

# History of Pharmacy Described in the Books and Articles Stored in Libraries, Museums and Scientific Databases

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**Background:** For many years, pharmacy and medicine were inseparable sciences, so everything that was done in the field of medicine, that is, treatment, can be related to pharmacy. The history of pharmacy therefore also includes the history of medicine, at least until the 13th century, when pharmacy was officially separated from medicine. **Objective:** The aim of this study was: to describe the books and monographs that are available on the Internet, which deal with the study of the history of Pharmacy; and to show pharmaceutical history museums around the world and their unique collections of pharmaceutical artifacts. **Methods:** During the preparation of this paper, a descriptive method of analysis from the available literature was used. The analysis of available literature included professional books, monographs, articles and other literature available on online browsers. **Results and Discussion:** Today there are a large number of societies, academies, associations and foundations dealing with the history of pharmacy. Also, a lot of books, monographs and scientific papers published in on-line databases. The goal of each organization is the research of historical facts in the field of pharmacy and medicine that will be shared with professionals, but also persons who are not from the profession (doctors, librarians, archaeologists, archivists). A large number of museums have been opened for the history of pharmacy, and almost every developed country has such a museum. Such museums represent a national treasure, because they preserve the valuables of pharmacy from the territory of the country, as well as the world.

**Keywords:** History, Pharmacy, On-line Scientific databases, Museums of Pharmacy.

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## 1. BACKGROUND

The pharmacy and medicine are among the oldest human activities (1-5). The history of these sciences is closely connected with the socio-economic, cultural and religious circumstances of the nations within which they developed (6-10). In the period from the 7th to the 15th century, Arab medicine experienced its prosperity. In the 6th century, the Persian university in Jundi-Shapur, as well as the then university hospital, became the backbone of the development of Arab medicine (11-20). Medical centers are Baghdad, Granada, Cairo and Damascus, with hospitals and medical schools, which is simply incredible for that time, were graded in two levels, medical schools of theoretical medicine, and a higher level - medical schools of practical medicine. In 931, the licensing of medical doctors was introduced in Baghdad, that is, there was a special commission that issued work permits after completing

school. In the first year alone, 860 medical doctors received their licenses. This kind of progress was achieved thanks to generous publicity. Libraries are practically full of books: in Cordoba the library has 600,000 books, in Granada 1,100,000 books, in Cairo 2,000,000 books, in Tripoli 3,000,000 books, in Timbuktu 1,000,000 books, etc. By burning the libraries in Granada and Córdoba, hundreds of thousands of manuscripts and books in Arabic, but also in Spanish, in the fields of anatomy, physiology, surgery, occultism, etc., were destroyed. On the other hand, the Mongols burned the libraries in Baghdad in 1258, during which practically millions of books disappeared into ashes, among them the capital original works of Arab doctors and scientists. In Mustansi-riyya University alone, a library with 80,000 medical titles was burned. Only in Cordoba, the library counted over 600,000 Arabic manuscripts from all the sciences, and about 6,000 of them was from the



Figure 1. This miniature is from Codex A.F. 10 of the Austrian National Library. The manuscript, containing a mere 31 pages, is invaluable as the second-oldest Galen text extant in Arabic. The oldest manuscript, from the 12th century, is in the Bibliothèque nationale in Paris. The illustration shows the portraits of the nine physicians who contributed to improving the theriac, while the text describes its powers and composition. From right to left we see in the first row: Andromachus, Pherecydes, Pythagoras; in the second row: Pericles, Pythagoras, Marinus; and in third row: Andromachus the Younger, Magnus, Galen. Vienna, Austrian National Library, Codex A.F. 10. Arabic translation of the first book of Galen's Treatise on electuaries, attributed to John the Grammarian. First half of the 13th century. Folio 1 verso.



Figure 2. Our next illustration also shows two rare representations of persons. This miniature depicts two doctors whose names are given in the Arabic script above their heads: Faritulus and Venzeius. The illustration comes from the same manuscript as the previous one (2 verso). The colors of a third figure, unfortunately, are almost completely faded. The Turks still regret that Dioscorides, the "Father of pharmacy", without whose original research the development of later and medieval pharmacology would have been inconceivable, remained an "idolater" and did not become a Christian, thus one of the "peoples of the Book", even though he was born at the beginning of the second half of the first century. Pedanius Dioscorides came from Cilicia, a region in Asia Minor (Anatolia) bordering in the east on Syria and in the south on the Mediterranean. Galen also refers to him as Tarseus, the man from Tarsus, the capital. According to the classical sources, Dioscorides was born in a town called Anazarbus, now in the district of Ceyhan, Adana province, Cilicia, Anazarbus was an ancient city and a centre of civilization. Arab sources refer to it as "Ayn Zarbah", which later became Anavarza.

