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World History of Pharmacy

- Key Moments in Pharmacy's History -

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The beginning of pharmacy

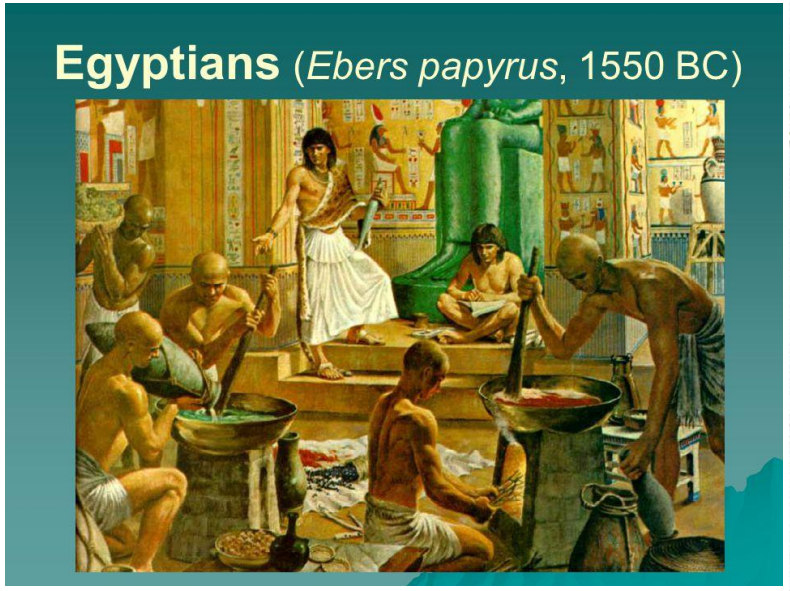
- “Shaman” (샤먼, 주술사, 무당)
- Before then, pharmacy evolved from antiquity as part of medicine.
- Prehistoric pharmacy: the use of medicinal plants in pre-history.

Doctor and pharmacist, illustration from *Medicinarius* (1505) by Hieronymus Brunschwig.

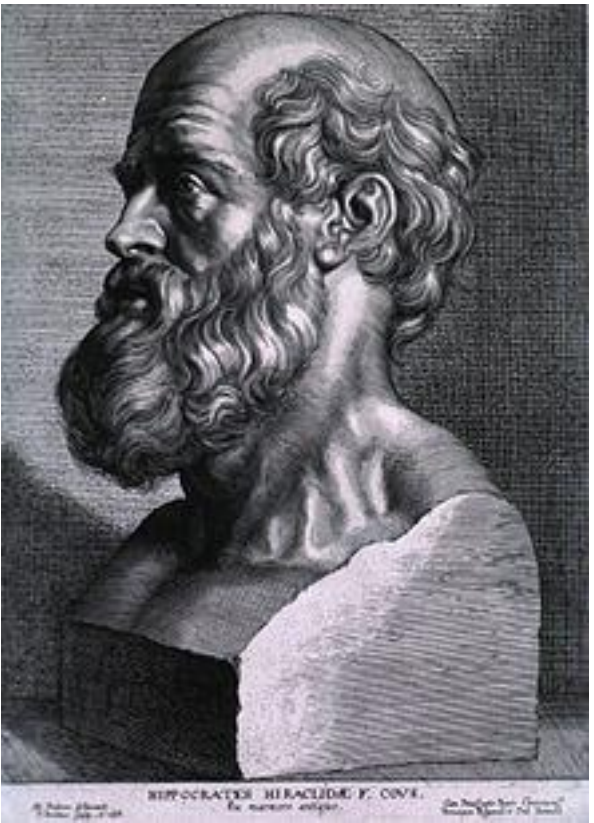
I. Antiquity (고대)

- Sumerian cuneiform tablets (수메르 점토판) record prescriptions for medicine (~2100 BC).
- The first pharmaceutical text is written on clay tablets by the Mesopotamians. Some of the formulas and instructions on the tablets include pulverization, infusion, boiling, filtering, and spreading. In addition to herbs, ingredients such as beer, tree bark, and wine are mentioned.
- Ancient Egyptian pharmacological knowledge was recorded in various papyri such as the *Ebers Papyrus* of 1550 BC, and the *Edwin Smith Papyrus* of the 16th century BC.

Papyrus Ebers



- In Ancient Greece, according to Edward Kremers and Glenn Sonnedecker, "before, during and after the time of Hippocrates there was a group of experts in medicinal plants.
- Probably the most important representative of these *rhizotomoi* (root collector) was Diocles of Carystus (4th century BC).
- He is considered to be the source for all Greek pharmacotherapeutic treatises between the time of Theophrastus and Dioscorides."

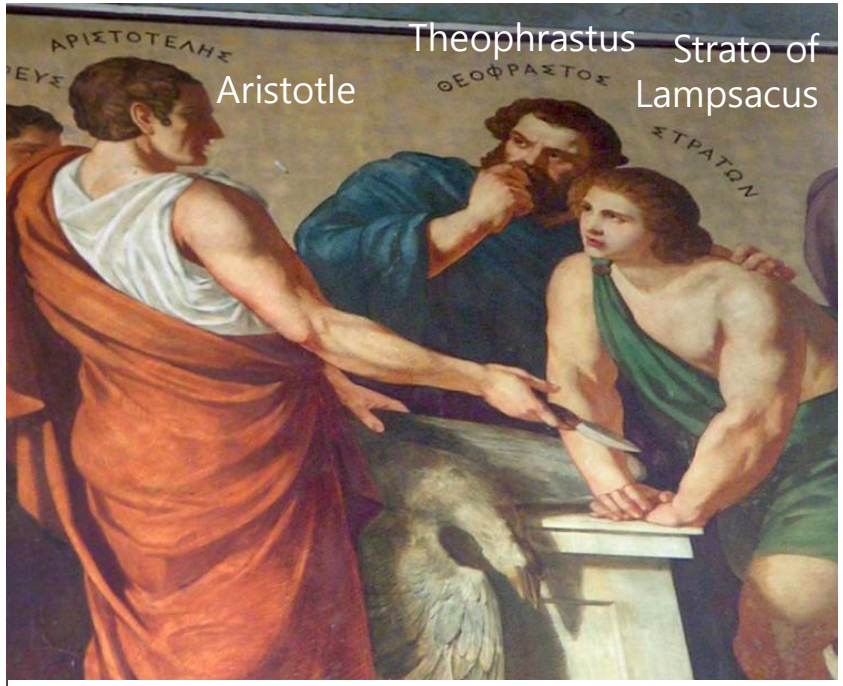


Hippocrates
- BC 460년 - BC 370년, 그리스
- His treatises, *Aphorisms* and *Prognostics*, discuss 265 drugs, the importance of diet and external treatments for diseases

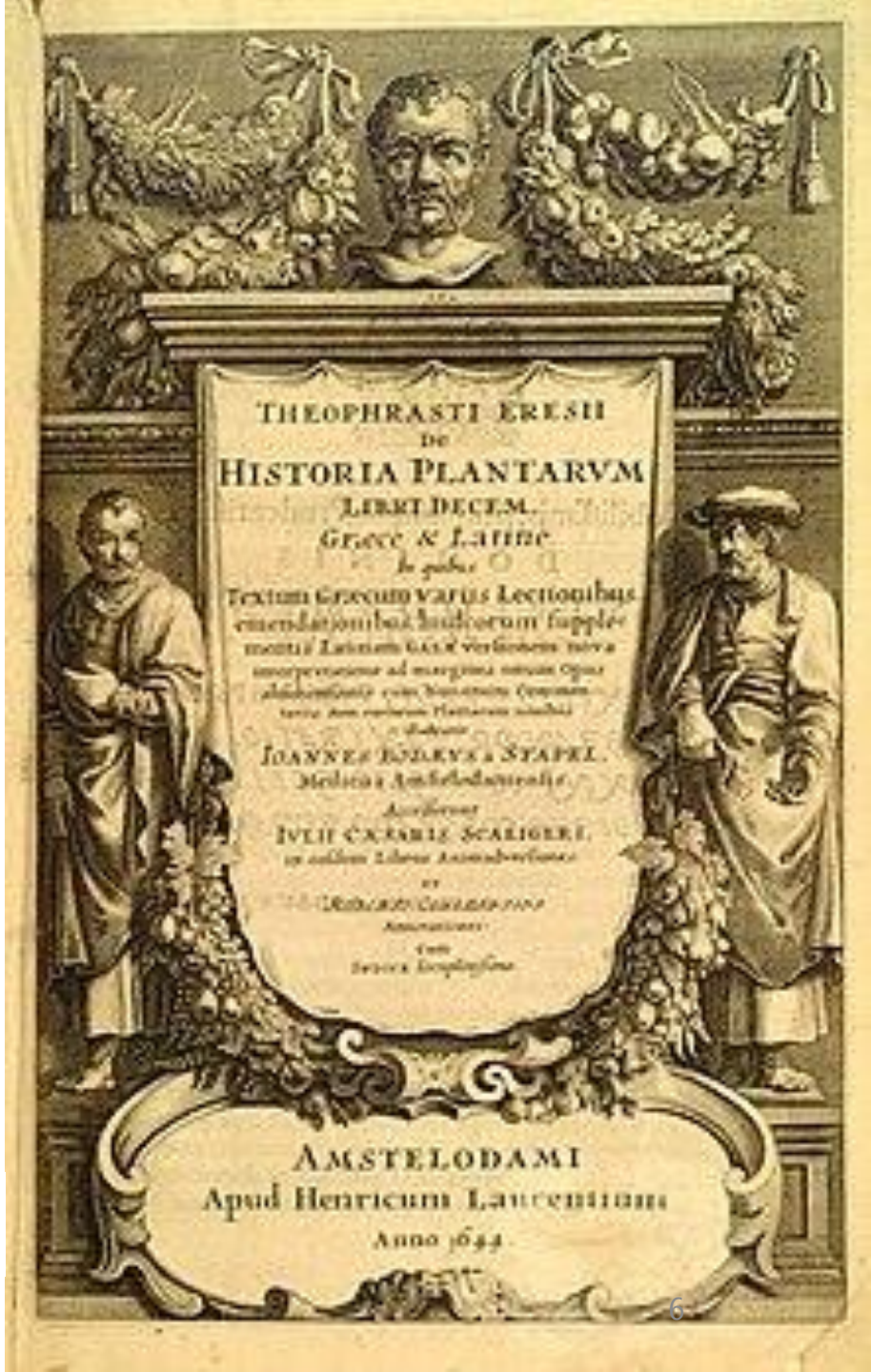
Diocles of Carystus
BC 375년 - BC 295년, 그리스

