumes.

Ancient Greek and Roman Pharmacy

ANCIENT GREEK & ROMAN PHARMACY

Hippocrates (450-370 BC), the "Father of Medicine," was well versed in herbal remedies. He was the first physician to reject superstitious beliefs; he tried to understand illness as an affliction within the patient as opposed to a divine intervention. Hippocrates was also the first to separate the fields of religion and medicine. He taught that disease was the product of environmental factors, living habits and diet rather than punishment inflicted by angry gods. Indeed there is no mention of mystical illness in the entire *Hippocratic Corpus*. While his teaching was based on incorrect anatomy and physiology, it greatly advanced critical thinking in his day. The Hippocratic School applied general diagnoses and passive treatments and Hippocrates effectively treated diseases, which led to great developments in clinical practice. Hippocrates's medicine and philosophy are far removed from today's way of practicing and thinking, but, in his day, it was a major shift in thought and belief. He believed that illness was a result of an imbalance of the four humors—blood, black bile, yellow bile and phlegm. When they were in balance a person remained healthy. This humoral theory of Hippocrates remained accepted medical teaching for nearly 2,000 years and his ideas were further developed by those who followed.



Hippocrates
Library of Congress.

The Father of Medicine.

Oil painting by Ernest Board.
Wellcome Library, London.

Dioscorides describing the mandrake.

Galen
Library of Congress.

Galen is said to have prepared his mixtures in a storeroom called an *apotheca*.

These ideas were expanded by Galen (AD 130-200) into a set of medical beliefs that would prevail until the mid-1850s. Galen practiced and taught both pharmacy and medicine in Rome. His practice of preparing and compounding medicines was influential in the Western world for hundreds of years.[2] His name is associated with a class of pharmaceuticals called *galenicals,* medicines that were prepared according to Galen's formulas. Today, the term usually denotes that the medicine contains one or more organic ingredients. One of his drugs, *hiera picra,* a mixture of aloe, spices and herbs in honey, is believed to be the oldest pharmaceutical compound.[3] Galen also invented cold cream, a mixture of fats and water that can smooth skin and remove makeup. He prepared his mixtures in a storeroom called an *apotheca,* from which we get the word "apothecary," or druggist.

In addition, the Greeks were responsible for creating the precursor of all modern pharmacopeias. The text for the famous five-volume book, *De Materia Medica,* was written by Dioscorides in the first century AD. It remained in use until about AD 1600. The *Materia Medica* gives us knowledge of the herbs and remedies used by the Greeks, Romans and other ancient cultures. The work presents about 500 plants in all.

Dioscorides's rhubarb.
From: *De Materia Medica*
By: Dioscorides, c. 1543.
Wellcome Library, London.

Rhubarb is still used in conventional as well as herbal medicine and is listed in the *British Pharmacopoeia* of 1988. Research shows it to be effective against Staphylococcus aureus.

CHINESE PHARMACY

Around the same time, in the East, the Chinese were also making strides in herbalism. By 200 BC, Chinese herbal medicine was firmly established.[4] The mythical Yellow Emperor Hyang-di, believed to have reigned from 2497 to 2398 BC, is remembered as the father of traditional Chinese medicine. He is credited with writing the *Huangdi Neijing (Inner Canon of Huangdi),* a guide to the principles of traditional Chinese medicine.

By the first century AD, several books describing a variety of herbal remedies, similar to a pharmacopeia, were in use.[5] During the Han Dynasty, Shen-nung wrote the *Shennong Bencao Jing,* the first native herbal directory, or *Pen Tsao,* with 365 medicines. Of these, 252 were herbal remedies. Shen-nung is credited with having written the first official pharmacopeia.

In the 7th century AD, during the Tang Dynasty, the *Yaoxing Lun,* or *Treatise on the Nature of Medicinal Herbs,* was widely circulated in China. Later, Li Shi-Zhen wrote *The Compendium of Materia Medica,* arguably the most important book on medicinal herbs, during the Ming Dynasty (1152-1578). Nearly 2,000 herbs and extracts were listed in Li Shi-Zen's pharmacopeia.

Supplement to Lei Gong's *Guide to the Preparation of Drugs.* Published: China 1591. Wellcome Library, London.

The Yellow Emperor (Huangdi) is shown presenting books containing medical knowledge to Lei Gong, the Thunder Duke.

Pao Shan, c. 1622. Wellcome Library, London.

Woodcut of jin gua'er (a kind of pumpkin) from *Yecai bolu (Compendium of edible wild plants).*

The Compendium of Materia Medica, which means "crude medicine," or "simple preparations," forms the basis of Chinese herbology. Typically, a batch of crude medicine would be made from one or two main ingredients thought to target the illness. Other ingredients were then added to adjust the formula to the patient's yin/yang conditions. The root of all Chinese medicine is the philosophy of yin/yang, which describes two opposing forces, each force comprising an element of its opposing force. The yin (usually represented by the black side of the yin/yang symbol) also has a dot of yang (or white) within its parameters and vice versa. Chinese medicine and pharmacy take into account the individuality of each patient—each person has a different yin/yang condition.

In ancient China, remedies were classified into three categories: the Four Natures, the Five Tastes and the Meridians. The Four Natures pertain to the degree of yin/yang of a patient's internal balance and temperature. There are four stages of yin/yang, ranging from extreme cold to extreme heat. If a patient was extremely cold, practitioners thought he or she had too much yin in the body, whereas if the patient was too hot, it meant he or she had too much yang. If a patient was too cold, he or she would be given hot (yang) herbs to correct the imbalance.

Another way to treat the patient depended on the symptoms' correlation to the Five Tastes, which included pungent, sweet, sour, bitter and salty. It was believed that food of each taste would cure a condition exhibiting symptoms of

that taste. For instance, sour tastes were considered to have a cooling and drying effect on the body. Thus, sour foods were used to dry up mucus and stop bodily discharges such as perspiration or diarrhea.[6]

The Meridians are pathways through which *qi,* or energy, flows through the body. Meridians connect the various organs of the body. The ancient Chinese believed that an energy imbalance could be corrected by pinpointing the meridian that caused the imbalance and then restoring energy flow. Acupuncture continues to be the most common way to stimulate points on the Meridians.

In ancient China, after the doctor diagnosed a patient, he would create and dispense the remedy himself. Chinese prescriptions often contained ingredients from all parts of a plant—the leaf, stem, flower and root. Ginseng root was used in traditional Chinese medicine as a muscle relaxant; it was also used to treat erectile dysfunction. Minerals and ingredients from animals were also popular.

Despite the impact of modern pharmacological practices, traditional Chinese doctors still create and dispense their own substances to this day.

The 'Illustration of Lei Gong preparing medicines', from *Supplement to Lei Gong's Guide to the Preparation of Drugs,* China 1591
Wellcome Library, London.

Typical scenes of drug preparation in early China. In the upper right, a man tends to the fire in a stove on which he is steaming herbs in a bamboo steamer. To the left is a figure in the act of lifting the lid of a pot of boiling herbs to check on the brew. In the center four people in a row illustrate sequential stages in drug processing from left to right: grinding ingredients in a mortar, sifting them, pulverizing them with a metal roller, and roasting ingredients while stirring them with fire tongs.

Photograph c. 2004.
Wellcome Images.

Physician preparing herbal compounds at the Qianyi Yachang Pharmaceutical Company, Nakung on Penghu near Taiwan.

William P. Didusch Center for Urologic History.
Donated by Erwin Rugendorff, MD.

Chinese herbs are used for colon cleansing. Dried longon improves memory and concentration, while the angelica sinensis root enriches the blood.

PERSIAN/ ARABIC MEDICINE

PERSIAN/ARABIC MEDICINE

Ancient Persian medicine combined more than 4,000 years of different medical traditions from Greece, Egypt, India and China to form what ultimately became the foundation of medical practice in European countries throughout the 13th century.[7]

In the medieval Islamic world, Arabic physicians discovered diuretics, anti-emetics, anti-epileptics and anti-inflammatory medicines, as well as the analgesic and antipyretic properties of medical cannabis, specifically cannabis sativa. Cannabis was used extensively as medication from the 8th to the 18th centuries. Arabic physicians also gave us the concept of dosage—taking a specific amount of medication during a particular period of time.

Cannabis Indica, Indian hemp.
Codex Aniciae Julianae picturis illustratus.
By: Dioscorides.
Wellcome Library, London.

