

ANCIENT AND CLASSIC WORLDS

Until the 5-th Century

MEDICINE & BIOLOGY

Collected and edited by Prof. Zvi Kam,
Weizmann Institute, Israel

Mathematics is considered the basic of all sciences. The Greeks appreciated mathematical logics, and were scarcely concerned with computations with numbers.

Yet we start our series with Medicine, Biology and Chemistry, subjects that were not considered till the Renaissance as one of the areas of science (termed “natural philosophy”) but as an artisan profession, similar to blacksmith, a priest, or a wheat growing peasant. We then continue with Physics, Astronomy, and last reach Mathematics, Geometry and Algebra.

This may grade first the most relevant every-day issues, and only then deal with basic sciences and questions about our universe.

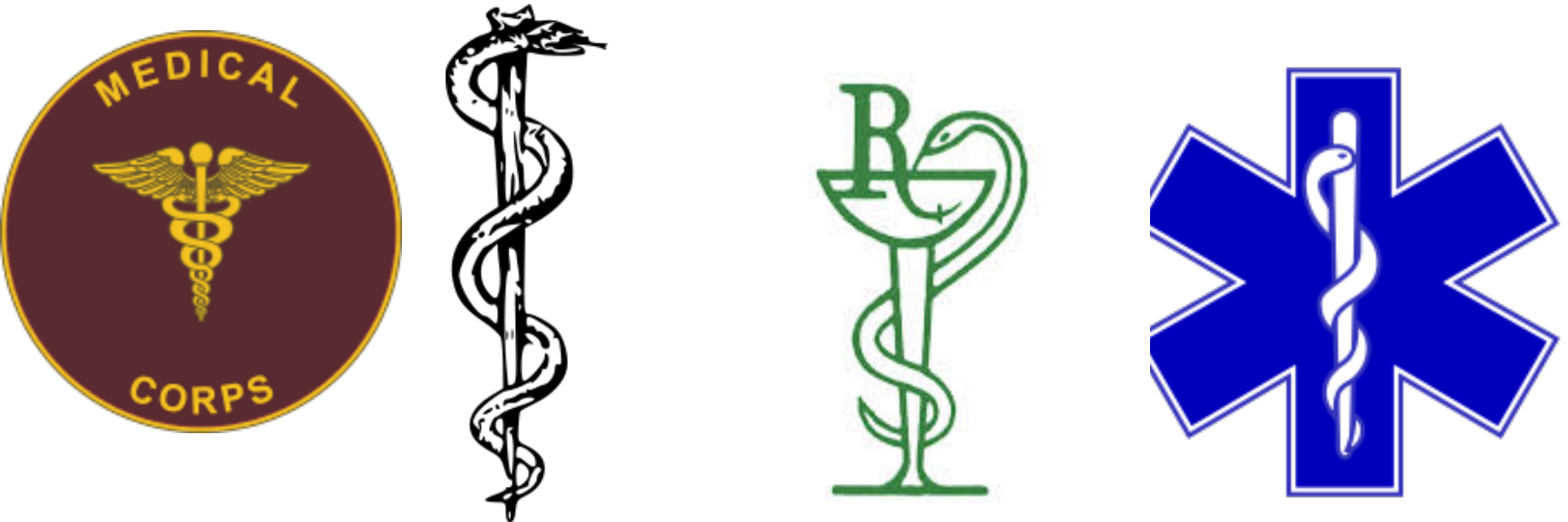
But there is another reason: We start with the more descriptive subjects. In time, these subjects turned highly challenging and complex, and are placed today at the front of modern research efforts.

BIBLICAL MEDICINE

Hygiene is an important component of old Jewish laws: Sick people were isolated from the population, hands are washed before meals, burial grounds are far away from the living area, and nutrition is bound by strict KOSHER regulation.

It took humanity 2000 years and numerous plagues (that annihilated large fraction of the population) to understand that disease spreading is hindered by doctors washing hands before treating patients, and by cleaning the environment from rats.

The logo of pharmaceutical institutions is the snake on a post, borrowed from the biblical story about the copper snake curing the plague.



EGYPT of the PHARAOHS

In all the old world diseases were believe to be godly punishment for misconduct. 3000BC Medicine and witchcraft merge. Yet cure is aided by medications prepared from herbs and other products (Opium, Cannabis, Garlic, Onion, Honey and Oils). The Pharaohs kept with them healers including dentists and women doctors for the court ladies. Preparation of mummies involved inner organ removal, advancing anatomical knowledge and its relation to diseases..

We know about Egyptian medical healer and their doings from medical papyruses and inscriptions on grave stones and kings burial grounds.

3000BC First recorder physician SkakhtAnakh. Later medical school (often headed by ladies) operated near temples, and educated specialized medicine, including birth-related medicine, dentistry, injury repair and Orthopedics, and beauty medications, creams, cosmetics etc.

2600BC Imhotep (see statue) is a medical adviser to the 3-rd Pharaoh dynasty , who composed an extensive papyrus describing 200 diseases, ointment creams, herbs, directions for operations, as well as Amulets and magical cures. He is believed also to design the stairs pyramid, and use of columns to support the ceiling in the grave halls. He became a god, with temples and hospitals built for his name.