Theophrastus of Eresos (BC 371 – BC 287)

- Greek native of Eresos in Lesbos (에게해 작은 섬)
- The grandfather of botany
- The successor to Aristotle in the Peripatetic school
- Wrote two surviving books:
  - '*Enquiry into Plants* (*Historia Plantarum*)'
  - '*On the Causes of Plants*'



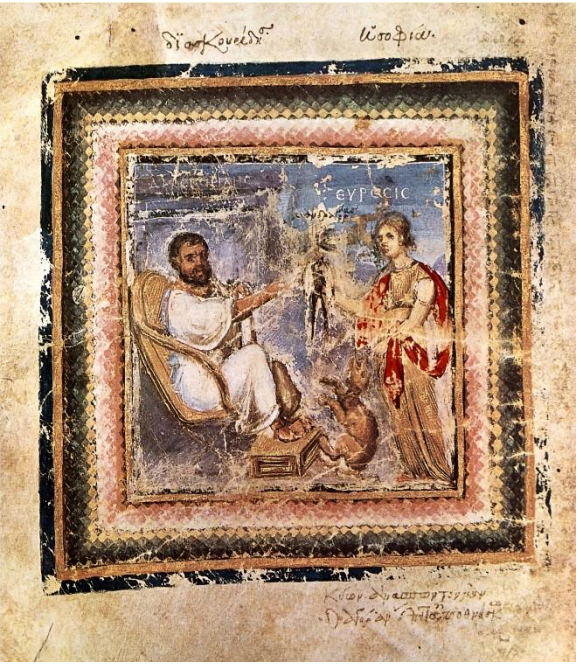
Part of a fresco in the portico of the University of Athens painted by Carl Rahl, c. 1888

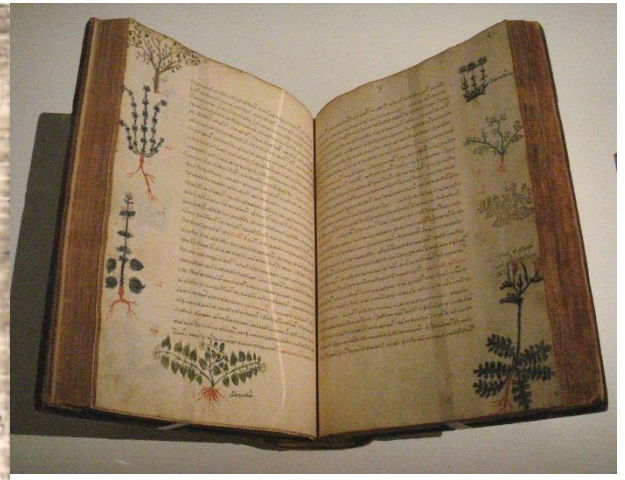


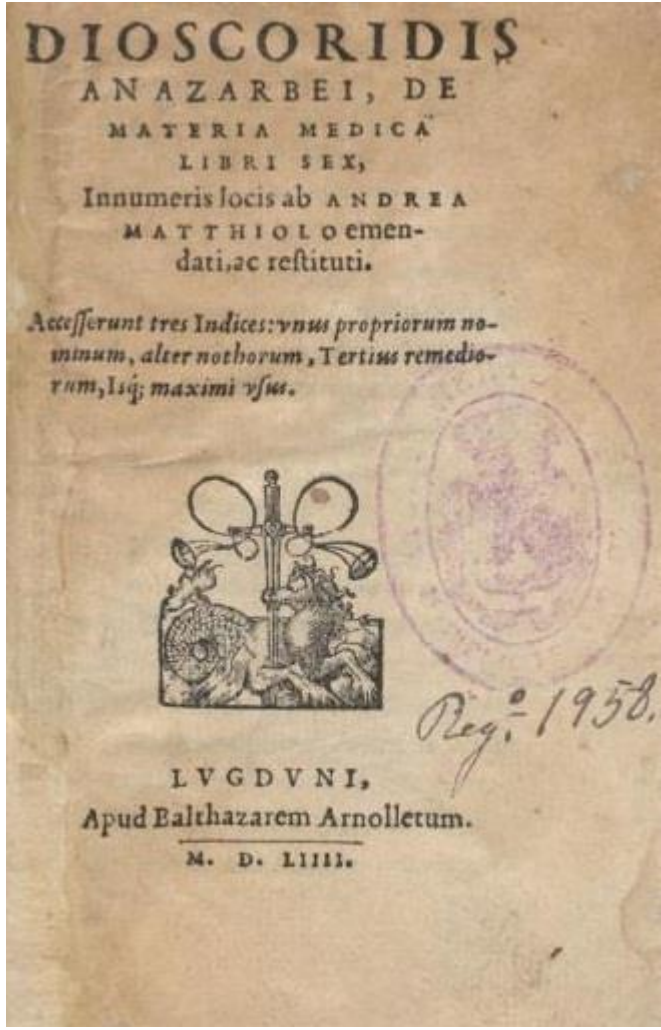
- The Greek physician Pedanius Dioscorides wrote a five volume book, *De Materia Medica* *(on medical material)*. ➔ the standard of drugs
- It formed the basis for many medieval texts, and was built upon by many middle eastern scientists during the Islamic Golden Age.
- The title coined the term *materia medica* *(English: medical material/substance)*
- There is a stone sign for a pharmacy with a tripod, a mortar, and a pestle opposite one for a doctor in the Arcadian Way in Ephesus, Turkey.

Pedanius Dioscorides (BC 40 ~ AD 90):

- a Greek physician, pharmacologist, botanist, and author of *De Materia Medica*
- a 5-volume Greek encyclopedia about herbal medicine and related medicinal substances (a pharmacopeia), that was widely read for more than 1,500 years.
- He was employed as a medic in the Roman army.

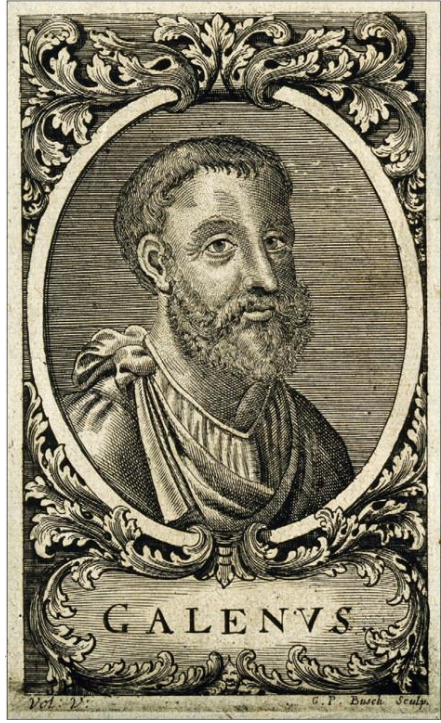




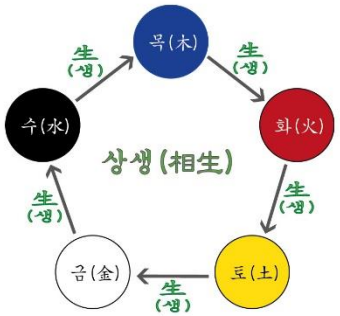


Dioscorides, *De Materia Medica*, Byzantium, 15th century

Galen (129 AD ~ 210 AD)



- Galen of Pergamon, a Greek physician, surgeon, pharmacist and philosopher in the Roman Empire.
- Arguably the most accomplished of all medical researchers of antiquity.
- He compiled an extensive record of the medical knowledge of his day and added his own observations.
- He wrote on the structure of organs, but not their uses; the pulse and its association with respiration; the arteries and the movement of blood; and the uses of theriacs.
- Galen introduces compounding, a process of mixing two or more medicines to meet the individual needs of a patient. Compounding is still practiced today for patients with special needs or for unique prescriptions.
- "In treatises such as *On Theriac to Piso*, *On Theriac to Pamphilius*, and *On Antidotes*, Galen identified theriac (만병통치약) as a sixty-four-ingredient compound, able to cure any ill known".
- His work was rediscovered in the 15th century and became the authority on medicine and healing for the next two centuries.
- His medicine was based on the regulation of the four humors [blood, phlegm (점액질), black bile, and yellow bile] and their properties (wet, dry, hot, and cold).
- Sanguine (다혈적인, 낙관적인) = Blood = Air = Spring = Adolescence = Heart = hot/moist
- Choleric (화를 잘 내는, 노란 담즙질적인) = Yellow Bile = Fire = Summer = Childhood = Gall Bladder = hot/dry
- Phlegmatic (냉정한, 점액질적인) = Phlegm = Water = Autumn = Maturity = Brain = cold/moist
- Melancholic (우울한, 검은 담즙질적인) = Black Bile = Earth = Winter = Old age = Spleen = cold/dry



II. Ancient India

- In India, the **Ayurveda** is traditional medicine that emphasizes plant-based treatments, hygiene, and balance in the body's state of being.
- Indian materia medica included knowledge of plants, where they grow in all season, methods for storage and shelf life of harvested materials.
- It also included directions for making juice from vegetables, dried powders from herb, cold infusions and extracts.