Hemp was used as an analgesic and anesthetic to treat earache, toothache, rheumatism, arthritis, labor and menstrual pains, headaches, convulsions and fever.

The history of Arabic medicine reveals the first efforts to separate the pharmacist and physician. In the Arab community, pharmacy was so important that a separate code of ethics, called the *Minhaj (The Handbook),* was adopted in the 13th century. It instructed pharmacists to keep a clean and well-stocked shop, with an inventory-monitoring system to ensure quality and freshness. *"The pharmacist was instructed to keep his profits moderate and 'to have deep religious convictions, consideration for the poor and needy, a sense of responsibility and be careful and God fearing.' He was also to be friendly, honest, thoughtful, slow to anger, modest and patient."* [8]

Pharmacists were not licensed until the 9th century, when qualified pharmacists were allowed to practice near Arab army camps.

In Arabic medicine, we also saw the resurgence of the traditional physician-researcher, as in the days of Hippocrates and Galen. Al-Razi and Avicenna were two of the foremost physician-researchers of this time.

Al-Razi (860-932) wrote 113 major works and 28 minor works on medicine. He was the chief physician at the hospital in Baghdad, the first Muslim hospital built at the beginning of the 9th century. He wrote the *Comprehensive Book of Medicine,* which included a description of measles and the first clinical account of smallpox. Because of the depth and breadth of his work, many scholars consider Razi the greatest physician of the Middle Ages.

After Al-Razi, the next best-known Arabic physician of this time was Ibn Sina (973-1013), known in the West as Avicenna. He encouraged fellow

c. 16th Century. Wellcome Library, London.

Double page from *Mugiz al-Qanun,* an Arabic medical text concerning a commentary on Ibn Sina's *al-Qanun*.

Tacuinum Sanitatis, works of the Arab physician Albucasis. Wellcome Library, London.

Miniatures from the Vienna Manuscript of *Tacuinum Sanitatis.*

Canon of Medicine, Avicenna. c. 1632. Wellcome Library, London.

Skeleton System.

physicians to travel the region carrying drugs and administering relief to the sick. Avicenna is also credited with having served as an administrator of the hospital in Baghdad.[9] In the Latin West, Avicenna was known as the "Prince of Physicians." His *Qanun (The Canon)* served as the final codification of Greco-Arabic medical thought. It was one of the first books published on a Gutenberg press.[10] Sir William Osler, MD, in *The Evolution of Modern Medicine*, says that Avicenna's *Qanun "has remained a medical bible for a longer period than any other work."* Avicenna also wrote about the anesthetic value of opium derivatives. His accomplishments include the introduction of systematic experimentation and quantification into the study of physiology, the development of clinical trials, the experimental use and testing of drugs, and creation of a precise guide for practical experimentation in the process of discovering and proving the effectiveness of medical substances.

Avicenna's *The Canon* and Razi's *al-Hawi (The Virtuous Life)* were among the central texts in Western medical education from the 13th to the 18th centuries.[11]

Another outstanding scholar of the Arab world was Albucasis (936-1013) who wrote 30 treatises heavily focused on pharmaceuticals. His treatise discussing medicinal chemistry became a handbook pharmacists used for generations to come.

Arabic medicine also introduced new forms of medication, such as syrups, conserves, confections and juleps, all of them based on sugar or honey and all of them challenging the previous belief that good medicine had to taste bitter to work.

Oil painting by Ernest Board. Wellcome Library, London.

Rhazes (Al-Razi), Arab physician and alchemist, in his laboratory at Baghdad.

Pharmacy in the Middle Ages

PHARMACY IN THE MIDDLE AGES

Following the fall of the Roman Empire (AD 476), standard medical and herbal knowledge was based chiefly upon surviving Greek and Roman texts, which were mainly preserved in monasteries. The church—holding most of the Mediterranean's ancient knowledge of pharmacology—taught that ideas about the origin and cure of disease were based on a world view in which factors such as destiny, sin and divine intervention played as great a part in sickness as any physical cause. The efficacy of cures was similarly bound in the beliefs of patient and doctor, rather than empirical evidence.

Miscellania Alchemica XXIV, c. 1543. Color Ink Drawing. Wellcome Library, London.

Two monks practicing alchemy; one standing by a furnace/oven and the other sitting down looking hot and flushed.

As Christianity grew in influence, tension developed between the church and folk medicine because the latter involved spells and incantations in addition to herbs; folk medicine was seen as magical and mystical—and was, therefore, not compatible with the Christian faith. Such spells had to be separated from the physical remedies, or replaced with Christian prayers or devotions to be acceptable. Similarly, the use of herbs or crystals and their "powers" needed to be explained through Christianity.

Crystals. William P. Didusch Center for Urologic History.

. . . the use of herbs or crystals and their "powers" needed to be explained through Christianity.

The Church taught, and many believed, that God sent illness as a punishment and that repentance could lead to recovery. This led to the practice of penance and pilgrimage as a means of treating ailments. In the Middle Ages, some people considered medicine an inappropriate profession for Christians because disease was often considered God sent. God was thought of as the "divine physician" who sent illness or healing, depending on his will and the person's sins.

However, many monastic orders, particularly the Benedictines, considered caring for the sick as a merciful and very important act. The monasteries relied on Greek medicine from the earliest medieval times.[12] Cassiodorus (468-560), who had been the secretary of the Ostrogoth Emperors (an empire in Italy), learned from the Benedictines. He promoted herbal medicine by recommending that people learn the nature of herbs and study their combinations in an attempt to advance human health. However, he also advised people not to place their entire hope on herbs because medicine was created by God. Thus, people should also turn to God for healing. We see in Cassiodorus a shift from relying primarily on divine intervention to a reliance on herbals first and divine intervention second. This paved the way for the scientific breakthroughs of the Reformation.

Medieval European medicine developed more rapidly during the 12th century, a time during which many Arabic medical texts on both ancient Greek medicine and Islamic medicine were translated. The most influential among these texts was Avicenna's *The Canon of Medicine.*

Silver gelatine print.
c. 1904.
By: Edward S. Curtis
Wellcome Library, London

A 'Yebichai Sweat' Navajo medicine ceremony.

Discovery of the New World and Native American Medicine

DISCOVERY OF THE NEW WORLD AND NATIVE AMERICAN MEDICINE

After Christopher Columbus's voyage to the Indies, which landed him in the Bahamas in 1492, Europeans travelled to America and began to colonize the land.

Some scholars estimate that Native American medicine has been practiced in North America for 40,000 years. Many believe it to have roots in different cultures, such as ancient Ayurvedic (East Indian) and Chinese cultures. However, it also has been influenced by what the natives learned about nature, plants and animals in the area. Migration of and contact with other tribes along trade routes also influenced Native American medicine. The tribes gathered herbs from the surrounding environment and sometimes traded over long distances. Knowledge of herbals was usually not shared with the invading Europeans and a great deal of Native American knowledge was lost during the assimilation process.

c. 1921.
By: Wilfred Langdon Kihn.
Wellcome Library, London.

Portrait of Jose Saiow, Laguna Pueblo medicine-man.

Like Ancient Chinese medicine, Native American medicine is rooted in the idea of healing the whole body from imbalance. Herbal remedies were used to treat many physical conditions. Native Americans believed that all things had a spirit—even "inanimate" objects such as rocks. Therefore, when gathering herbs, they would ask the plant's permission to pick it, just as they would ask a deer's permission before killing it. They believed that all life was sacred, and that permission was required to take another life; the death of one life should be necessary for the preservation of another. The need for food and medicine constituted acceptable reasons to kill another spirit. These beliefs helped protect against extinction of known herbs and animals. Other measures to avoid extinction of life-saving herbs were also taken, such as picking only every third plant or keeping gathering places a secret from other gatherers.[13]

Se-Quo-Yah, half-length portrait, seated, facing right, holding Cherokee alphabet.
Library of Congress.

Se-Quo-Yah, inventor of the Cherokee alphabet.

Like medical knowledge of many earlier cultures, Native American medicine was passed on orally. Some Native Americans, however, documented medical knowledge on ledgers that were handed down through generations. The Cherokee, an Indian nation that developed a written language, recorded its medical knowledge. But experts warn, *"it is dangerous to try to interpret the Cherokee writing in these books and use them without the proper training, as most are written in cryptic fashion; leaving out major portions that the practitioner has learned verbally, written in code or even written backwards."* [14]

Many Native American medicine practices were driven underground or lost when European settlers colonized America; most settlers believed that European medicine was far superior and would not tolerate Native American healing methods. Some practices were banned or considered illegal in parts of the United States even up until 1978, when Congress passed the American Indian Religious Freedom Act. There are still obstacles to practicing

Europe
From the Middle Ages through the Renaissance and Beyond

c. 1543.
By: Vesalius, Andreas.
Wellcome Library, London.