2500BC Iry is mentioned in Egyptian script as a specialist court physician for eyes, stomach and guts, expert pharmacist, and mastering of body fluids.

The following list of the contents of medical papyruses, summarizing 4000 years old medical literature and knowledge, illustrates the diseases described by physicians, and the methods of curing them in old Egypt:

1800BC The **Khun papyrus**: deals with female medicine.



1700BC **Ramesseum papyrus**: (named after the temple where it was found), describes tendons and muscles, Eye problems, children diseases, birth and newborn handling.



1600BC **Hearst Phoebe papyrus**: (named after the mother of the journalist Randolph Hearst, who donated money to the delegation that found the papyrus), deals with urine, blood, hair and animal bytes. Describes diagnostic procedures and methods of treatment of injuries. The brain is recognized, but thoughts are attributed to the heart. Heartbeats are not associated to blood pumping.

1551BC **Ebers papyrus**: medications, prescriptions and witchcraft for 700 medical problems of gut, eyes, skin, teeth, bone fractures, burns, abscess and cancer surgeries. The heart is the centralizer of the blood vessels. Lack of knowledge about the kidneys and body fluids (tears, sperm). Treats mental diseases such as depression and dementia on the same line with physical diseases.

1500BC **Edwin-Smith papyrus**: Text deals with trauma and surgeries. For the first time there is no reference to witchcraft as a medical method.

1300BC **Brugsch (or Berlin) papyrus**: Deals with fertility and birth control.

1300BC **London papyrus**: medications and witchcrafts for eye diseases, skin, bleeding (at birth) and burns.

In summary: the medical problems in ancient Egypt are not substantially different than those treated by modern physicians. The emphasis on sorting of diseases indicate a systematic approach to specialist treatment. Ointments and herbs are the pharmaceuticals used later for centuries.

The Egyptian medical tradition was highly appraised by the Greeks and the Romans, especially the specialization of the professionals.

INDIA - INDUS VALEY

3000BC villages of houses made of bricks from burnt clay. Advanced technology for measurements, standardization of weights with decimal number system (Values of 500, 200, 100, 50, 20, 10, 5, 2, 1, 0.5, 0.2, 0.1). Writing did not exist yet.

Sculptured figurines in clay and bronze indicate importance of dancing and Yoga in the culture. Bead necklaces from Agate stones, combs for friseur etc. indicate beauty culture. Musical instruments and game stones prove free-time culture.

3000BC Bow drill, to start fire and as a dental drill.

2000BC Herbs used as medications

4-300BC **Ayurveda**: body and mind health tightly linked.

450BC **Sushruta Samhita**: published. 120 medical tools and List of 8 groups of procedures, including cosmetic and other Surgeries, Cataract removal, infant medicine.

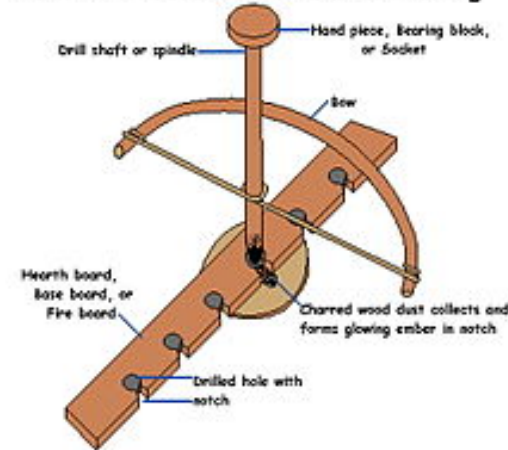
Anatomic knowledge. Preparation of sugar. Gardening.

500BC **Buddha**

Advanced metallurgy, mineral separation, alcohol distillation, Pharmacology (extraction of drugs by alcohol).

200BC **Charaka Samhita**: Rational approach to diagnostics based on medical examination.

Bow Drill as Used for Fire Starting



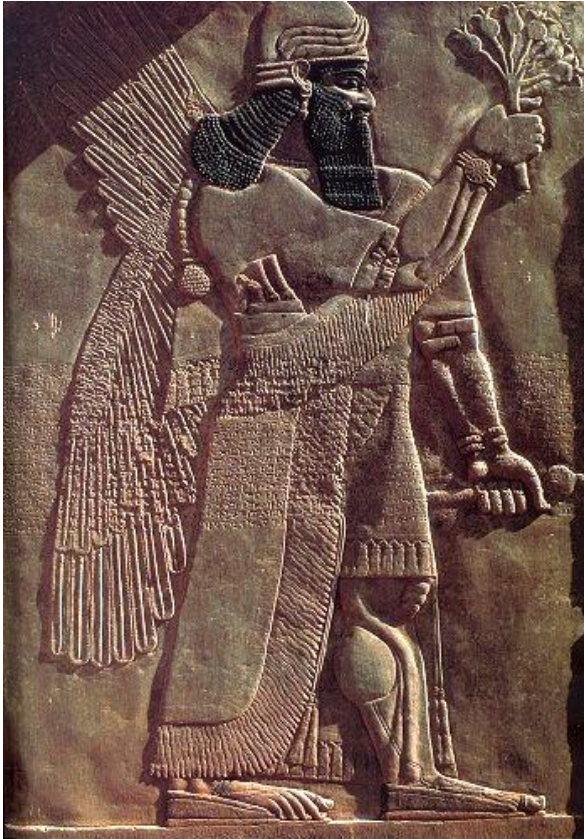
BABILON

1900-1600BC Arcadian clay tablets discuss medicine. Restored in **Assurbanipal's** library in Nineveh