A typical Ayurvedic pharmacy, Rishikesh.

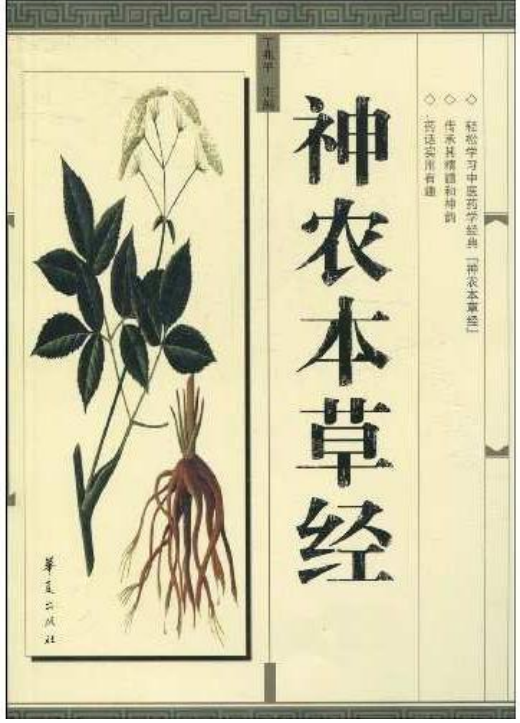
Nagarjuna, known chiefly for his doctrine of the *Madhyamaka* (middle path). He wrote the medical works *The Hundred Prescriptions* and *The Precious Collection*, among others.

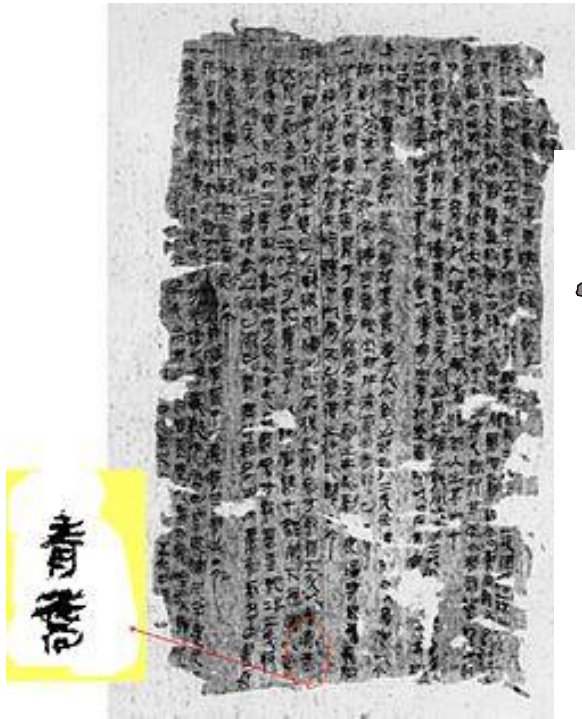
- The earliest known compilation of medicinal substances in Indian traditional medicine dates to the 3rd or 4th century AD)(attributed to Sushruta, who is recorded as a physician of the 6th century BC).

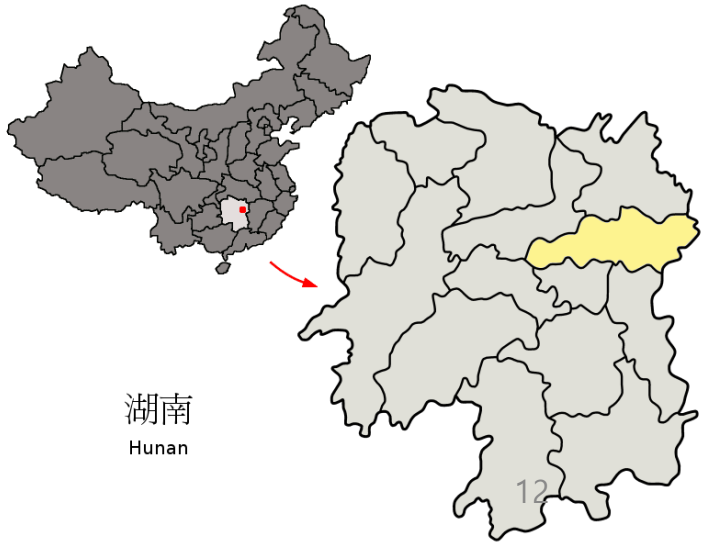
an ancient Indian physician, known as the main author of the treatise *The Compendium of Suśruta.*

III. Ancient China

- The earliest known Chinese manual on materia medica is the *Shennong Bencao Jing* (신농본초경, *The Divine Farmer's Herb-Root Classic*), dating back to the 1st century AD. It was compiled during the Han dynasty (206 BC ~ 9 AD) and was attributed to the mythical Shennong.
- Earlier literature included lists of prescriptions for specific ailments, exemplified by a manuscript "*Recipes for 52 Ailments*", found in the Mawangdui [馬王堆(마왕퇴), 중국 장사(長沙) 고(古) 유적지,], sealed in 168 BC.
- Further details on Chinese pharmacy can be found in the Pharmacy in China article.







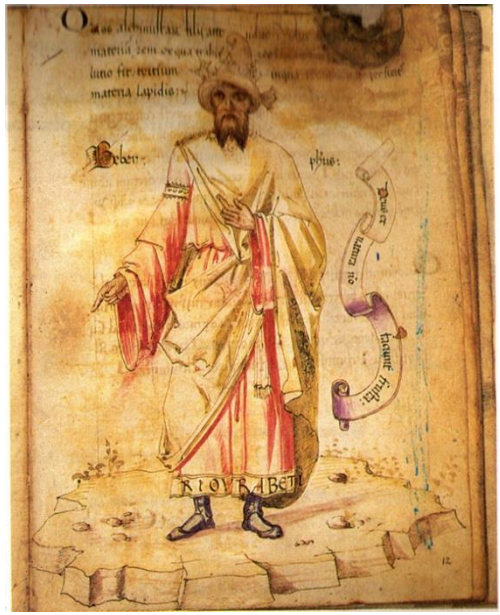
IV. Ancient Japan

- In Japan, at the end of the Asuka period (538-710) and the early Nara period (710-794), the men who fulfilled roles similar to those of modern pharmacists were highly respected. The place of pharmacists in society was expressly defined in the Taihō Code (701) and re-stated in the Yōrō Code (718).
- Ranked positions in the pre-Heian Imperial court were established; and this organizational structure remained largely intact until the Meiji Restoration (1868). In this highly stable hierarchy, the pharmacists—and even pharmacist assistants—were assigned status superior to all others in health-related fields such as physicians and acupuncturists.
- In the Imperial household, the pharmacist was even ranked above the two personal physicians of the Emperor.

V. Middle Ages

Abbasid Caliphate

- In Baghdad the first pharmacies, or drug stores, were established in 754, under the Abbasid Caliphate **(압바스 왕조, 750 ~ 1258)** during the Islamic Golden Age.
- By the 9th century, these pharmacies were state-regulated.
- The advances made in the Middle East in botany and chemistry led medicine in medieval Islam substantially to develop pharmacology.
- **Jabir Ibn Hayyan** (721-815, Persian; "**Geber**" in the west)
  - ✓ a polymath: a chemist and alchemist, astronomer and astrologer, engineer, geographer, philosopher, physicist, and pharmacist and physician. ➔ God Father of modern chemistry.
  - ✓ Born and educated in Tus, he later traveled to Kufa. He has been described as the father of early chemistry.
  - ✓ Prepared Nitric acid, Sulphuric Acid, Hydrochloric Acid.
  - ✓ Chemical technique: Sublimation distillation, melting & crystallization.
  - ✓ Composition of "Alchemy".



15th-century European portrait of "Geber"

- **Muhammad ibn Zakarīya Rāzi** (**Rhazes** in the west) (865-915), for instance, acted to promote the medical uses of chemical compounds.

✓Father of pediatrics

✓“Arbian Medicine”

- **Abu al-Qasim al-Zahrawi** (**Abulcasis** in the west) (936-1013) pioneered the preparation of medicines by sublimation and distillation.

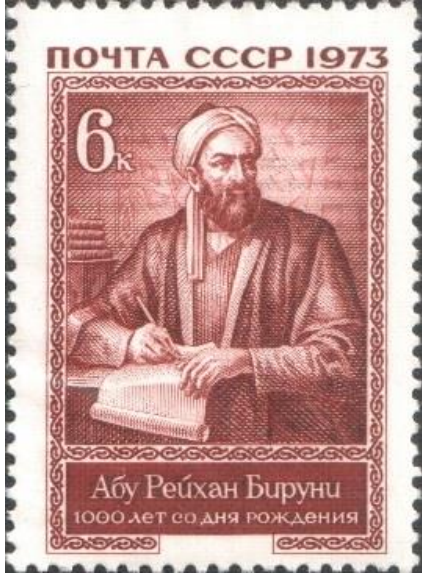
✓ His *Liber servitoris* is of particular interest, as it provides the reader with recipes and explains how to prepare the `simples’ from which were compounded the complex drugs then generally used.