Male torso, revealing urinary sytem.

ceremonies and rituals on previously sacred sites in some areas, because the land is now used for another purpose. However, some Native American community-based medical systems still practice select Native American healing practices and rituals, such as the use of sweat lodges, herbal remedies, teas and smudging (cleansing a person or place using ashes from sacred plants).[15]

Several modern medicines have roots in these early remedies. For instance, willow bark, a common Native American pain reliever, contains the same compound used in aspirin. Native Americans also used blackberries to sooth stomachaches. A tea made from greenbriar root was used to treat arthritis and is a mild diuretic. Mint was used to aid in digestion and was added to water to relieve itchy skin. The cattail plant was thought to be useful for preventative medicine as it is rich in starch and protein and was easily accessible. Today, Cherokee healers use an infusion of mint leaves and stems to lower high blood pressure.[16]

c. 1850.
By: C. Schuessele.
Library of Congress..

The healing process took a long time; the healer spent a lot of time with the sick, providing both guidance and treatment.

EUROPE — FROM THE MIDDLE AGES THROUGH THE RENAISSANCE AND BEYOND

Preparation and sale of medications became regulated and supervised in the early 12th and 13th centuries in northern Italy and southern France. Around this time, pharmacists began to form guilds, sometimes shared with physicians. These guilds maintained a monopoly within a town, protecting the quality of the products, establishing and maintaining prices, but also controlling training and length of service of apprentices. They also set rules for journeymen and oversaw admission to the status of master in the guilds. Being a master in the guild required not only the passing of an examination, but also a demonstrated ability to compound a complex prescription. Pharmacists were not formally separated from the practice of medicine until Holy Roman Emperor Frederick II wrote the *Constitutiones* between 1231 and 1240, which regulated the practice of medicine and separated it from the field of pharmacy.

The world began to change with the Renaissance in the 15th century and the political upheaval that ensued. Scientific discoveries, great literature and art, schisms in religion (with Reformation and Counter-Reformation) and wars were marks of this period. These tremendous shifts and changes included advances in pharmacy. Two scientists, Paracelsus and Vesalius, started to question traditional knowledge and, in doing so, led the world toward a new medical schema.

Paracelsus (AD 1493-1541), who discovered the elements nitrogen and hydrogen, challenged the concepts of previous physicians after studying early Greek medicine from the writings of Avicenna. During Paracelsus's time, physicians relied on specific diets (to help in the "cleansing of the putrefied juices") and purging and bloodletting (to restore the imbalance of the four humors) to combat disease. Paracelsus supplemented and challenged this view with his belief that illness was the result of the body being attacked by outside agents, a belief that labeled him the father of modern-day germ theory. Paracelsus publicly condemned the theories of Galen and Avicenna.[17]

Other major changes that occurred during the Renaissance led to the ultimate rejection of Galen's theories. In 1543, Andreas Vesalius (1514-1564) published his book, *De Humani Corporis Fabrica,* and publicly pointed out errors in Galen's theories. Vesalius angered many of his peers, who denounced his ideas. Pressured to renounce his findings and teachings, Vesalius did not recant but left his academic teaching position. Some of Vesalius's critics even argued that human anatomy might have changed since the days of Galen. It took another century for society to accept Vesalius's findings.

Woodcut and text, c. 1543.
From: *Suorum de humani corporis fabrica librorum epitome.*
By: Andreas Vesalius.
Wellcome Library, London.

Skeleton leaning on a pedestal and contemplating a skull.

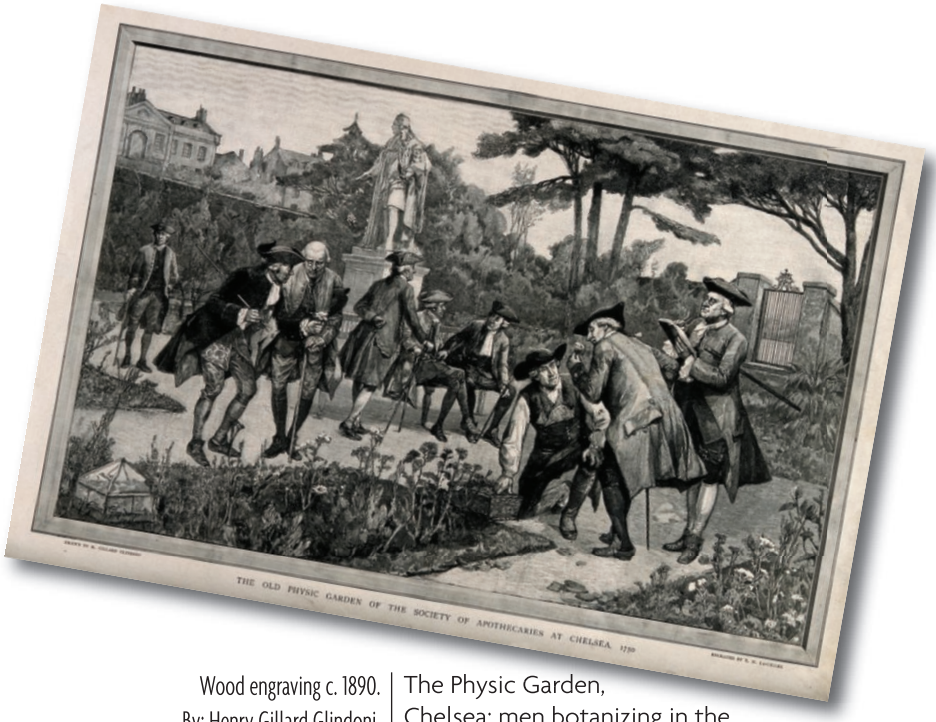
Oil painting on canvas.
c. 1526.
By: Ernest Board.
Wellcome Library, London.

Paracelsus burning the books of the "Fathers of Medicine."

Supporters of Galen came under assault by students of Paracelsus and Vesalius. The two worlds of medicine began to clash, not only in Germany but also in France, where these battles were often fought in the courts and in public broadsheets, pitting universities against each other. However, in England, the new ideas melded with the old, and the *Royal College of Physicians of London* even accepted a number of the new chemical remedies. The *Pharmacopocia Londinensis,* conceived in 1589 and finally published in 1618, included a number of Paracelsian remedies, such as crocus of antimony, to treat tuberculosis and mercuric sulphate to treat syphilis.

Gradually, these new ideas replaced the old and the understanding of medicine evolved from humoral to chemical. Advancements in the field of anatomy, which further refuted Galen's theories on the makeup of the human body, were central to the rejection of the humoral understanding and allowed for a paradigm shift within society. Advancements in anatomy included the discovery of the circulatory system. Spanish physician Michael Servetus first described the circulation of blood through the lungs in 1553. For this, he was accused of heresy by Catholics and Protestants alike; he was burned at the stake the same year. In 1559, Realdo Colombo furthered Servetus's theory by describing the circulation of blood through the lungs in detail. In 1593, Andrea Celsalpino proposed a chemical theory of circulation involving the evaporation and condensation of blood. Hieronymus Fabricius discovered valves in veins around 1562, but did not understand their function. William Harvey (1578-1657), a student of Fabricius, was not satisfied and made it his goal to determine the function of those valves. He an-

Michael Servetus.



Wood engraving c. 1890.
By: Henry Gillard Glindoni.
Wellcome Library, London.

The Physic Garden, Chelsea: men botanizing in the garden, near the statue of Sir Hans Sloane.

nounced his discovery of the circulatory system in 1616. In 1628, he published his work *Exercitatio Anatomica de Motu Cordis et Sanguinis in Animalibus (An Anatomical Exercise on the Motion of the Heart and Blood in Animals),* in which, based on scientific methodology, he argued that blood was pumped through the body by the heart before returning to the heart and being re-circulated in a closed system. While the discovery of the circulatory system was not directly related to the development of pharmacy as a field, it contributed significantly to the downfall of the humoral theory. Once the humoral theory and Galen's anatomy had been refuted, it became easier for society to consider other theories, including Paracelsus's more chemical-based view of medicine—a view which led to the idea of compounding medicine, and paved the way for modern pharmacy.