1800BC The **Hammurabi** code details surgeon's fees and punishment for medical misconduct

1069BC Medical books describing diseases and use of bandages and ointments.

500BC **Darius** I orders to reconstruct "house of living", first documented medical school.



Assurbanipal



Hammurabi



Darius

CHINA

2696-2598BC A dialog between the emperor and his minister concerning internal medicine.

500BC **bian Que** is the first physician using **acupuncture**. Measured heart beat rate.

282-215BC Diseases are due to body imbalance – acupuncture is the cure.

400BC **Huangdi Neijing**, the basis of Chinese medicine: Yellow Emperor's Classic of Internal Medicine.

270BC **Huangfu Mi** publishes Zhenjiu Jiayijing: a book about acupuncture.

200BC **Zhang Zhongjing** published book about the damage of colds: Shang Han Lun

Summarizing:

Acupuncture is a Chinese-unique medical procedure.

Search for eternal life drives extensive study of medically-beneficial herbs and fruits.

GREECE

1500BC Saffron is used as a medication. Mandragora help reduce pain.

1250BC **Asklepius** is the Greek guru of medicine. His daughter is the goddess **Hygiene**...

Asklepius stick – with a snake – the logo of pharmacy. Reminiscent of the copper snake that cured the Israelites.

Hermes (with his wings) used with the snake in the logo of the American Medical Corps.

Interesting: Medicine is not one of the **Seven Liberal Arts**:

Grammar, Dialectics (arguing skill or logics), rhetoric (speech skills) Arithmetic, Geometry, Music and Astronomy (equivalent to Astrology), but considered as a craft together with engineering, sculpturing, gymnastic trainers etc.



8th century BC, Homer writes the earliest medical text. The body humors are named after him. He describes in the Odyssey the supply of medications to the Greek forces sieging on Troy. Idomeneus tells Nestor that a surgeon who knows to extrude an arrow and cure the wound with ointments worth a battalion of soldiers.

6th century BC, Thales First science philosopher. Lived in Miletus.

Believed that water is the source of all materials, and earth and air emerged from water.

Anaximander claimed that humans are made of water. The universe exists in equilibrium between opposing forces.

Anaximenes believes that air is the primary element that enables life.

Heraclitus from Epos – Oz is the primary element. Opposing forces create tension necessary for the existence of the universe.

Pythagoras – established a school. Life is sacred (prohibited Autopsies). Integer numbers are the basis of everything (including ratio of musical tones in harmonies). Balance in life maintained by diet, gymnastics and meditation.

510-430BC Alcmaeon of Coton – (from the Pythagorean school) anatomy by autopsy (including of animals), centralize on human, not the universe. Composed a book about harmony and disease. The eye ball contains fire and water. Brain is the organ of memory. Blood vessels in the brain fill up during sleep, and emptied when alert. Describes veins and arteries and optic nerves.

484-425BC Herodotus – Admires specialization of Egyptian physicians

496-405BC Sophocles – Disgusted by witchcraft in medicine.

700BC The schools in Cos and Knidos – Influence on Hippocrates who composed “The sick human” “corpus Hippocrati”: Catalogue of diseases sorted by the sick organs, with symptoms. Formed a basis to Galen’s compositions.

490-430 BC Empedocles of Sicily - The first medical scientist. Wrote a poem about nature that teaches his theory, reminiscent of evolutionary natural selection .
Extended Pythagoras to four elements that combine in life and disintegrate at death.
Linked blood and air flow in breathing.

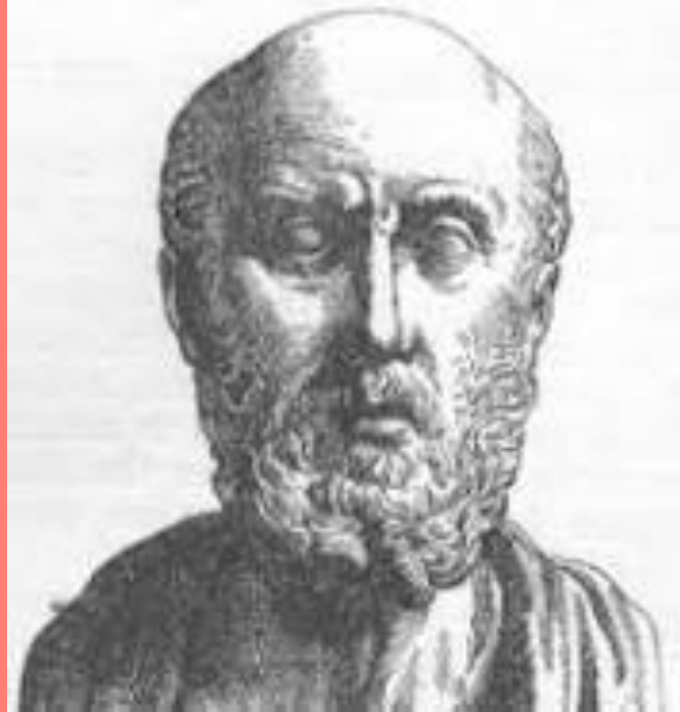
350BC Aristo – Classified animals. Anatomy, physiology and developmental biology. Described the organs and attributed tasks for them. Based his science on observations and experiments. Claimed that plants, like humans, depend on nutrition, but plants do not depend on animals for life, but animals need plants for nutrition.