✓ Invented surgical instruments (~200 species)

✓ Placed artificial tooth instead of diseased

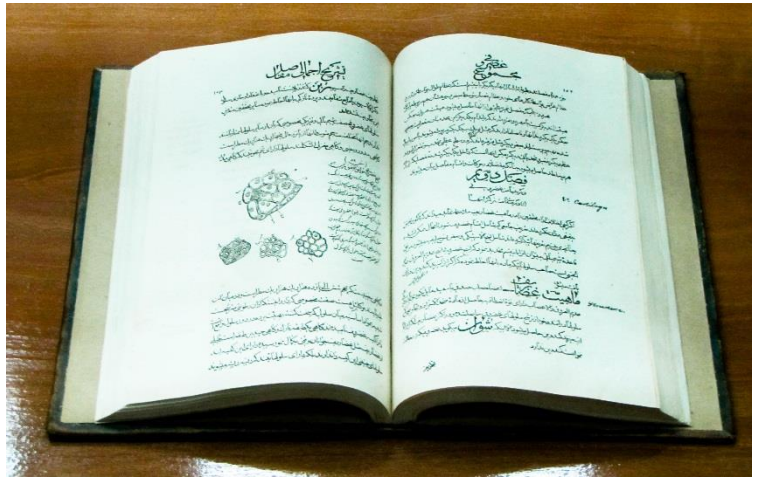
✓ “Al-Tasrif” (medical encyclopaedia)

- **Sabur Ibn Sahl** (d 869), was, however, the first physician to initiate pharmacopoedia, describing a large variety of drugs and remedies for ailments.
- **Al-Biruni** (973-1050) wrote one of the most valuable Islamic works on pharmacology entitled *Kitab al-Saydalah* (*The Book of Drugs*), where he gave detailed knowledge of the properties of drugs and outlined the role of pharmacy and the functions and duties of the pharmacist.
- **Ibn Sina** (Avicenna, 980-1037), too, described no less than 700 preparations, their properties, mode of action and their indications. He devoted in fact a whole volume to simple drugs in *The Canon of Medicine*.



Al-Biruni (973-1050)

The Canon of Medicine



Ibn Sina (Avicenna)
(980-1037)

- Of great impact were also the works by al-Maridini of Baghdad and Cairo, and Ibn al-Wafid (1008–1074), both of which were printed in Latin more than fifty times, appearing as *De Medicinis universalibus et particularibus* by `Mesue the Younger', and the *De mdicamentis simplicibus* by `Abenguefit'.
- 'Mesue the Younger' wrote books called the *Antidotarium sive Grabadin medicamentorum*, which remained for centuries the standard textbook of pharmacy in the West.
- Abenguefit (997-1074):
  - Ali Ibn al-Husain Ibn al-Wafid al-Lakhmi, known in Latin Europe as Abenguefit, was an Arab pharmacologist and physician from Toledo, Spain.
  - His main work is *Kitāb al-adwiya al-mufrada* (,كتاب الأدوية المفردة translated into Latin as *De medicamentis simplicibus*).
  - a pharmacist in Toledo, and he used the techniques and methods available in alchemy to extract at least 520 different kinds of medicines from various plants and herbs.

Al-Maridini of Baghdad =
Masawaih al-Mardini =
Known as 'Mesue the Younger'
(925 – 1015)

- Al-Muwaffaq (840-891)'s contributions in the field are also pioneering.

- an Abbasid prince and military leader
- Living in the 10th century, he wrote *The foundations of the true properties of Remedies*, amongst others describing arsenious oxide, and being acquainted with silicic acid.
- He made clear distinction between sodium carbonate and potassium carbonate, and drew attention to the poisonous nature of copper compounds, especially copper vitriol, and also lead compounds. He also describes the distillation of sea-water for drinking.

- In *Europe* pharmacy-like shops began to appear during the 12th century.
- In 1240 emperor Frederick II issued a decree by which the physician's and the apothecary(약제상)'s professions were separated and issued issues an edict for the first time in Europe completely separating the professions of physicians and pharmacists, and issuing professional regulations for both.
- In Europe there are old pharmacies still operating in Dubrovnik, Croatia located inside the Franciscan monastery, opening in 1317; and one in the Town Hall Square of Tallinn, Estonia dating from at least 1422.

Frederick II (26 December 1194 – 13 December 1250; Sicilian: *Fidiricu*, German: *Friedrich*) was King of Sicily from 1198, King of Germany from 1212, King of Italy and Holy Roman Emperor from 1220 and King of Jerusalem from 1225.

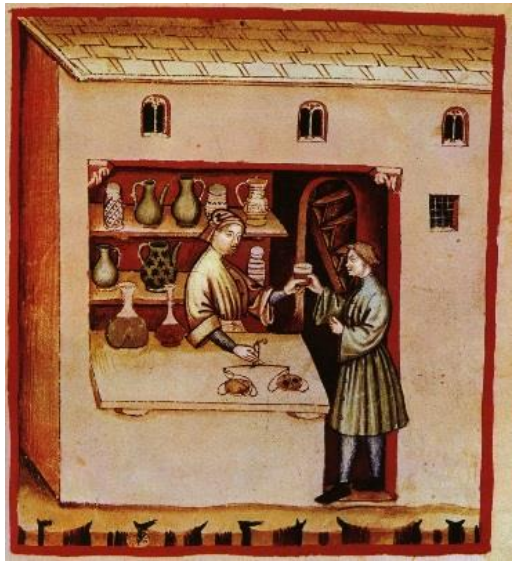


Illustration of a pharmacy in the Italian *Tacuinum sanitatis*, 14th century.

Sign of Apteek Muuseum the pharmacy museum in old town Tallinn Estonia Europe

- The oldest pharmacy is claimed to be set up in 1221 in the Church of Santa Maria Novella in Florence (피렌체), Italy, which now houses a perfume museum.
- The medieval Esteve Pharmacy, located in Llívia (in the comarca of Cerdanya, Catalonia, Spain), a Catalan enclave close to Puigcerdà, is also now a museum dating back to the 15th century, keeping albarellos from the 16th and 17th centuries, old prescription books and antique drugs.
- The Republic of Venice (베네치아공화국, 697-1797) was the first State with health modern policies which requires that the nature of the drug is public. In actuality, thirteen secrets survive which were offered to sale to the Venetian Republic.

The Church of Santa Maria Novella In Florence (피렌체)

Medieval Esteve Pharmacy

The Republic of Venice in 1789

Cupboard of the Esteve Pharmacy

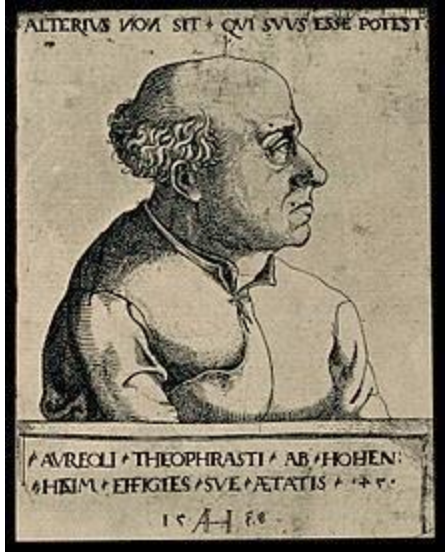
- **Valerius Cordus (1515-1544, German): German physician and botanist** who authored one of the greatest pharmacopoeias and one of the most celebrated herbals in history. He is also widely credited with developing a method for synthesizing ether (which he called by the poetic Latin name *oleum dulci vitrioli*, or "sweet oil of vitriol").

(1515-1544, German)

- ✓ Valerius began his higher education in 1527, at the young age of 12, studying botany and pharmacy under the tutelage of his father. In the same year he also enrolled at the University of Marburg. He completed his bachelor's degree in 1531, whereupon he furthered his studies by enrolling in the University of Leipzig, and by working at an apothecary shop in Leipzig owned by his uncle (either Johannes or Joachim).
- ✓ Cordus wrote prolifically, and identified and described several new plant species and varieties. The plant genus *Cordia* is named for him.
- ✓ New concepts of diseases & drugs arose.
- ✓ Valerians Cordus work on formula book having name as *Dispensatorium* (1546) becomes standard book for preparation of medicine.

Paracelsus (1494-1541)

- a Swiss physician, alchemist, and astrologer of the German Renaissance.
- He was a pioneer in several aspects of the "medical revolution" of the Renaissance, emphasizing the value of observation in combination with received wisdom. He is credited as the "father of toxicology".
- He also had a substantial impact as a prophet or diviner, his "Prognostications" being studied by Rosicrucians in the 1700s.
- Paracelsianism is the early modern medical movement inspired by the study of his works.



Paracelsus (1494-1541)

Apothecary(약제상, 약제상인)