In the early 17th century, the fields of medicine and pharmacy began to separate all across Europe. In 1614, King James I of England gave apothecaries their own guild after Fideon Delaune, apothecary to Queen Anne of Denmark, petitioned him. The guild was called *"The Worshipful Society of Apothecaries of London."* Later, the *Apothecaries Act of 1815* granted the Society the power to license and regulate their practitioners throughout England and Wales.

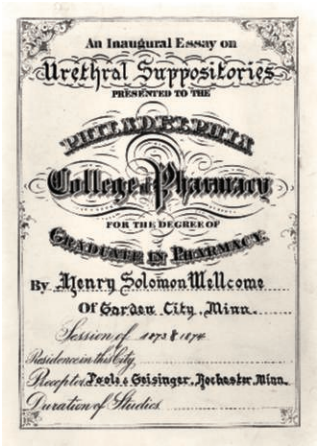
Pharmacists were called apothecaries until the French satirist Moliere wrote a play in which the apothecary was made the laughing stock of the nation for his principal use of enemas. French pharmacists promptly dropped the name "apothecary" and started using *"pharmacien"* instead. Records show that the first American pharmacy shop was operating in Boston in 1646. The second opened in New York in 1653.[18]

Dated November 20, 1817.
Wellcome Library, London.

Worshipful Society of Apothecaries. Summons to appear at a Court.

Colored engraving 18th Century.
By: Martin Engelbrecht.
Wellcome Library, London.

An apothecary with the tools, costume and apparatus of his trade.


An Inaugural Essay on
Urethral Suppositories
PRESENTED TO THE
PHILADELPHIA
College of Pharmacy
FOR THE DEGREE OF
GRADUATE IN PHARMACY
By Henry Solomon Wellcome
Of Garden City, Minn.
Session of 1873 & 1874
Residence in this City
Preceptor Peele & Coxe, Rochester, Minn.
Duration of Studies

Published by College of Pharmacy. Philadelphia, c. 1873. Wellcome Library, London.

H. S. Wellcome's thesis on urethral suppositories for degree of Graduate in Pharmacy.

THE RISE OF Pharmaceutical Training

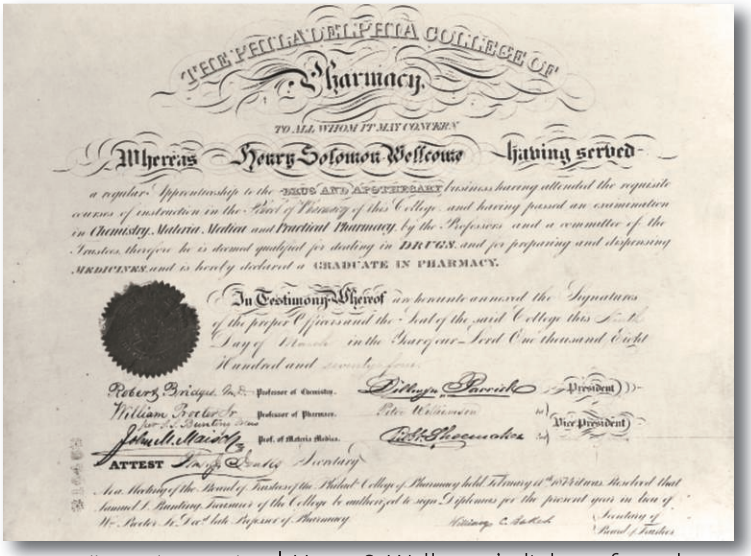
THE RISE OF PHARMACEUTICAL TRAINING

In the 17th century, medical teaching facilities were still largely dependent on the church and/or state. Private colleges to train pharmacists did not exist. Gradually, research and teaching became supported by academic groups. Paris was the first city to require formal pharmaceutical training. In the early 1500s, Parisian pharmaceutical apprentices attended two lectures a week given by a member of the medical faculty, not a practicing pharmacist. Formal training for pharmacists took root across Europe in the 17th century (1603 *Accademia dei Linseii* in Rome; 1652, *Academia Naturae Curiosorum* in Schweinfurt, Germany; 1660, the *Royal Society in London;* 1666, *L'Académie des Sciences,* in Paris; 1700, *Prussian Academy of Science* in Berlin, Germany).

Training for pharmacists was similar to that for physicians, and was conducted by institutions such as *The Society of Apothecaries* (London, 1617) or the *Collegium Pharmaceuticum* (Nuremburg, 1632). In the United States, pharmacist education shifted from apprenticeship to formal instruction in the 19th century.

Gradually, the traditional hands-on learning with apprenticeship and a few didactic courses began to give way to a full academic course of study for aspiring pharmacists. In the United States, medical education for the practicing physicians remained an apprenticeship of two years, supplemented by academic courses, often in proprietary schools. However, the training of apothecaries differed because it changed significantly during this time. A group of 68 apothecaries in the Delaware Valley convened on February 23, 1821 in Carpenter's Hall in Philadelphia. They decided to establish *The Philadelphia College of Apothecaries,* which was incorporated the following year as *The Philadelphia College of Pharmacy.* Representing the first college of pharmacy in North America, this group began their instruction in a few rented rooms in the hall of the German Society in Philadelphia in the fall of 1821; four years later they published the first U.S. journal in their specialty—the *American Journal of Pharmacy*—the oldest continuously published professional journal in the United States.

Five years after instruction began, the first class of three students graduated and, a few years later, the organization moved into its own building. Graduates of the college became leaders in their field. At the time, essentially every pharmacy school in the United States had at least one faculty member who was a graduate of the *Philadelphia College of Pharmacy.* Many of the founders of major U.S. pharmaceutical companies graduated from this college, including John Wyeth (class of 1854), William R. Warner (class of 1856), Henry S. Wellcome (class of 1874), Robert McNeil (class of 1876), Silas M. Burroughs (class of 1877), Josiah K. Lilly (class of 1882), Eli Lilly (class of 1907), Gerald F. Rohrer (class of 1931) and Robert L. McNeil (class of 1938). These pioneering pharmacists made some of the greatest medical advances to date, including creating the first table of elements; isolating urea and dextrose; and characterizing the properties of albumin, amino acids, glycine and other substances. In the late 18th and early 19th centuries, these discoveries laid the foundation for chemistry and, thus, the beginning of the hometown compounding pharmacist.


THE PHILADELPHIA COLLEGE OF
Pharmacy.
TO ALL WHOM IT MAY CONCERN
Whereas Henry Solomon Wellcome having served
a regular Apprenticeship to the DRUG AND APOTHECARY business having attended the requisite courses of instruction in the Chair of Chemistry of this College, and having passed an examination in Chemistry, Materia Medica and Practical Pharmacy, by the Professors and a committee of the Trustees, thereon he is deemed qualified for dealing in DRUGS, and for preparing and dispensing MEDICINES and is hereby declared a GRADUATE IN PHARMACY.
In Testimony Whereof we have hereunto annexed the Signatures of the proper Officers and the Seal of the said College this [illegible] Day of [illegible] in the Year of our Lord One thousand Eight Hundred and [illegible]
Robert Bridges, M.D. Professor of Chemistry — Dillwyn Parrish — President
William Procter Jr. Professor of Pharmacy — Peter Williamson — Vice President
John D. Mason Prof. of Materia Medica — [illegible]
ATTEST [illegible] Secretary
At a Meeting of the Board of Trustees of the Philad.a College of Pharmacy held February 4th 1878 it was Resolved that Samuel S. Bunting Treasurer of the College be authorized to sign Diplomas for the present year in lieu of Wm. Procter Jr. Prof. of Pharmacy [illegible] Secretary of Board of Trustees

Wellcome Library, London. | Henry S. Wellcome's diploma from the Philadelphia College of Pharmacy.

Milestones That Led to the Antibiotic

MILESTONES THAT LED TO THE ANTIBIOTIC

During the 19th century, researchers were building the foundation of germ theory. Though the end result was neither suspected nor predicted, their research would result in life-saving processes and drugs that would eventually lead to the development of the first antibiotic.