371-287 BC Theophrastos of Eressus – classified plants by shape, growing arena, yearly cycle, flowers, fruits and leaves. The father of Botany. Did not study fertilization and sources of nutrition, although understood that plants take it from their roots.

420 BC Democritus – relate thoughts to the brain, transporting “mental atoms” to the whole body via the nerves. This theory is amazingly close to present picture of the brain and the nervous system, yet his experimental evidence was totally lacking...

400 BC Xenophanes – Studied fossils, and concluded that the ocean covered once earth. Linked his findings to evolution of life on earth. Again an amazing foresight.

470-370BC
Hippocrates of Cos



470-370 Hippocrates of Cos is considered the father of physicians. “The physician Oath of Ethics” is attributed to him.

He described and sorted diseases (Chronic, Acute, Endemic, Infectious), studied inner organs such as the heart and blood vessels (discriminate between veins and arteries) and their relevance to body temperature (carried by the “Pneuma” in the blood vessels) and to air transport in the body.

He discusses vision with the eye ball and image formation by the eye lens.

Elaborated the “four humors” theory and the importance of balance between them for health. He preferred not to intervene with drugs, although he elaborated on diagnostic methods: breathing noises (but not heart beats), and taste. Preached to experience chirurgical procedures on the battle fields. Pus discharge is needed for healing wounds. His treatment of various problems with bleeding to balance the humors was a common procedure for thousand of years (Physicians bled wounded soldiers to death until the first world war).

Described the position of the baby at birth. Studied Uterus and ovaries. Male is born from the right, female from left ovary.

He was interested in mental diseases and related the brain to reasoning.

Hippocrates doctrine was considered the basic truth in medicine for more than 2000 years, and maybe even deterred studies that might have challenged his theories.

“Corpus Hippocrati” was composed by later scientists, but gained its credibility from Hippocrates inheritance.

Hippocrates Oath: (Translated from Greek as quoted in Corpus Hippocrati)

I swear by Apollo Physician, by Asclepius, by Hygieia, by Panacea, and by all the gods and goddesses, making them my witnesses, that I will carry out, according to my ability and judgment, this oath and this indenture.

To hold my teacher in this art equal to my own parents; to make him partner in my livelihood; when he is in need of money to share mine with him; to consider his family as my own brothers, and to teach them this art, if they want to learn it, without fee or indenture; to impart precept, oral instruction, and all other instruction to my own sons, the sons of my teacher, and to indentured pupils who have taken the physician's oath, but to nobody else.

I will use treatment to help the sick according to my ability and judgment, but never with a view to injury and wrong-doing. Neither will I administer a poison to anybody when asked to do so, nor will I suggest such a course. Similarly I will not give to a woman a pessary to cause abortion. But I will keep pure and holy both my life and my art. I will not use the knife, not even, verily, on sufferers from stone, but I will give place to such as are craftsmen therein.

Into whatsoever houses I enter, I will enter to help the sick, and I will abstain from all intentional wrong-doing and harm, especially from abusing the bodies of man or woman, bond or free. And whatsoever I shall see or hear in the course of my profession, as well as outside my profession in my intercourse with men, if it be what should not be published abroad, I will never divulge, holding such things to be holy secrets.

Now if I carry out this oath, and break it not, may I gain for ever reputation among all men for my life and for my art; but if I break it and forswear myself, may the opposite befall me.

To summarize essentials:

Unquestionable respect to the medical teachers, and endless devotion to students.

Dedication to the patient's well being.

Against use of poisons / drugs.

Against surgery (use of knife).

Against abortion.

Medical privacy.

Modern physician ethical Oath: (various versions are used by medical schools)

I swear to fulfill, to the best of my ability and judgment, this covenant:

I will respect the hard-won scientific gains of those physicians in whose steps I walk, and gladly share such knowledge as is mine with those who are to follow.

I will apply, for the benefit of the sick, all measures [that] are required, avoiding those twin traps of overtreatment and therapeutic nihilism.

I will remember that there is art to medicine as well as science, and that warmth, sympathy, and understanding may outweigh the surgeon's knife or the chemist's drug.

I will not be ashamed to say "I know not," nor will I fail to call in my colleagues when the skills of another are needed for a patient's recovery.