An apothecary in the 15th century

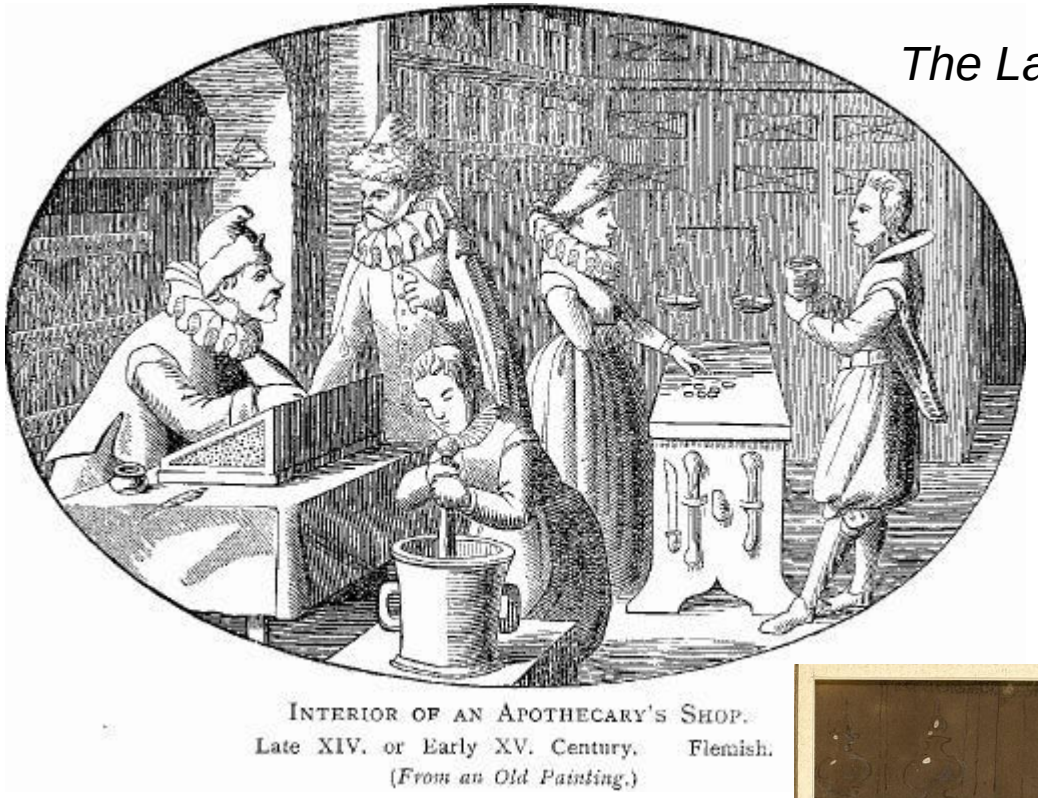
- One term for a medical professional who formulates and dispenses *materia medica* to physicians, surgeons, and patients.
- The modern pharmacist (also colloquially referred to as a chemist in British English) has taken over this role.
- In some languages and regions, the word "apothecary" is still used to refer to a retail pharmacy or a pharmacist who owns one.
- Apothecaries' investigation of herbal and chemical ingredients was a precursor to the modern sciences of chemistry and pharmacology.
- In addition to dispensing herbs and medicine, the apothecary offered general medical advice and a range of services that are now performed by other specialist practitioners, such as surgeons and obstetricians.
- Apothecary shops sold ingredients and the medicines they prepared wholesale to other medical practitioners, as well as dispensing them to patients.
- In 1600s England, they also controlled the trade of tobacco which was imported as a medicine.

French apothecary (15th century)

Early Italian Pharmacy, 17th century, Gift of Fisher Scientific International, Science History Institute From the 15th century to the 16th century, the apothecary gained the status of a skilled practitioner. In England, the apothecaries merited their own livery company (동업조합), the Worshipful Society of Apothecaries (고명한 약제상협회), founded in 1617. Its roots, however, go back much earlier to the Guild of Pepperers (후추상인조합) formed in London in 1180.

The Apothecary or The Chemist by Gabriël Metsu (c. 1651–67)

The Lady Apothecary



INTERIOR OF AN APOTHECARY'S SHOP.
Late XIV. or Early XV. Century. Flemish.
(*From an Old Painting.*)

Interior of an apothecary's shop. Illustration from *Illustrated History of Furniture, From the Earliest to the Present Time* from 1893 by Frederick Litchfield (1850–1930)

Apothecary in England

- The Guild of Pepperers(후추상인조합): founded in 1180
- The Worshipful Company of Grocers(고명한 잡화상인 협회):
  - Established in 1345
  - responsible for maintaining standards for the purity of spices and for the setting of certain weights and measures.
  - Its members included London's pharmacists.
- The Worshipful Society of Apothecaries (고명한 약제상인 협회): founded in 1617 separated from the Worshipful Company of Grocers.
- Having sought autonomy for many years, the apothecaries finally separated from the Grocers' Company in 1617 when they were granted a Royal Charter by King James I.
- King James I of England (1566-1625) established Western society's first independent pharmacist guild in England during the early 17th century, pharmacy has held a central role in health care.
- During the remainder of the 17th century its members (including Nicholas Culpeper) challenged the College of Physicians members' monopoly of practicing medicine.
- In 1704, the House of Lords overturned a ruling of the Queen's Bench in the "Rose Case", which effectively gave apothecaries the right to practice medicine, meaning that apothecaries may be viewed as forerunners of present-day general (medical) practitioners or family physicians.

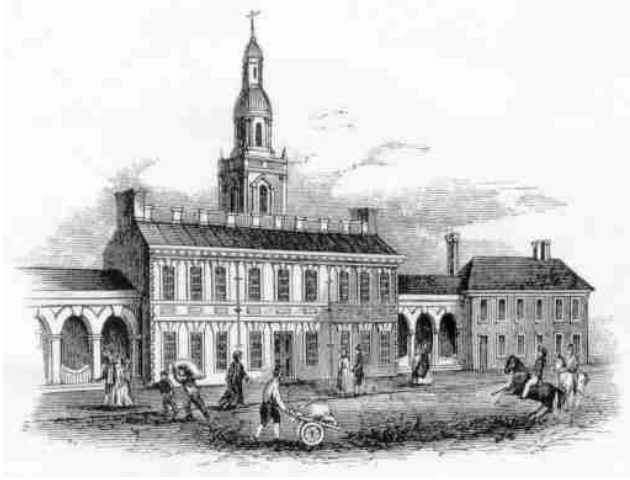
VI. History of Pharmacy in the United States (1492~current)

- Since King James I (King of England) established Western society's first independent pharmacist guild in England during the early 17th century, pharmacy has held a central role in health care.
- Initially known as "apothecaries", early community pharmacists prepared and dispensed remedies while offering front-line medical advice to their customers.
- Apothecary traditions traveled to the New World with the English colonists, where they flourished for centuries.

- The first true retail pharmacy (one of Colonial America's first apothecaries) in the U.S. was founded in 1729, in Philadelphia, by Irish immigrant Christopher Marshall.
- **Christopher Marshall** (1709 – 1797) was a leader in the American Revolution. Born in Dublin, Ireland, he went to America in 1727, settled in Philadelphia and worked as a chemist and pharmacist.
- English physician **John Ferriar** discovers the first known heart medicine (*Digitalis*).

John Ferriar (1761-1815)

- 1752 : The first hospital pharmacy was established in Philadelphia by John Morgan, a pharmacist who was an early advocate of prescription writing.
- 1820 : Creation of the United States Pharmacopeia (USP), which offers a system of standards to be used as a reference guide for professional pharmacists.
- 1821 : Philadelphia College of Pharmacy (PCP), the first college of pharmacy in the US.

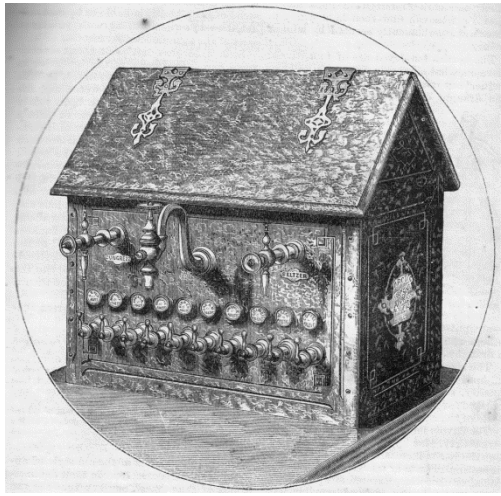


The first hospital pharmacy in Philadelphia (1752)

PCP (1821)

- 1825 : Elias Durand (1794-1873) becomes one of the first pharmacists to introduce the soda fountain at his shop. The soda fountain became a hallmark of the American drugstore from the 1860s to the 1950s.

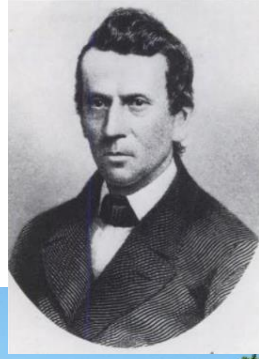
Elias Durand (1794-1873)

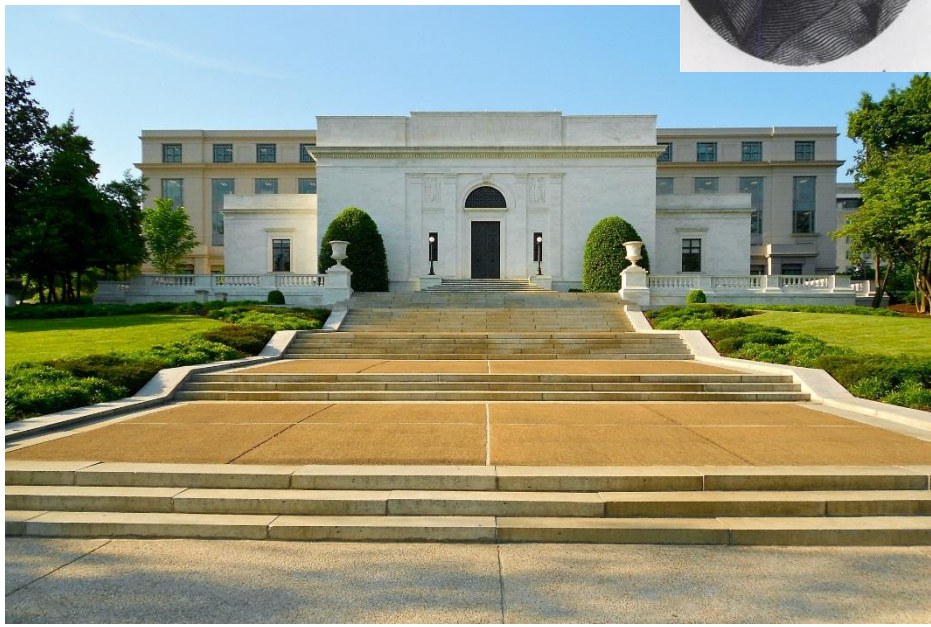


An early soda fountain, from an 1872 engraving

- William Procter, Jr. (1817-1874, aged 56), often described as "the father of American pharmacy", was a PCP professor from 1846–1874, as well as serving as an officer of the board. He and Daniel B. Smith were instrumental in the founding of the American Pharmaceutical Association, the national professional society of pharmacists, which was founded and organized in Philadelphia in 1852.
- October 6, 1852 : The American Pharmaceutical Association was founded, now the American Pharmacists Association (AphA). APhA today represents more than 62,000 practicing pharmacists, pharmaceutical scientists, student pharmacists, pharmacy technicians, and others interested in advancing the profession.
- 1852 AD: The first attempt to standardize pharmaceutical medicines was made.