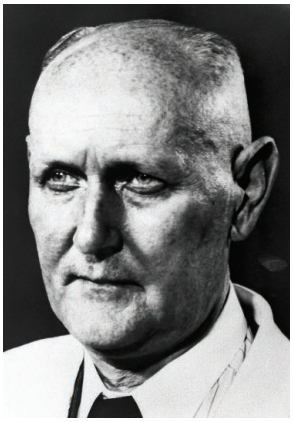
Louis Pasteur (1822-1895), a French chemist and microbiologist, is best known for his groundbreaking theories in the causes and prevention of disease. He not only created a vaccine for hydrophobia (rabies), but he invented pasteurization—a method of heating liquids for the purpose of destroying bacteria, protozoa, molds and yeasts, which, if left in milk and wine, caused illness.

Inspired by Louis Pasteur's germ theory of putrefaction, which posited that germs caused decay, Joseph Lister (1827-1912) began exploring how to make surgical environments more sterile. He introduced carbolic acid (phenol) to sterilize surgical instruments and to clean wounds. In 1867, he wrote the *Antiseptic Principle of the Practice of Surgery* to advance his theory that a clean operating environment would decrease the risk of disease. In 1879, Listerine® mouthwash was named to honor Lister's pioneering advances in antisepsis; the bacterial genus *Listeria* is also named after him.

The ancient Egyptians, ancient Greeks and medieval Arabs already used molds and plants to treat infections, but did not fully understand that these organisms had antibiotic potential. But, while Pasteur and Lister were pioneers in fighting molds and bacteria, other researchers had discovered that these organisms were capable of antibiosis—the ability to fight bacteria that could cause illness—and were exploring means of using these organisms to fight disease.

Antibiosis in bacteria was first described in 1877, when Louis Pasteur and Robert Koch (ultimately known for their pioneering work with infectious diseases) observed that an airborne bacillus could inhibit the growth of *Bacillus anthracis.* French researcher Ernest Duchesne (1874-1912) first described the antibiotic properties of *Penicillium sp.* in 1897. However, Duchesne's work was largely ignored by the scientific community until, more than 30 years later when Alexander Fleming inadvertently discovered the disease-fighting qualities of mold. Returning from a vacation, Fleming discovered that one spot of a particular mold inhibited growth in a Petri dish of staphylococci. His discovery would change the face of pharmaceuticals. Physiologist Howard Florey and biochemist Ernst Chain furthered Fleming's work by purifying penicillin and testing the drug in mice. By the early 1940s, the drug was in mass production—just in time to save countless lives during the late years of World War II.

Photograph c. 1860. Wellcome Library, London. | Portrait of The Right Honourable Joseph Lister, 1st Baron Lister [1827-1912], British surgeon, in his 30's.



Wellcome Library, London. | Portrait of Gerhard Domagk.

Wellcome Library, London.

Back row, left to right: S. Waksman, H. Florey, J. Trefouel, E. Chain, A. Gratia. Front row: P. Fredericq and Maurice Welsch.

Streptomycin, the first effective antibiotic against tuberculosis, was originally isolated in 1939 by Albert Schatz, a graduate student in the Rutger's University laboratory of Selman Waksman. Waksman's research was focused on actinobacteria and the organism's role in organic decomposition. Streptomycin is a bactericidal antibiotic derived from *Streptomyces griseus,* an actinobacterium. Both Waksman and Schatz are credited for this discovery—the former for his groundbreaking work in the basic science of the organism, and the latter for first isolating streptomycin itself.

In addition to penicillin and streptomycin—both very powerful tools in the physician's disease-fighting arsenal—other major antibiotics also emerged. In 1939, Rene Dubos isolated gramicidin, a highly effective treatment for wounds and ulcers. The era of sulfa drugs began with the discovery and synthesis of Prontosil, the first antibacterial antibiotic available commercially. Prontosil is a derivative of sulphanilamide. Its antibacterial nature was made public in 1935 when discoverer Gerhard Domagk (1895-1964), working at the Bayer Laboratories at Wuppertal, Germany, published data showing the drug's effect on staphylococci and streptococci. The drug was shown to have a relatively broad effect against Gram-positive cocci, but not against enterobacteria, a class that includes familiar pathogens such as *Escherichia coli* and Salmonella. Domagk earned the 1939 Nobel Prize for Medicine for this work.

William P. Didusch Center for Urologic History. Donated by Friedrich Moll, MD.

Prontosil, the first antibacterial antibiotic available commercially.

The Soda Fountain's Influence on the Home-town Pharmacy

William P. Didusch Center for Urologic History. | Modern day Show Globe.

THE SODA FOUNTAIN'S INFLUENCE ON THE HOMETOWN PHARMACY

Soda fountains evoke fond memories for many, but not everyone fully understands that the popular neighborhood hotspots helped shape the reputation of the local pharmacy. Soda fountains helped to make the pharmacy a neighborhood gathering center. From the 1830s until the 1970s, soda fountains were an institution on Main Street America. Many believe that, when Prohibition began in 1919, soda fountains filled the social void caused by bar closures. By the early 1920s, almost every drugstore had a soda fountain.

The soda fountain was originally created to replicate mineral waters that bubbled up from the earth's crust. Many civilizations believed that drinking and/or bathing in these mineral waters cured diseases and large, profitable industries often sprang up around hot springs in such places as Bath, England or the many onsen of Japan. Thus, it isn't surprising that early scientists tried to create effervescent waters with curative powers. These scientists included Robert Boyle, Friedrich Hoffmann, Jean Baptiste van Helmont, William Brownrigg, Antoine Laurent Lavoisier and David Macbride. In the early 1770s, Swedish chemist Torbern Bergman and English scientist Joseph Priestley invented equipment for saturating water with carbon dioxide. In 1774, John Mervin Nooth demonstrated an apparatus that improved upon Priestley's design. In 1807, Henry Thompson received the first British patent for a method to saturate water with carbon dioxide. This bubbly water was commonly called soda water, even though it contained no soda.

The soda fountain originated in Europe in the 1850s but achieved its greatest success in the United States. It was not until 1888, when Jacob Baur, a pharmacist, founded the Liquid Carbonic Company, that fountain owners had a way to produce their own carbonated water. This increased revenue and reduced costs for the soda fountain owner. Many fountain drinks were flavored and effervesced to hide the taste of cocaine, caffeine, bromides or plant extracts. Prior to 1914, every drug was basically "over-the-counter." People did not need prescriptions from their doctors to purchase opiates, which were also found in some carbonated beverages such as Coca-Cola.

The two original main ingredients of Coca-Cola, originally a patent medicine, were cocaine and caffeine. The cocaine was derived from the coca leaf and the caffeine from kola nuts. The name Coca-Cola described the two ingredients—the "K" in kola was changed to a "C" for marketing purposes. Coca-Cola once contained an estimated nine milligrams of cocaine per glass, but in 1906, the narcotic was removed.

Cocaine was relatively unregulated and as easy to come by in the 1880s as sugar is today. In 1885, the U.S. manufacturer Parke-Davis sold cocaine in various forms, including cigarettes, powder and even a mixture that could be injected into the user's veins (a needle was included in the package). The company promised that its cocaine products would "supply the place of food, make the coward brave, the silent eloquent and ... render the sufferer insensitive to pain." The Sears & Roebuck catalogue, which was distributed to millions of American homes, offered a syringe and a small amount of cocaine for $1.50. Addicts were not in short supply.

Cocaine was not the only substance to which people were becoming addicted. It has been estimated that, in 1914, one out of every 400 U.S. citizens was addicted to opium. Opium addicts were mostly women, who were prescribed and dispensed legal opiates by physicians and pharmacists for "female problems," including menstrual pain.

In 1914, the Harrison Narcotic Act regulated opiate importation, production and distribution. The law eventually led to the prohibition of opiates—even with a doctor's prescription. Physicians who prescribed narcotics to addicts for "maintenance purposes" were prosecuted. In 1925, Linder v. United States ruled that the government cannot regulate medical practice. However, during the decade before that ruling, physicians were arrested and persecuted for prescribing narcotics.[19]

Though cocaine- and opiate-laced formulas were discarded, soda was here to stay. Some sodas, like Coca-Cola, still contain coca flavoring. The soda fountain might have continued to be the center of social life, even without opiates, if it were not for the rise of soda dispensers, which diminished the need to have an actual fountain. Prior to the arrival of the soda dispensers, the druggist would make his own syrup and would then add carbonated water and phosphate. But, the dispensers would take the pharmacist-made syrup and mix it with the carbonated water simultaneously. Eventually, soda companies bottled their own mixtures (eliminating the need for the pharmacists' special mixtures) and sent them to pharmacists, who just needed to add carbonated water. Soon, soda fountains were all dispensing the same sodas. The pre-mixed concoctions and hassle-free soda dispensers, which were meant to make life easier for the soda jerk, hastened the demise of the soda fountain. The dispensers and pre-mixed formulas built brand loyalty, as people could travel to different towns and still enjoy the same Coca-Cola, Pepsi or Orange Crush, three popular sodas of the time. Eventually these sodas were bottled so that they could be sold anywhere, which rendered the soda fountain obsolete.[20]

Library of Congress.