I will respect the privacy of my patients, for their problems are not disclosed to me that the world may know. Most especially must I tread with care in matters of life and death. If it is given me to save a life, all thanks. But it may also be within my power to take a life; this awesome responsibility must be faced with great humbleness and awareness of my own frailty. Above all, I must not play at God.

I will remember that I do not treat a fever chart, a cancerous growth, but a sick human being, whose illness may affect the person's family and economic stability. My responsibility includes these related problems, if I am to care adequately for the sick.

I will prevent disease whenever I can, for prevention is preferable to cure.

I will protect the environment which sustains us, in the knowledge that the continuing health of ourselves and our societies is dependent on a healthy planet.

I will remember that I remain a member of society, with special obligations to all my fellow human beings, those sound of mind and body as well as the infirm.

If I do not violate this oath, may I enjoy life and art, respected while I live and remembered with affection thereafter. May I always act so as to preserve the finest traditions of my calling and may I long experience the joy of healing those who seek my help.

To summarize essentials:

Respect to the teachers, and devotion to students.

Dedication to the patient's well being.

Accept drugs and surgery but they are outweighed by sympathy and understanding !!!

Recognize that medical treatment affects not only the patient but family and society.

Prevention of a disease is preferable to curing.

Ask colleagues when you do not know.

Medical privacy.

These principles are also stressed in Maimonides' physician oath, and in the modern doctors oath in Hebrew (brought in the original language)



**Statue of Maimonides at the entrance to his home
Cordoba, Spain.**

Maimonides, 1190AC:

Was a Jewish philosopher and a physician in Maori Spain, who studies Galen but often diverted from his theories.

Physician oath (Hebrew):

אל עליון. קודם שאני מתחיל בעבודתי
הקדושה לרפא את יצירי כפיך אני מפיל
תחינתי לפני כסא כבודך שתתן לי אומץ
רוח ומרץ רב לעשות את עבודתי באמונה,
והשאיפה לצבור הון או שם טוב לא
תעוור את עיני מראות נכוחה. תזכני
להביט על כל סובל הבא לשאל בעצתי
כעל אדם בלי הבדל בין עשיר ועני, ידיד
ושונא איש טוב ורע, את האדם בצר לו
הראני רק את האדם. אם רופאים נבונים
ממני רוצים ללמדני בינה תן לי רצון
ללמוד מהם כי תורת הרפואה אין ערוך
לה, אך אם כסילים יבזוני אחלי, אהבתי
למקצוע תחזק את רוחי בלי להתחשב
עם זיקנת המלעיגים כבודם, רק האמת
תהיה נר לרגלי כי כל ויתור במקצועי יכול
להביא כליון מחלה ליציר כפיך. אנא ה'
רחום וחנון חזקני ואמצני בגופי ובנפשי
ורוח שלום תטע בקרבי.

שבועת הרופא המודרנית, בעברית

אתם ניצבים היום כולכם, בפני מוריכם בדרכי הרפואה וחוקותיה, לעברכם בברית הרפואה. למען תקיימו את תורתה בכל מאודכם, בשום שכל וביושר לבב למען קום דור רופאים, דרוכי מעש ואמוני יעוד לעזרת האדם הדווי.

וזאת הברית אשר אנכי כורת אתכם היום לאמור: על משמרתכם הופקדתם יומם ולילה לעמוד לימין החולה במצוקתו בכל עת ובכל שעה.

ושמרתם עד מאוד חיי אדם מרחם אמו, והיה שלומו ראש חרדתכם כל הימים.

ועזרתם לאדם החולה באשר הוא חולה, אם זר אם נכרי, אם אזרח נקלה ואם נכבד.

והשכלתם להבין לנפש החולה ולשובב את רוחו בדרכי תבונות ובאהבת אנוש.

אל תמהרו להוציא משפט ושקלתם את עצתכם במאזני החכמה הצרופה בכור הניסיון.

שמרו אמונים לאדם שהאמין בכם, אל תגלו סודו ואל תהלכו רכיל.

יחכם לבבכם גם לבריאות הרבים, להעלות ארוכה למדווי העם.

תנו כבוד ויקר לרבותיכם, שנחלצו להנחותכם במעגלי הרפואה.

תרבו חכמה ואל תרפו כי היא חייכם וממנה תוצאות חיים.

היזהרו בכבוד חבריכם, כי בכבודם הם תכובדו גם אתם.