William Procter, Jr. (1817-1874)
1837 PCP 졸업
1846~1874: PCP 교수





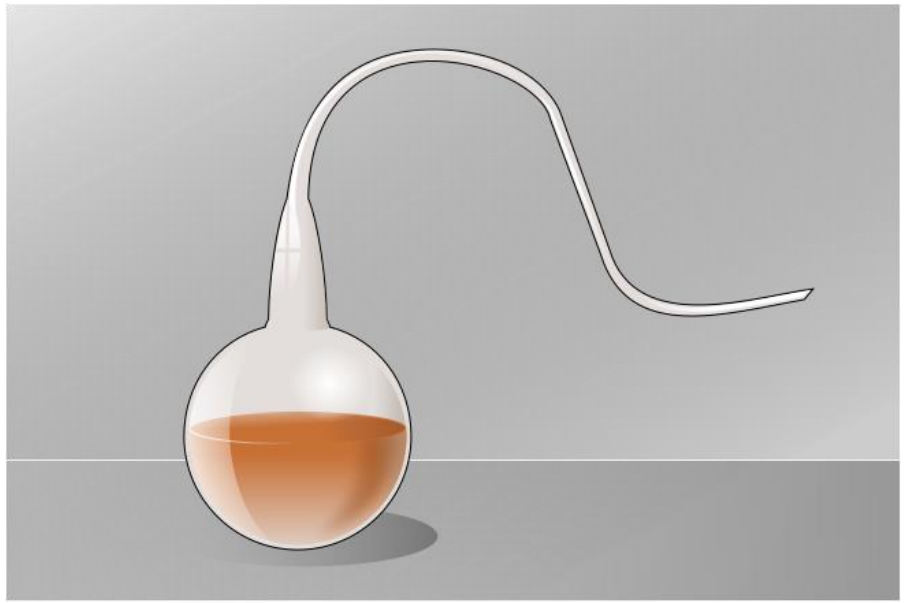
American Institute of Pharmacy Building, Washington, DC

American Pharmacists Association
Improving medication use. Advancing patient care.
APhA

- In an effort to standardize the field, Edward Parrish (1822-1872) successfully proposed that members of the national professional organization consider all the varied pharmaceutical practitioners "pharmacists." Their field formally identified, pharmacists made, as well as prescribed, medicines and remained community medical counselors until the 1950s.
- 1894 : The first biological medicines were created by inoculating horses with diphtheria to produce an antitoxin for the disease.
- 1885 : Louis Pasteur (1822-1895) develops the rabies vaccine.

Edward Parrish (1822-1872) graduated from the Philadelphia College of Pharmacy in 1842

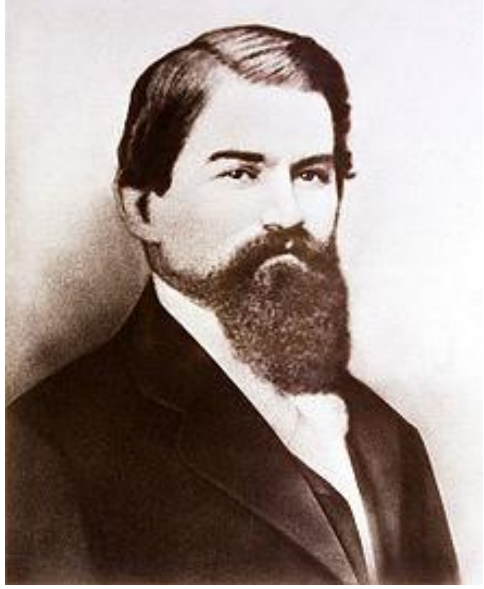
Louis Pasteur (1822-1895)



Bottle en *col de cygne* (swan-neck bottle) used by Pasteur

Louis Pasteur (1822-1895) : a French biologist, microbiologist and chemist renowned for his discoveries of the principles of vaccination, microbial fermentation and pasteurization.

- 1886: John Stith Pemberton (1831-1888), a local Atlanta pharmacist, creates a syrup which is sold at nearby Jacob's Pharmacy. The syrup is an instant hit and, when combined witl carbonated water, sells for five cents a glass. This drink is the original Coca-Cola. However, he sold his rights to the drink shortly before his death. Pemberton made many health claims for his product, touting it as a "valuable brain tonic" that would cure headaches, relieve exhaustion, and calm nerves, and marketed it as "delicious, refreshing, pure joy, exhilarating", and "invigorating".



John Stith Pemberton (1831-1888)

- 1893: Brad's Drink by Caleb Bradham (1867-1934, a pharmacist in New Bern, North Carolina, the inventor of Pepsi)

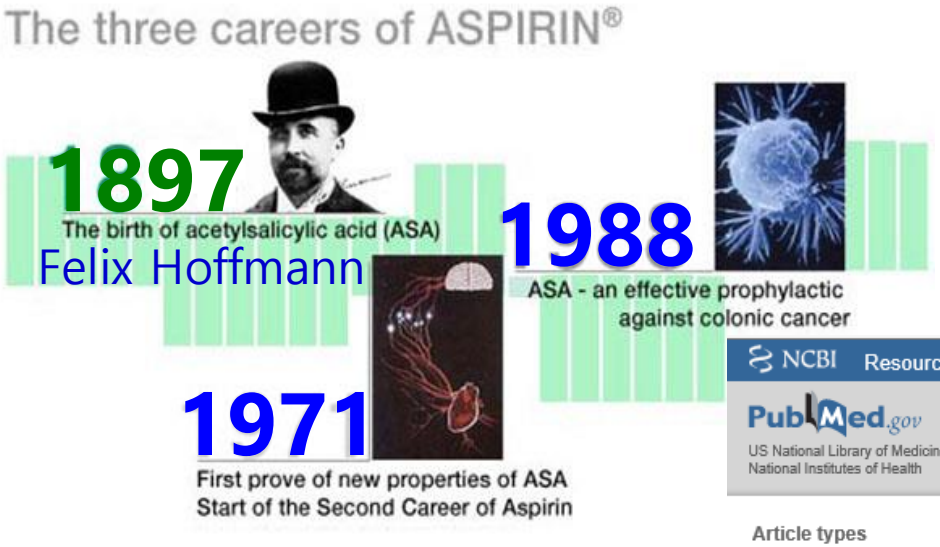
Caleb Bradham (1867-1934)

- 1898: Renamed Pepsi-Cola after the root of the world "dyspepsia (소화불량)" and the kola nuts used in the recipe.

※ market share in 2018:

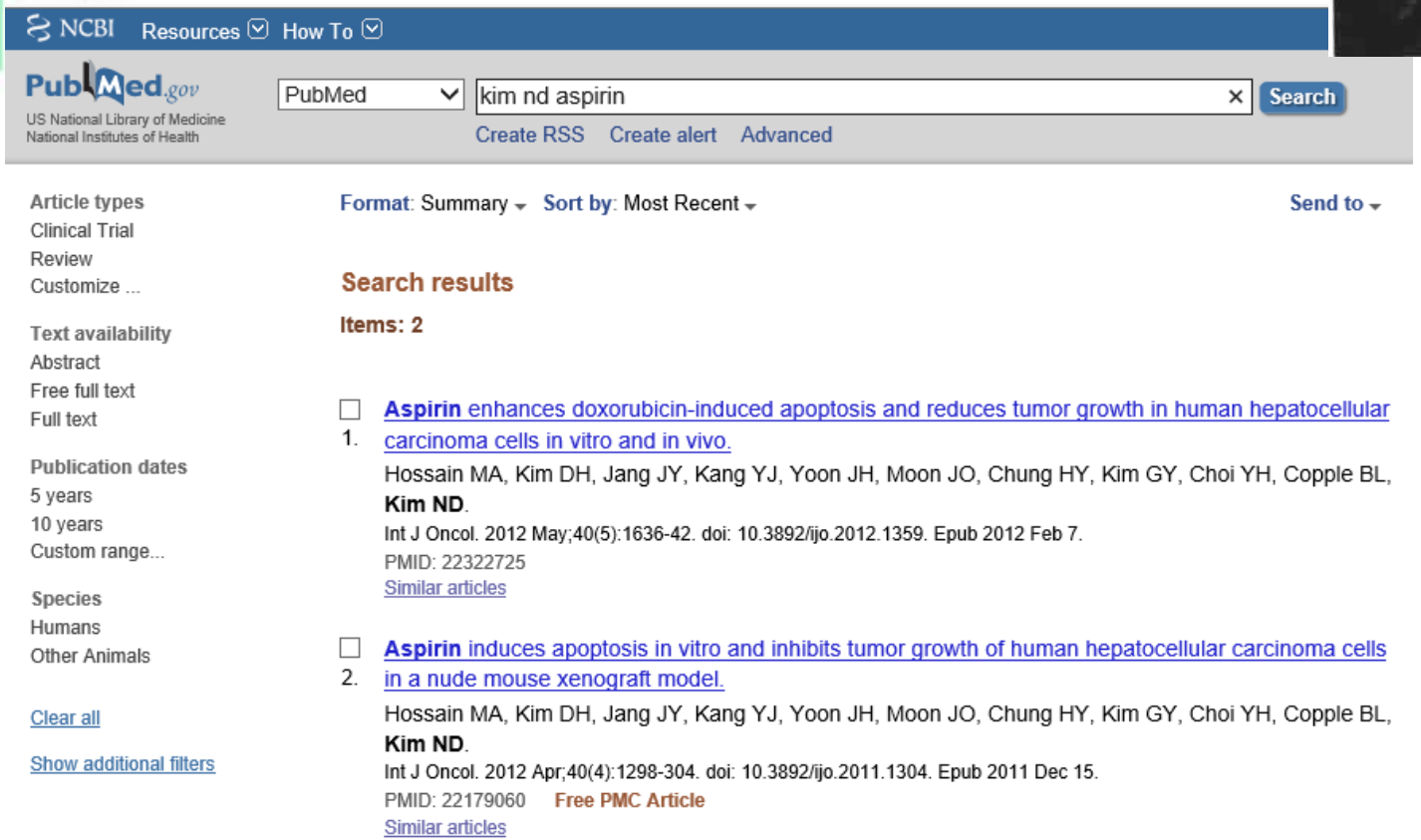
Coke (Coca-cola) 17.6% vs Pepsi (Pepsi-cola) 8.4%

- 1897: German pharmacist Felix Hoffmann (1868-1946) successfully synthesizes salicylic acid, or aspirin, for commercial sale, which becomes the most widely used drug in modern times.