Soda jerk flipping ice cream into malted milk shakes. Corpus Christi, TX.

Courtesy Ben Swanson, DDS

Some druggists developed custom preparations that went on to become popular soft drinks, including Dr. Pepper, Coca-Cola, Hires Root Beer and Pepsi Cola.

PATENT MEDICINES AND PHARMACEUTICAL REGULATION

The name "patent medicine" dates back to the 17th century, when royalty endorsed certain preparations. "Letters patent" were issued to allow the advertiser of such medicines to publicize the royal endorsement. Patent medicines were not covered by any patent; chemical patents did not come into use in the United States until 1925 when the inventor Eugene Marcus won a suit to allow chemical structures and formulas to be used in patent claims. The name "patent medicine" has become particularly associated with certain drug compounds with colorful names and even more colorful claims peddled in the 19th century. Patent medicine advertising often emphasized exotic ingredients, even if the actual effects of the medicine came from more prosaic drugs. One memorable group of patent medicines—liniments that allegedly contained the universal panacea, snake oil—made *snake oil salesman* a lasting synonym for "charlatan." Many familiar names from the era live on in brands such as Luden's cough drops, Lydia E. Pinkham's vegetable compound for women, Fletcher's Castoria, and even Angostura bitters, which was once marketed as a stomach remedy. Many of these medicines, though sold at high prices, were made from rather inexpensive ingredients.

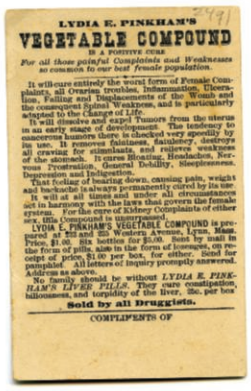
Small firms advertised their patent medicines in a "medicine show," a traveling circus of sorts that offered vaudeville-style entertainment on a small scale. The show climaxed in a pitch for the nostrum being sold. Muscle man acts were especially popular on these tours because they enabled the salesman to tout the physical vigor offered by the potion he was selling. The showmen frequently employed shills, who would step forward from the crowd and offer "unsolicited" testimonials about the benefits of the medicine for sale. Often, the nostrum "was manufactured" and bottled in the same wagon in which the show travelled.

When, around the turn of the century, journalists began to focus on the narcotic contents of patent medicines, some producers substituted acetanilide for these agents. However acetanilide, discovered in 1886, is a highly toxic, non-steroidal, anti-inflammatory drug that is highly toxic to the kidneys. The ingredient change probably killed more of the nostrum users than did the narcotics.

Wellcome Library, London. A medicine show; a charlatan holds up a phial, a miserable patient sits in the carriage and a black man in uniform bangs the drums.

Journalists and other investigators continued to publicize other incidents of death, drug addiction and hazards in a world where publishers relied heavily on the ads from patent medicine producers. In 1905, Samuel Hopkins Adams published the exposé, "The Great American Fraud," in *Collier's Weekly.* This, along with other literature—including Upton Sinclair's novel, *The Jungle*—eventually led to the passage of the first Pure Food and Drug Act in 1906. Nationwide regulation of the production and labeling of medications began with the Act, which was designed to prevent the abuses of the proprietary medicine industry. This legislation was the first step in prohibiting false and misleading statements about a product's effectiveness by requiring that labels list the presence and the amount of dangerous drugs, such as alcohol, morphine and heroin. However, the law was inadequate because there was no provision to control advertising. A 1911 Supreme Court decision ruled that the 1906 Act did not apply to false claims of therapeutic efficacy and that companies were not responsible for harm caused by misleading the public. A 1912 amendment added "false and fraudulent" claims of "curative or therapeutic effect" to the Act's definition of "misbranded." However, these powers continued to be narrowly defined by the courts, which set high standards for proof of fraudulent intent.

William P. Didusch Center for Urologic History. Courtesy of Ben Swanson, DDS.


LYDIA E. PINKHAM'S
VEGETABLE COMPOUND
IS A POSITIVE CURE
For all those painful Complaints and Weaknesses so common to our best female population.
It will cure entirely the worst form of Female Complaints, all Ovarian troubles, Inflammation, Ulceration, Falling and Displacements of the Womb and the consequent Spinal Weakness, and is particularly adapted to the Change of Life.
It will dissolve and expel Tumors from the uterus in an early stage of development. The tendency to cancerous humors there is checked very speedily by its use. It removes faintness, flatulency, destroys all craving for stimulants, and relieves weakness of the stomach. It cures Bloating, Headaches, Nervous Prostration, General Debility, Sleeplessness, Depression and Indigestion.
That feeling of bearing down, causing pain, weight and backache is always permanently cured by its use. It will at all times and under all circumstances act in harmony with the laws that govern the female system. For the cure of Kidney Complaints of either sex, this Compound is unsurpassed.
LYDIA E. PINKHAM'S VEGETABLE COMPOUND is prepared at 233 and 235 Western Avenue, Lynn, Mass. Price, $1.00. Six bottles for $5.00. Sent by mail in the form of pills, also in the form of lozenges, on receipt of price, $1.00 per box, for either. Send for pamphlet. All letters of inquiry promptly answered. Address as above.
No family should be without LYDIA E. PINKHAM'S LIVER PILLS. They cure constipation, biliousness, and torpidity of the liver. 25c. per box.
Sold by all Druggists.
COMPLIMENTS OF

Lydia Pinkham's Vegetable Compound Trade Card.

By the 1930s, journalists, consumer protection organizations and federal regulators began advocating for stronger regulatory authority of product advertising. They publicized a list of injurious products that had been ruled permissible under the 1906 law, including radioactive beverages, cosmetics that caused blindness, and worthless "cures" for diabetes and tuberculosis. Subsequently, members of Congress proposed a new law but were unable to get it passed for five years. It was finally enacted following the public outcry over the 1937 Elixir Sulfanilamide Tragedy, in which more than 100 people died after using a drug prepared with a toxic solvent.

In 1938, President Franklin D. Roosevelt signed the *Food, Drug and Cosmetic Act* into law. The new law significantly increased federal regulatory authority over drugs by mandating a pre-market review of the safety of all new drugs, as well as banning false therapeutic claims in drug labeling, without requiring that the U.S. Food and Drug Administration (FDA) prove fraudulent intent. The law also authorized factory inspections, expanded enforcement powers, set new regulatory standards for foods, and brought cosmetics and therapeutic devices under federal regulatory authority. In 1962, a significant amendment was made to this law: proof of efficacy became necessary for FDA approval.

Modern pharmacy has changed substantially since the days of patent medicines. Fewer prescriptions require the pharmacists to compound the medicine in house. In the 1920s, 80 percent of prescriptions required some knowledge of compounding. By 1971, only a fraction of all prescriptions required compounding knowledge. Instead, pharmacists now needed to know such facts as the length of shelf life and the effect of light exposure, and they were required to judge the reliability and reputation of the manufacturers.[21]

Despite a decrease in pharmaceutical compounding, today's pharmacist is busier than ever. There are more pharmaceuticals now than ever before.

Tried and true antibiotics now share shelf space with whole new classes of drugs, including chemotherapy agents, antiretroviral drugs, antispasmodics, blockers and inhibitors, which, over the past 50 years, have significantly enhanced the physician's medical arsenal in ways unimaginable even decades ago. These drugs have revolutionized the way we treat killer diseases such as cancer and acquired immune deficiency syndrome (AIDS), and created a cache of preventive measures that today help us to slow the progression of debilitating diseases such as Alzheimer's. With the ever-increasing number of drugs that come to market each year, pharmacists must continue to stay abreast of industry developments through continuing education and maintaining a working knowledge of all modern pharmaceuticals, including drug interactions and side effects.

Many would agree that modern pharmacists still play as significant a role in the communities as their predecessors did at the dawn of the specialty.