דברי הברית האלה קרובים אליכם מאוד בפיכם ובלבבכם לעשותם. ועניתם כולכם אמן,

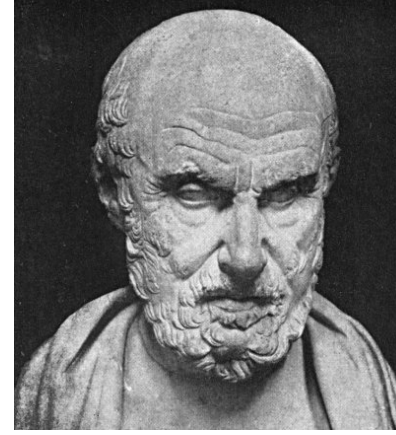
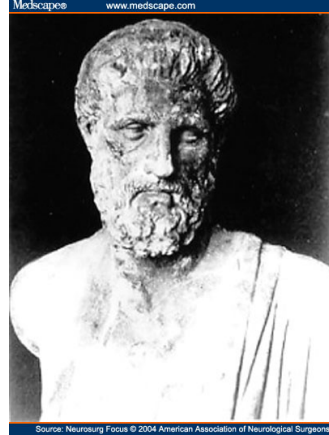
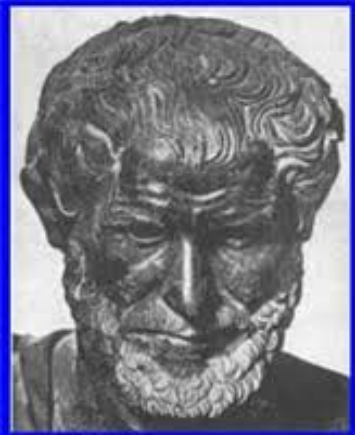
אמן כן נעשה.

יהיה רצון שישגא פועלכם להאדרת מורשת הרפואה.

4th century BC Philistion of Locri – believes that drunk liquids reach the lungs.
Fixation of bone fractures was a curing methods attributed to him.
His scripts were probably added to “Corpus Hippocrati”.

3rd century BC Philinus of Cos – founded the medical school at Cos, and conducted after death autopsies and live people surgeries.

356-323 BC Alexander the Great promoted assimilation of Persian Indian and Egyptian sciences and medicine in the Classical world.



Source: Neurology Focus © 2004 American Association of Neurological Surgeons

340-100BC Diocles of Carystus, Herophilus, Erasistratus & Praxagoras – pioneers of experimental anatomy. **Praxagoras** lists 11 body fluids, (extending the 4 humors), and still believes that their balance is the determinant of health and sickness. Considered digestion of food as a disintegration process (but do not explain its purpose).

Following the death of Alexander the great Egypt was ruled by the his companion and historian, **Ptolemy**. He built a university and medical school in Alexandria, where **Herophilus**, a student of **Praxagoras** of the Knidos school, established a world center. Autopsies were only allowed in the Alexandria. But corpses could not manifest dynamic body features, and led to many misconceptions: vital fluid flow in veins, Arteries come from the liver, and blood flow is created from food. Body heat is generated from mixing blood with vital fluid. Arteries create body movement (since small arteries ended in muscles), and their blocking cause paralysis. **Erasistratus**, a student of Erasistratus, performed live surgeries, and therefore acquired improved information: He describes motor and sensory nerves and their connection with the retina of eyes. He assigns brain as the center of thinking, and describes cerebrum and cerebellum, sweat is the psychic nutrition. The heart is a blood pump, and he considered beat rate to be diagnostic.

Erasistratus understood that air is absorbed by the lungs. Yet he confused ligaments with nerves. He talked about atoms, and less so about pneuma and other humors or vital fluids.

354 BC Critobulus – pulls out an arrow from Phillip II eye together with his eye ball with minimal damage to his face.

100 BC Diocles - composes a book about anatomy

144-124 BC Asclepiades of Bithynia – worked in Rome. Influenced by Democritus & Epicurus atomic theory, developed a theory of disease due to flow of atoms in body pores: Acute diseases are due to excess atoms and blocked pores. Chronic diseases due to excess pore opening and loss of atoms. Treatment by attending to the patient needs, diet, massages, gymnastics and baths, as well as drinking wine, inducing vomit and bleeding. Galen attributes to him opening a breathing bypass in the throat for cancer patients.

1st century BC Rufus of Ephesus - Studies in Alexandria and wrote about specialized medicine for elderly and slaves. Considered the spleen to be unneeded. Realized that pressure on the neck cause fainting due to nerve and not vein blockage. Describes motor and sensory nerves. Heart is the center of life. Discusses kidney and bladder-related diseases, jaundice, gout and syphilis.

Noted physician in the 1st century AC: **Marcellinus** and **Numisianus of Corintus**, who taught Galen.

Summary of Greek medicine:

Medical knowledge developed from experimental anatomy limited by what could be seen by bare eyes, and wrapped by explanations biased by accepted physical theories (e.g. atomic theory, humors).

Despite traces of systematic methodology, such as sorting diseases by the organ they attack, or by their being acute or chronic, misconceptions imposed long-term beliefs that were difficult to deny given the tools available, and cause treatment strategies to persist although had little effect on the curing process in good cases or accelerated death in many other cases.

The emphasis of Greek science on philosophical argumentation made Greek medicine inferior to Egyptian medicine, which was based on long accumulation of practical experience, with specialization of physicians with good experience in curing a defined range of diseases.

MEDICINE IN ROME

Roman science emphasizes practical issues and engineering solutions that were necessary for the development and maintenance of the Roman empire. This science is mainly known today as encyclopedia collections and less from innovative breakthroughs. Roman medicine was centered around soldiers health and military related injuries, but also dealt with hygiene which was essential to maintain dense city populations.