1. 1897: 소염진통제
2. 1971: 뇌졸중, 심근경색 예방
3. 1988: 암예방(대장암 등)

Felix Hoffmann (1868-1946)

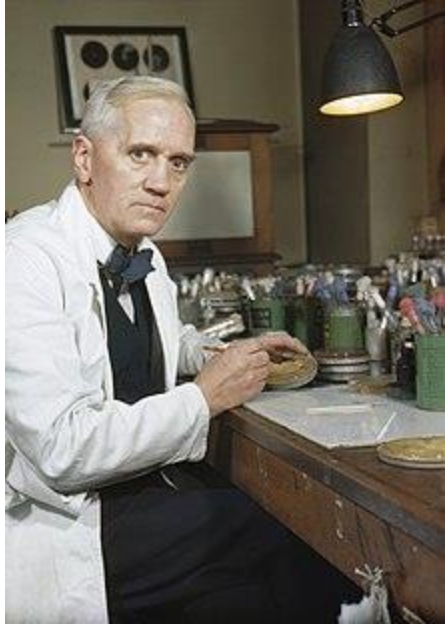


- 1907: Paul Ehrlich (1854-1915, Prussia) discovers arsphenamine (Compound 606), the first effective treatment against syphilis, for which he is awarded a Nobel Prize the following year.
- 1914: The Harrison Narcotic Act requires all parties who manufacture or import addictive substances, such as opium and cocaine, as well as licensed prescribers and pharmacies, to be registered.
- 1921: Formation of Kappa Epsilon (KE, 1921~), America's first pharmacy sorority, created to represent the interests of women pharmacists. Kappa Epsilon is still active today as an organization accepting both women and men.
  - ✓a professional pharmacy fraternity founded by Zada M. Cooper on May 13, 1921.
  - ✓Today, KE has 43 collegiate chapters and 10 alumni chapters.
  - ✓Over 20,000 women and men have been initiated into KE since its founding.
- 1922: Canadian scientists Frederick Banting, Charles Best, John Macleod, and James Collip isolate insulin, which Eli Lilly and Company introduces commercially the following year.

Paul Ehrlich
(1854-1915)

Kappa Epsilon

- 1928: Alexander Fleming (1881-1955, Scottish physician, microbiologist, pharmacologist) discovers Penicillin.
- 1932: American schools of pharmacy begin to require completion of a four-year program to receive a Bachelor of Pharmacy or Bachelor of Science in Pharmacy degree.
- 1938: Congress passes the Food, Drug and Cosmetic Act in response to the Elixir of Sulfonilamide tragedy. The law requires that new drugs be tested for safety and approved by the Food and Drug Administration (FDA) before being sold on the market.
  - ✓ 1937: In 1937, S. E. Massengill Company, a pharmaceutical manufacturer, created a preparation of sulfanilamide using diethylene glycol (DEG) as a solvent, and called the preparation "Elixir Sulfanilamide".
  - ✓ Animal testing was not required by law, and Massengill performed none; there were no regulations requiring premarket safety testing of new drugs.
  - ✓ At least 100 deaths were blamed on the medication.

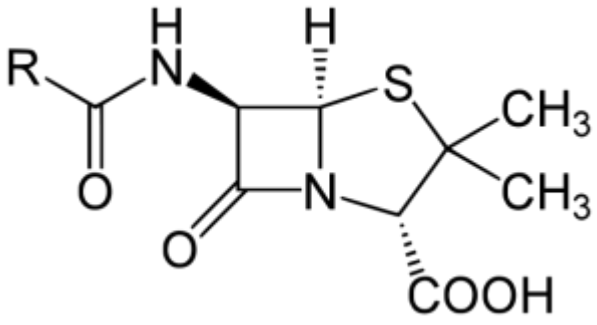


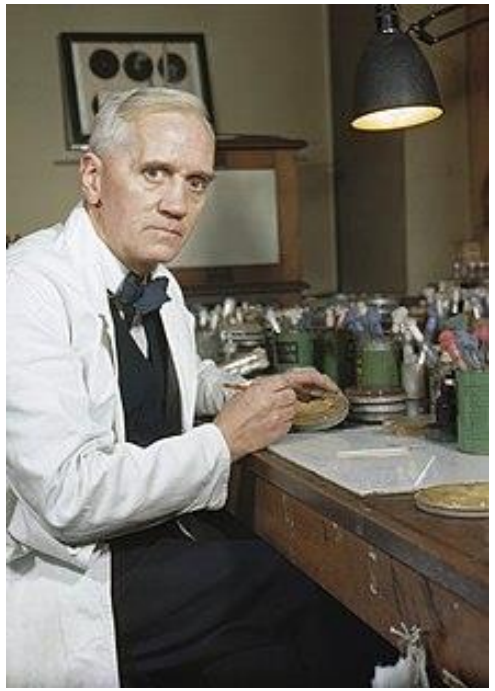
Sir Alexander Fleming (1881-1955)

Bottles of Elixir Sulfanilamide

- 1940: Oxford University scientists Howard Florey, Ernest Chain and Norman Heatley successfully develop penicillin in medicinal form; by 1943, a number of U.S. pharmaceutical companies were mass-producing purified penicillin to meet the military's needs during World War II.

✓1945: shared the Nobel Prize in Physiology or Medicine in 1945 with Sir Ernst Boris Chain and Sir Alexander Fleming for his role in the development of penicillin.





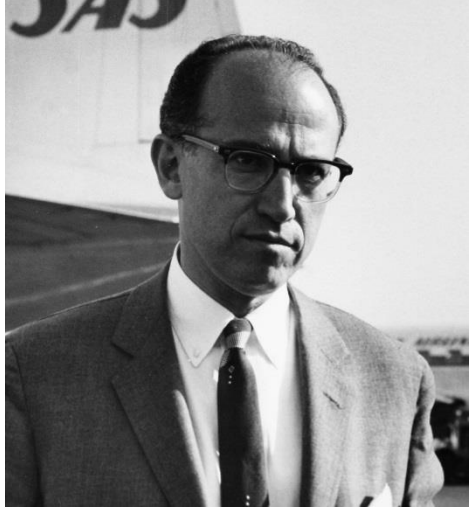
Sir Alexander Fleming
(1881-1955)

Sir Howard Florey
(1898-1968, Australian)

Sir Ernst Boris Chain
(1906-1979, German, British)

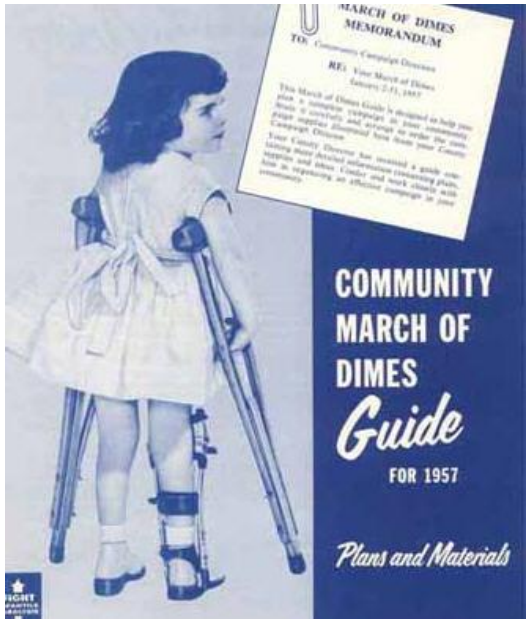
- 1942: Formation of the American Society of Hospital (now Health-System) Pharmacists, or ASHP, representing the interests of hospital pharmacists.
- 1942: After World War II, pharmaceutical manufacturing took on its modern, industrialized form.
- Federal legislation substantially changed pharmacy's role in 1951. With the passage of the Durham-Humphrey Amendment to the Federal Food, Drug and Cosmetic Act of 1938, pharmacists, who until then had been able to dispense all drugs except narcotics, needed a physician's prescription to dispense many medications.
- 1954: The American Association of Colleges of Pharmacy (AACP) approves a proposal requiring the completion of five years of academic training to earn a degree in pharmacy.
- Restricted to recommending over-the-counter medications, pharmacists began focusing on dispensing and product safety.

- 1955: Dr. Jonas Edward Salk at the University of Pittsburgh develops an injectable polio vaccine.
- An American medical researcher and virologist. He discovered and developed one of the first successful polio vaccines.
- Salk campaigned for mandatory vaccination, claiming that public health should be considered a "moral commitment."
- In 1960, he founded the Salk Institute for Biological Studies in La Jolla, California, which is today a center for medical and scientific research.