PHARMACEUTICAL GIANTS

The 19th century ushered in an era of unprecedented change for the medical community. Wars around the globe, including the Crimean War in Europe and the Civil War in the United States—sparked significant advances in the field, including the advent of germ theory, sanitation, triage and medical transport, anesthesia, nursing and, of course, pharmaceuticals. Some of today's major pharmaceutical companies are rooted in this era, including Lilly, Bayer, Merck and Pfizer—all of which have had significant impacts on the field of urology.

LILLY

Eli Lilly, who studied pharmacology at Asbury College (now known as Depauw University), opened his first drug store in Greencastle, IN, in 1860. The young pharmacist joined the Union Army and later organized and served as a captain in the 18th Indiana Battery of Light Artillery. After serving in the 121st Regiment of the 9th Indiana Cavalry, Eli was promoted to colonel and mustered out in August 1865. Following several business ventures (which included two unsuccessful partnerships) Lilly opened a new pharmaceutical manufacturing firm in 1876 in a small two-story building on Pearl Street in downtown Indianapolis. This was the beginning of Eli Lilly and Company.

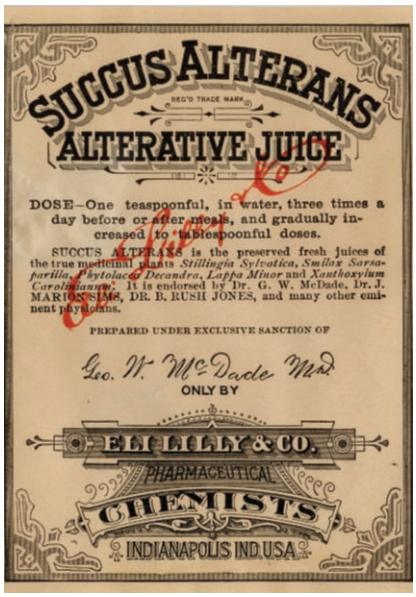
Although the business flourished, Lilly soon discovered that existing methods for testing the quality of drug products were antiquated. In 1886, the company hired its first chemist, Ernest Eberhardt, who devised a system for testing the quality and purity of all raw materials to be used for Lilly products. His arrival also marked the beginning of the company's formal research program, which expanded into the research, development and discovery of new pharmaceuticals.

Lilly Archives. | Josiah K. Lilly Sr. and Scientist Ernest Eberhardt.

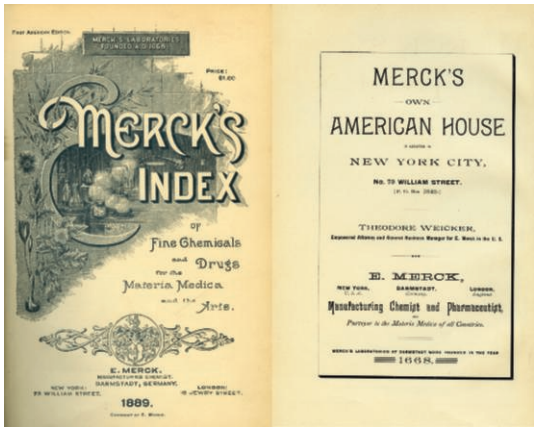
Frustrated by the often ineffective and haphazardly prepared medicines of his day, Colonel Lilly promised that he would:

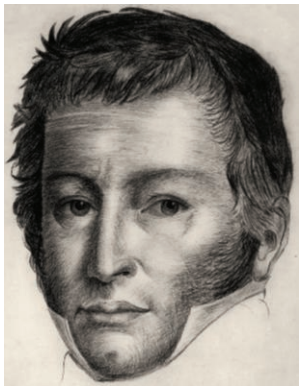
- manufacture pharmaceutical products of the highest possible quality;
- develop medicines that would be dispensed only by the medical profession;
- produce pharmaceutical products based on the best science of the day.

Lilly posted a profit of $1,952.17 by 1877, and the company was incorporated in 1881. One of its earliest innovations was gelatin-coated capsules. Other early major contributions to medicine include the manufacture of vaccines, animal and human insulin, liver extract, and a wide range of antibiotics. The company remained family-operated by the Colonel's only son, Josiah K. Lilly Sr., and grandsons Eli and Josiah Jr., until 1953.



c. 1886. Lilly Archives. | Succus Alterans Label from Eli Lilly and Company.





Heinrich Emanuel Merck.

MERCK The history of Merck & Co., Inc dates back to 1668 when Friedrich Jacob Merck, an apothecary, established a chemical firm in Darmstadt, Germany. This store remained in the Merck family for generations. In the centuries that followed, Merck's descendants would make a number of contributions to medicine and pharmacy, including the 1848 isolation of papaverine—an alkaloid used in the treatment of vasospasm—by Georg Franz Merck (1825-1873).

The modern company's beginnings date back to Heinrich Emanuel Merck (1794-1855), who owned the Engel Pharmacy in Darmstadt. Heinrich was producing alkaloids in his pharmacy as early as 1827. In 1850, he founded a company with his three sons, Karl, Wilhelm and Georg Franz. This creation of Merck & Co. was the birth of the pharmaceutical giant that exists today. Georg was sent to the United States to strengthen Merck's reputation for high-quality products and, by 1880, he had established a company subsidiary in New York.

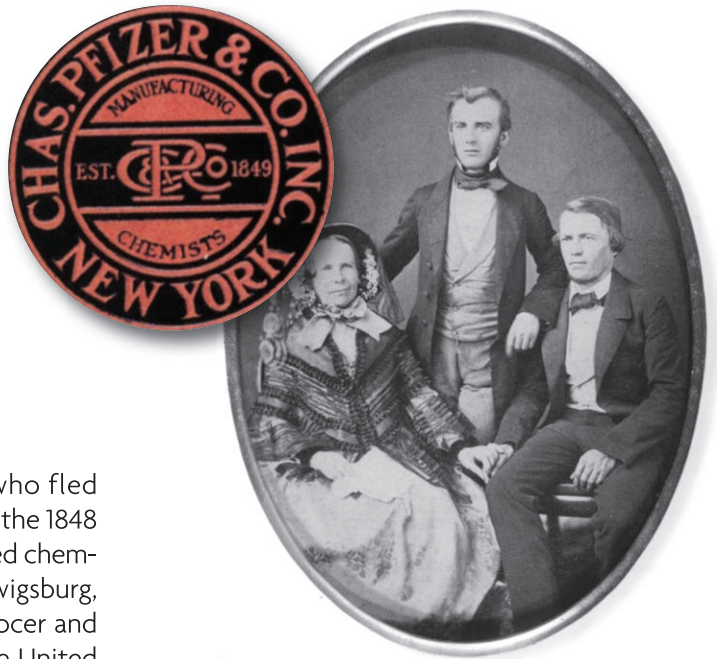
After the United States entered World War I in 1917, German-owned chemical companies were targeted by Judge Alexander Mitchell Palmer, who would ultimately become notorious for his seizure and sale of properties belonging to resident aliens. Following an announcement that all German-owned chemical companies in the United States "would be thoroughly Americanized," Merck was seized, along with the Bayer Co. and Rohm and Haas in New Jersey. Georg Merck, a long-time American citizen, protested the maneuver but, despite several rounds of intense negotiation, Palmer decided to sell Merck & Co. at a public auction. Fortunately, the company was in solid financial condition at the time and Merck was able to persuade his banking companies, Goldman Sachs and Co. and Lehman Bros., to get involved. The auction took place at the Merck & Co. office in New York on May 9, 1919. Merck's representative was among the five who bid fiercely for the company and ultimately made the winning bid of $3.75 million. Georg Merck again had control of his company.

c. 1915. Harvard University Library. | George Wilhelm Merck.

Georg's son, George Wilhelm, became president of the company in 1925. George went on to expand the company's factory facilities in New Jersey and guided it through several mergers. Not a scientist himself, George began assembling a scientific team to create new drugs, and sought new approaches to sell Merck products, which by this time included penicillin, streptomycin and cortisone. The merger of the company with Baltimore-based Sharp and Dohme facilitated the transformation of Merck from a chemical company to a full pharmaceutical producer and distributor. Merck's acquisition of this company provided both a larger market for major products, and also a nationwide network of salesmen experienced in dealing with both physicians and pharmacies. Merck, Sharp and Dohme, as the company was then named, was able to compete effectively with other large companies, such as the Upjohn Company, E.R. Squibb and Eli Lilly and Company.