23 BC-79 AC Gaius Plinius Secundus (Pliny the elder) - composed the first 37 volumes encyclopedia “history of Nature”. This extensive collection summarizes the science knowledge at his time, and includes detailed descriptions of surgical tools (knives, scissors, needles, forceps, and clamps for newborn birth (see medical tools in the following Middle ages medicine chapter).



Aqueducts leading water into cities supplied not only drinking water, but also water for sanitary uses, such as public Baths and Toilets, undoubtedly most important for viability of dense population in city life.

25 BC-50 AC Aulus Cornelius Celsus – another Encyclopedia writer who lived at the times of Augustus and Tiberius Caesars. He was probably not a physician himself. His collection included nutrition, medications, surgery and more, Lost volumes include agriculture, rhetoric and war strategies.

70 AC Pedanius Dioscorides – First of 5 volumes about pharmacy: “De Materia Medica”, listing uses of 600 medical plants and minerals. The book was translated to Latin, Arabic and Indu, and decorated with plant drawings with their assume identifications.



2nd century AC Aretaeus of Cappadocia – a physician during Nero and Vespasian Caesars. He specifies symptoms for diseases, advice uses of laxatives and anesthetic drugs, and recognized Celiac disease.

138-98 BC Soranus of Ephesus – a physician in Alexandria and Rome during Trian and Hadrian Caesars, wrote about gynecology, bandages and bone fractures.

216 – 129 Claudius Galen

The Gladiators physician



129-216 AC Claudius Galen – moved from Pergamon to Rome, and continued **Herophilus** medicine, based on diagnostics and experience. As the gladiators physician he acquired unique knowledge from surgeries. He constructed a comprehensive medical system that formed the professional basis until modern times. He preached aggressive treatment of diseases by diets, gymnastics, hygiene and drugs (preventive medicine). His most known medication, Teriac, prescribes mixtures of 64 components, was in use for 2000 years. He followed **Hippocrates** for treatment and **Dioscorides** for drugs.

Galen described the blood system, lungs, kidneys and nerves. He edited the classical world knowledge in anatomy and physiology, and performed study surgeries on animals. Although this comparative studies corrected common errors: veins lead to the heart and conduct blood (but still claims that pneuma flow in arteries), nerves are connected to the brain, including hearing sensory nerves and spinal nerves, and control motion, (confirmed by surgery on monkeys). He discusses psychological illness, identifies uterus and list bones. But the assumption that animals are faithful model for human anatomy and physiology led to mistakes such as gut anatomy (e.g. caws double stomach anatomy differs from humans, or Mirablex Flexus of Horseshoe that does not exist in human feet). He also identified mistakenly openings in heart barriers (probably to support pneuma flow), and wrongly attributed blood generation to the liver (since many blood vessels thin down and seem to end at the liver). Galen failed to understand that light is necessary for plants. Galen was the most influential proponent of the Hippocrates humor theory, which he extended from causes of sickness to partitioning of human character, e.g. Melancholic (black bile excess) hot spirited (yellow bile) optimistic (blood excess) phlegmatic (blood shortage).

Galen recognized the utility of soap (invented by the Phoenicians 600BC) for cleaning although the importance of sterility was not realized till the end of the 19th century.



Embryology and birth

Despite some ancient scientists describing cells in plants (Thales, and later atomistic school), common theories did not include cells in plants or animals, but rather considered the sperm and the embryo as a shrunk version of adult human, (“Homunculus”) extrapolating back from the growth of babies.

Summary: Medicine in the Classical era:

Documented from Hippocrates (3rd century BC) till Galen (129-216 AC)

Medicine shifts from witchcraft to a profession with formal education in medical schools, accumulation of medical literature, and establishment of hospitals.

Studies of anatomy from corpses, as well as surgery on live animals and people, provided disease classification according to the malfunctioning organ, specialization of the healers (Females, birth, children, teeth, guts, skin), as well as better understanding of organ functions. Nevertheless, misconceptions persisted due to low magnification view of organs (notably blood vessels and nerves), and unsubstantiated beliefs (heart is the site of feelings, blood cycle is not considered. Rather blood generation from food in the liver). Body heat is attributed to mystical fluids and not with metabolism.

Heart beats and breathing noises are vague sickness indicators.

Nerves connect from the brain to the retina, and to muscles, but nerves and blood vessels are confused in muscles.

Lungs absorb air and liquids into the body while breathing.

Kidneys generate urine (inflated kidneys after blockage in dogs).

Surgeries applied to remove cancers, extrude arrows in battles, and fixation of bone fractures.

Link mental and physical maladies. (Galen interpreted dreams...)

In addition to the Hippocrates four humors, three live pneuma in the body: Brain and nerves- feelings pneuma, Heart and vessels: life pneuma, and Liver and veins- Energy pneuma. This theory cannot be supported by experiments...

Medications (from plants), ointments (with Bandages) and minerals (for stomach problems) used as curing drugs. Galen graded drug "strength" by body reaction, as in modern pharmacology. Strong taste was probably the common proof for a good drug...