Jonas Edward Salk
(1914-1995, USA)

Salk in 1955 at the University of Pittsburgh

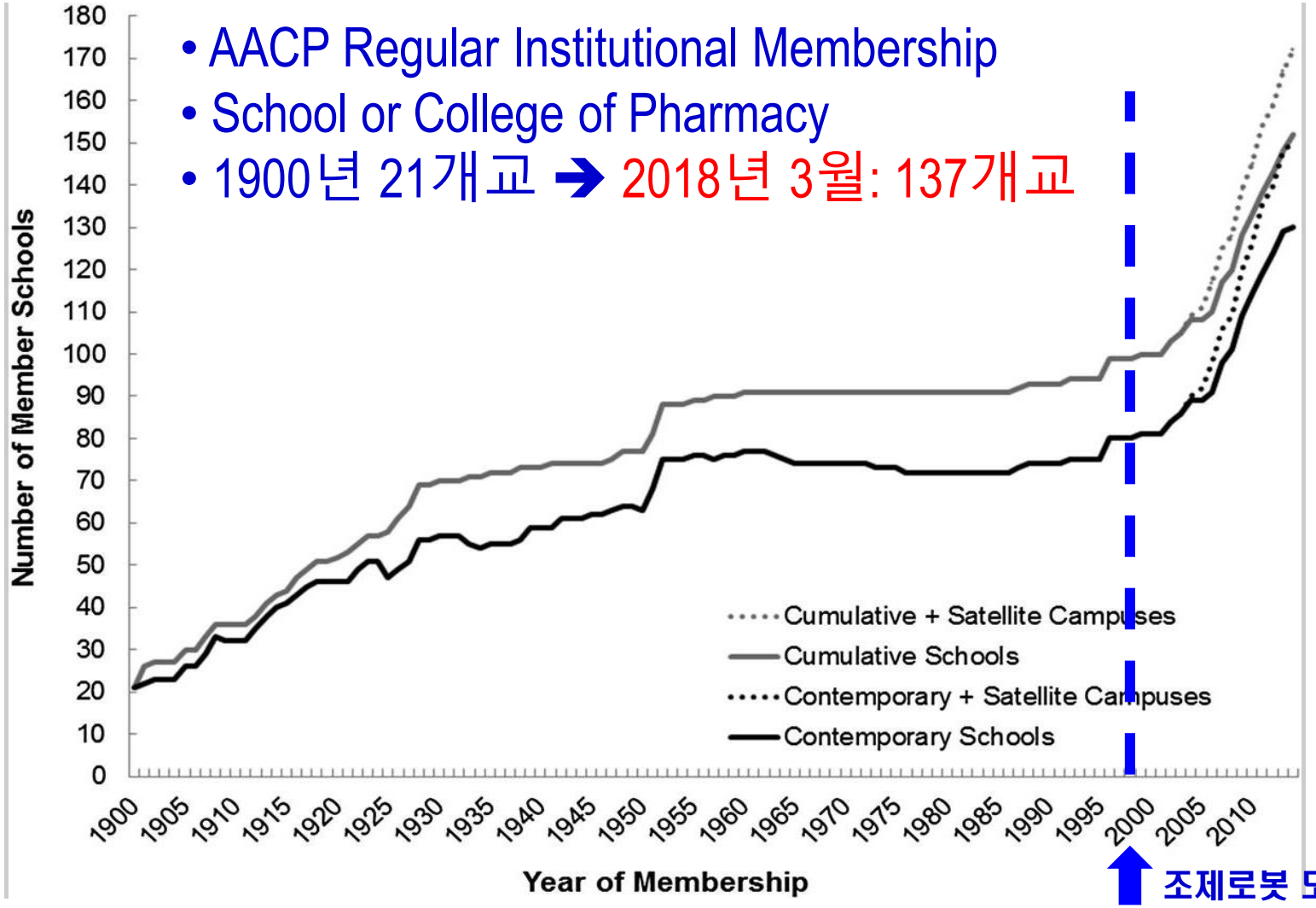


The Salk Institute at La Jolla

- 1965: The National Medicare and Medicaid programs are created.
- 1982: Merck Sharp & Dohme introduces the first Hepatitis B vaccine.
- 1984: Congress passes the Hatch-Waxman Act, which makes it easier for generic drugs to be approved for sale while giving pharmaceutical companies longer market exclusivity to encourage continued drug research and development.
- 1984: FDA approves the drug Retrovir (zidovudine or AZT), the first medication proven to help treat people infected with HIV/AIDS.
- Pharmacy's focus began to expand again during the 1980s. A professional movement that proponents called clinical pharmacy gained momentum, urging pharmacists to take on a vital role in the American health care system by providing medication expertise to ensure patients properly and safely use their medications. The movement had gathered considerable steam by the time federal legislation once again intervened, this time in the form of the 2003 Medicare Prescription Drug Improvement and Modernization Act.
- 1990: Pioneered in the U.S., electronic prescribing systems are used to automate the prescribing, supply and administration of medicine in hospitals.

- 1996: A nationally recognized training program, Pharmacy-Based Immunization Delivery, is instituted to support pharmacists administering vaccinations.
  - ✓2009: Maine becomes the last state in the U.S. to allow pharmacists to administer immunizations directly to patients.
- 2015: President Obama launches the "Precision Medicine Initiative (now "All of US")" proposing customization of healthcare, with medical decisions, practices, and/or products being tailored to the individual patient. The project aims to collect genetic and health data from one million subjects.
  - ✓ a research project created in 2015 during the tenure of Barack Obama with $215 million in funding that aimed to make advances in tailoring medical care to the individual.
  - ✓ The project aimed to collect genetic and health data from one million subjects.
  - ✓ The initiative was announced during the 2015 State of the Union Address, was run by the National Institutes of Health and was advised by Verily Life Sciences.
  - ✓ In October 2016, the project was renamed "All of Us".
  - ✓ By January 2018 an initial pilot project had enrolled
  - ✓ about 10,000 people and 2022 was targeted for one million people

미국 약학대학 연도별 현황 (1900~2017)



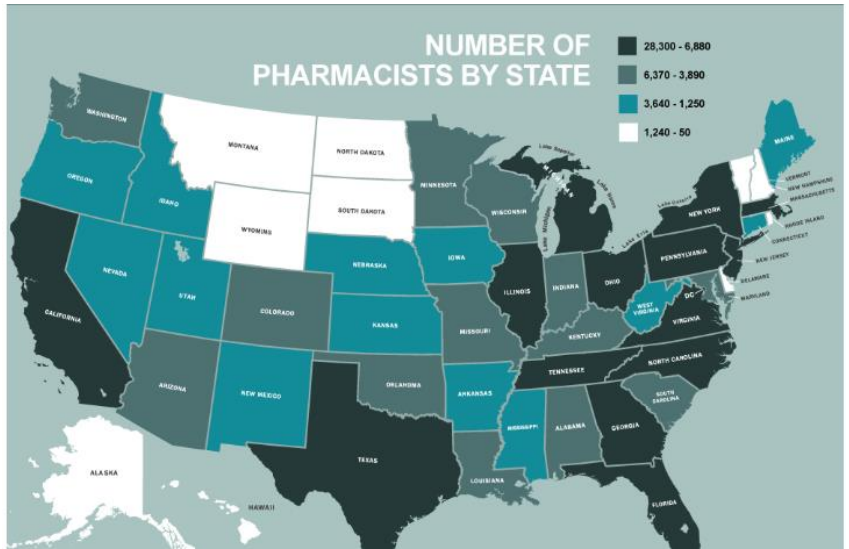
Accreditation Council for Pharmacy Education (ACPE)
•Regular members: 137 schools
•Associate members: 4 schools

Cumulative and Contemporary Numbers of US Schools of Pharmacy, 1900-2014 (based on ACPF or AACP regular membership). *Am J Pharm Educ*. 2016 Mar 25: 80(2):25.

Pharmacist in the US (as of 2016)

- 290,780 estimated number of pharmacists employed in the U.S., with a mean annual wage of $118,470.
- 한국 총 약사 수 3만4000명 (활동 약사 2만9,000명)
- 2016년 인구: 미국 3억2천3백1십만 명 vs 2016년 한국 5천125만 명

	한국	미국	비고
인구(2016년)	5천125만 명	3.231억 명	6.30 배
GDP (2016년)	1.411조 USD	18.57조 USD	13.16 배
약학대학 수(개)	35	137	3.91 배
약대 졸업생 수			
2016년 활동 약사 수	29,000 명	290,780 명	10.02배



한국 약사 vs 일본 약제사 비교(2019년 기준)

	한국	일본	비고
인구(2016년)	5천125만 명	1.26억 명	2.48 배
GDP (2016년)	1.411조 USD	4.939조 USD	3.50 배
약학대학 수(개)	35	73	2.09 배
6년제 졸업생 수	1,700 명	9,633 명	5.57 배
2017년 약(제)사 면허 취득자 수	1,868 명	9,479 명	5.07 배

※ 한국 약대: 국립대 10 (서울대 포함), 사립대 25개 = 총 35

※ 일본 약대: 국립대 14, 공립대 3, 사립대 56 = 총 73

※ 일본 약제사 신규 면허 취득자 수(최근 3년):

- 2015년: 9,044 명
- 2016년: 11,488 명
- 2017년: 9,479 명

※ 일본 약제사 평균 연봉: 590만엔(약 6천만원)-2017년 일본 후생성 발표

- 1위 제약회사: 650만엔~800만엔
- 2위 드럭스토어: 450만엔~650만엔
- 3위 조제약국: 450만엔~600만엔
- 4위 병원(대학, 국공립): 400~550만엔