William P. Didusch Center for Urologic History.

Pharmaceutical Giants



c. 1885-1860
Pfizer Inc.

Wilhelmine Klotz Erhart; her son, Karl Erhart (seated); and her nephew Karl Pfizer.

PFIZER Karl Pfizer was one of the thousands who fled Germany and emigrated to the United States following the 1848 revolution of German Democrats. Pfizer, who had studied chemistry as an apothecary's apprentice while living in Ludwigsburg, was joined by his older cousin, Karl Erhart, a skilled grocer and confectioner. Realizing that the industrialization of the United States at that time called for a number of chemicals in agriculture, manufacturing and other industries, the two settled in Brooklyn, NY, and opened a chemical shop in a small brick building. The goal of Charles Pfizer & Co. was two-fold: to develop improved chemical products for U.S. industry and to produce them in the United States. Domestic production allowed the company to sell its products at a much lower price than did foreign competitors, whose profits were impacted by stiff import taxes. The company's first product was an almond-and-toffee flavored candy cone containing santonin, a common treatment for dysentery that was so bitter that few could stand to ingest it in its pure form. The product was an immediate success.

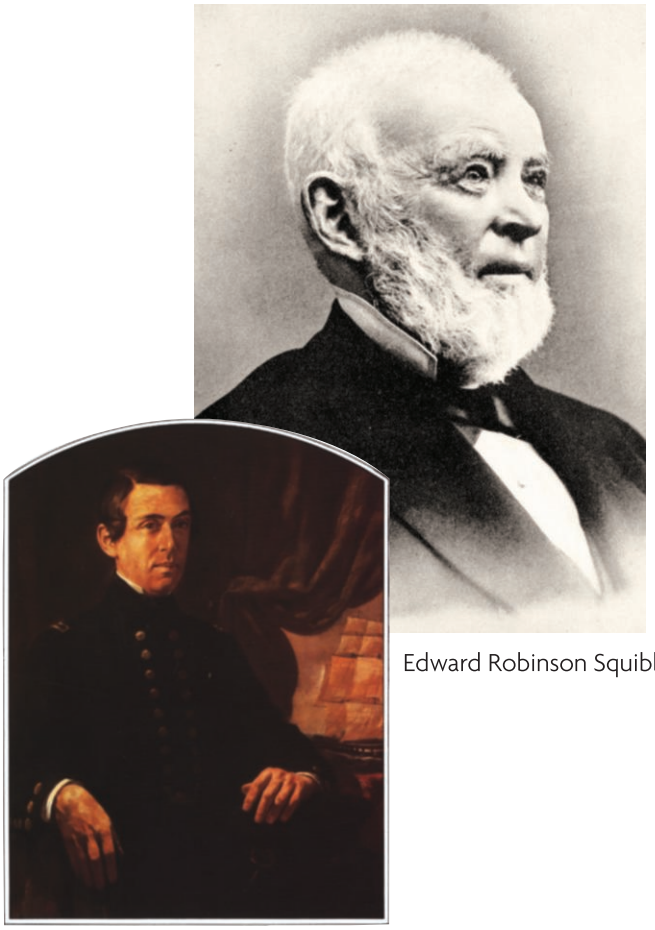
Production of painkillers, preservatives and disinfectants at Charles Pfizer & Co. increased dramatically to meet demand created by the U.S. Civil War. The company produced iodine in large quantities, along with drugs such as morphine, chloroform and camphor, and an array of purgatives, fungicides and mercurials. After the war, using imported lemon and lime concentrates the company began to manufacture citric acid, a popular chemical used for a variety of purposes, including paper making, iron oxide dissolution, and flavoring foods and soft drinks.

The outbreak of World War I impacted production as military blockades made shipping increasingly difficult. To decrease its reliance on imported materials, Charles Pfizer & Co. developed a fermentation process to mass produce citric acid from sugar. The chemists' use of deep-tank fermentation (pumping sterile air through the liquid and blending it with electrical mixers) improved production. The technique, however, would go on to serve a much more critical role in pharmaceutical production—it held the key to the mass production of penicillin.

In the dark days of the Great Depression, Pfizer income fell by more than half, but the company's owners avoided mass layoffs by investing personal funds to maintain employment. In 1932, Emile Pfizer, who did not want to lose good workers, donated $250,000 in personal funds to keep workers employed, even if all they did was paint and clean.

In 1941, when the U.S. government made a mass appeal to companies for penicillin, Pfizer, with its deep-tank fermentation technology, answered the call. The company became the largest producer of the miracle drug. In fact, Pfizer manufactured the bulk of the penicillin carried by troops on D-Day.

Like other pharmaceutical companies of the time, Pfizer began to expand its operations across the globe in the decades following World War II. The company's expansion incorporated acquisitions such as the Desitin Chemical Company (which produced over-the-counter products such as Visine® eye drops, the analgesic BenGay® and Desitin® ointment). In the urologic community, Pfizer's best-known breakthrough is Viagra®(sildenafil citrate), the first drug of its class used to treat a seldom-discussed condition: erectile dysfunction (ED). The drug was launched in 1998 and its benefits were initially touted by former U.S. Senator Robert "Bob" Dole. Senator Dole was present at the 1999 Annual Meeting of the American Urological Association to speak to urologists about his experience with the drug, and many credit him with the de-stigmatization of ED.



Edward Robinson Squibb

E.R. SQUIBB

Edward Robinson Squibb founded his pharmaceutical company in 1856 in Brooklyn, NY. A life-long crusader for safe and reliable pharmaceuticals, he insisted on the production of consistently pure medicines. His reputation as an honest and expert drug maker led to his appointment by both the Union Navy and the Army during the Civil War to help them establish their own pharmaceutical laboratories. He tested, assayed and set standards for drug production, reminding his team, *"You do not kill one, you kill by thousands."* He personally signed labels of products he had tested or made, and would ultimately go on to propose legislation in 1879 that would become the model for the Pure Food and Drug Act of 1906. By the end of the 19th century, Squibb had passed most of the responsibility for the management of his company to his sons, Charles and Edward. Through mergers and acquisitions over the years, E.R. Squibb became known as the modern-day Bristol-Myers Squibb.

c. 1930.
Wellcome Library, London.

Ether can: E.R. Squibb & Sons/New York. Metal-capped canister containing 100g of ether. The cans in which ether was sold were adapted by P.J. Flagg of New York for emergency anaesthesia and recommended for military use.

CONCLUSION

From the herbal remedies of old to the biochemical breakthroughs of late, the field of pharmacy has dramatically changed every medical specialty. Urology, a surgical specialty, has been uniquely affected. Drugs allow us to treat conditions that previously required more invasive action. Because of the advances in the field of pharmacy, we can all live healthier lives and cope with chronic diseases that would otherwise be debilitating.

However, there are trade-offs. Today, people often forego lifestyle changes to improve their health problems, counting on drugs to treat their every ill. Furthermore, antibiotica are possibly the closest humankind has come to creating a true panacea, yet they have been over-prescribed and abused to the point of creating nearly invincible superbugs, such as methicillin-resistant Staphylococcus aureus (MRSA) or clostridium difficile (CD). Is our quest for a cure creating incurable killers? And who will win— man or microbe?

ENDNOTES

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Date	Time	Topic
Saturday, April 25	3:00 PM–4:00 PM	Individualizing Treatment with CIALIS® (tadalafil)
Sunday, April 26	12:00 PM–1:00 PM	Other Considerations for Treatment with CIALIS® (tadalafil) • Important Safety Considerations for Treatment with CIALIS® (tadalafil) • Evaluating Individual Patient Needs

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	11:30 AM–11:50 AM	Important Safety Considerations for Treatment with CIALIS® (tadalafil)
	1:30 PM–1:50 PM	Individualizing Treatment with CIALIS® (tadalafil)
	2:30 PM–2:50 PM	CIALIS® (tadalafil) Review Article from *Current Medical Research and Opinion*
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	1:00 PM–1:20 PM	CIALIS® (tadalafil) Review Article from *Current Medical Research and Opinion*
	3:00 PM–3:20 PM	Important Safety Considerations for Treatment with CIALIS® (tadalafil)
Tuesday, April 28	9:30 AM–9:50 AM	Evaluating Individual Patient Needs
	11:00 AM–11:20 AM	Individualizing Treatment with CIALIS® (tadalafil)
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