Summary: Botany and Zoology in the Classical era:

Classification of plants by shape and structure, flowers and habitats:

Trees (fruit trees, forestry), weeds (wheat grains), bushes, decorative plants.

All plants get nutrition from their roots. (what about algae and water plants ?)

Classification of animals: Fishes, insects, birds, mammals.

Fossils: conclude that the seas covered earth: supported by the bible...

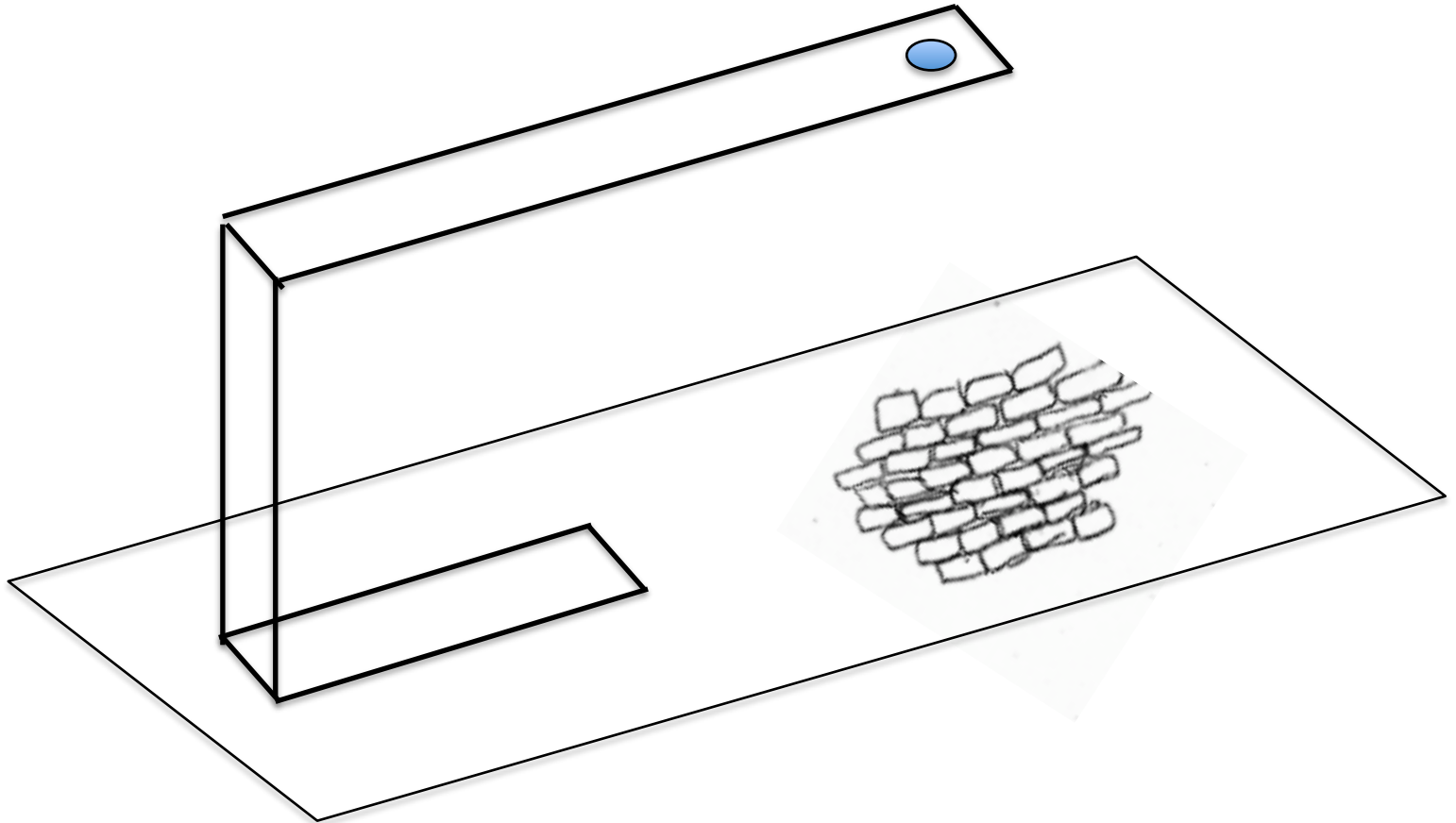
Classification of knowledge is the first stage in systematic understanding.

It has huge practical significance for tree transplants, selective improvement of grains, domestication and inbreeding of animals, and seed cycle to preserve ground fertility.

LAB WORK:

Hanging drop microscope.

Visualize cells in onion shell and a thin slice of cork.



The story tells about Thales, wondering early morning in the open field, and observing that tiny dew droplets on leaves display an enlarged view of aphids. He later discovered the cellular structure of leaves, supporting the atomic theory of nature.

LAB WORK (cont.):

Extraction of materials from leaves:

Extract mint by alcohol
Extract chlorophyll by acetone

Blow air into a vile with a burning candle.

Lighted candle in a vile with a plant in sunlight and dark.

Why was it difficult to perform such experiments in ancient times?