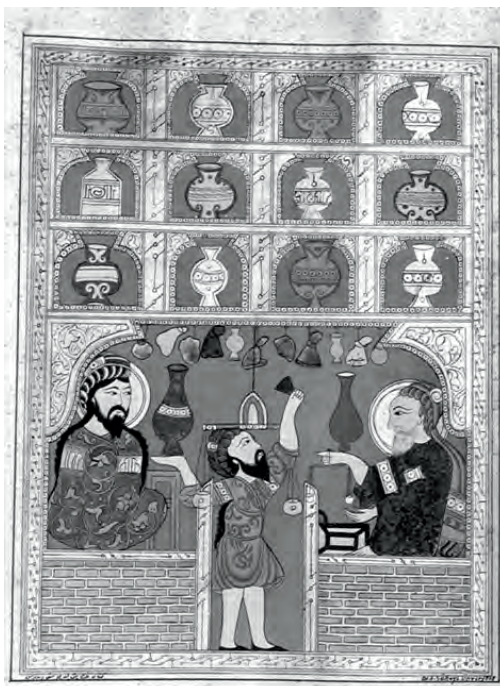


Figure 4. In an earlier booklet, we reproduced the dispensary illustrated in a Baghdad manuscript from 1224 of the work of Dioscorides. The original is now in the Metropolitan Museum of Art in New York. The miniature depicted here is similar and is also dated 1224. It is taken from another Dioscorides manuscript (in Istanbul) containing the fourth and fifth books of "Materia Medica" as well as a work of Hunayn, the "Kitab al-karma". According to E.J. Grube in his article "Materialien zum Dioskurides Arabicus", only this miniature has remained in the Istanbul manuscript. Thirty leaves containing miniatures of the very highest quality are now in fifteen different public and private collections in Europe and America. Istanbul, Aya Sofya Muzesi, MS 3703. Dated Rajab 621 (1224 AD, June-July). Folio 2 recto.



Figure 3. Portraits of Islamic doctors are extremely rare, and only a few examples are known. Either the pictures show the idealized portrait of "the doctor", lacking any individual facial traits (there are similar portraits of the Prophet himself), in which the physician is depicted as an allegorical figure; or those portrayed are the "teachers" of Islamic medicine, mostly doctors of classical Antiquity usually clothed in Arab, Persian or Turkish dress and bearing the insignia of the scholar caste. Although the doctor had no official attire, as a worthy man of learning he wore a long gown and had a beard; he never appeared in the short coat of the craftsman or peasant. Our illustration shows two students of Dioscorides. The prohibitions of living things in Islam is much disputed. It is not actually found in the Qur'an, but in Hadith (the record of the Traditions of Muhammad) and is interpreted differently by various schools of thought: the creation of images of living beings is viewed as an attempt to vie with God, "the creator of all things". Istanbul, Topkapı Sarayı Müzesi. De Materia dated 626 A.H. (or A.D. 1229). Ahmet III, 2127, Folio 1 recto (left title page).



field of the medicine and astronomy.

Towards the end of the 8th century, a special translation school was established in Baghdad. The foundation of Arabic medicine was laid in this translation school, and the school will later grow into the Academy of Sciences. The credit for this belongs exclusively to the progressive rulers of the Islamic theocratic state who generously and with unparalleled religious tolerance accepted and helped the cooperation of experts in medicine and philology (3). One of the key reasons why Muslims translated scientific sources into Arabic is the desire of Arab caliphs to strengthen the Islamic faith by translating Greek philosophical works. This period is known as the Madrasah–Shurrah al-Igrikijjin (School of Commentators of Greek Works), whose scholars have translated mostly all Greek works on medicine and pharmacy. In fact, Muslims are credited with preserving many parts of Galen and Hippocrates. It is a historical fact that Europe first became acquainted with Greek medicine through Arabic translations.

In the next phase of the rapid acquisition of Greek and Persian sciences, a new generation of Muslim scholars emerged with their authentic concepts and contributions to medicine, and the works of such scholastics as Ibn Sina and Ar-Razi dominated European medical schools for centuries (2-4). These medical schools established a base of medical practice at the time and contributed greatly to innovations in medical practice, outpatient patient care, and mobile clinics. Among these schools and hospitals, the largest and most famous was the El-Nuri Hospital, in Damascus (1160), which remained active for almost three hundred years, and the Mensuri Hospital in Cairo, Egypt (1276). At one time, Baghdad had close to 600, while Cordoba had more than 500 hospitals in Spain. The largest hospitals had libraries, outpatient clinics and medical schools. These hospitals have done careful research into the separation of patients with fever or infectious diseases, as well as the mentally ill. Medical education was transferred from these hospitals. Students sought theoretical and practical education there, and well-known doctors and surgeons were chosen to serve in these hospitals. Mensuri Hospital was the first hospital to nurture science, learning and social care. She divided the wards into women, children and those who are recovering, and wards suffering from specific diseases. In addition, there were smaller libraries and private collections, all of which contained no less than 100,000 books. These libraries contained medical works, among other scientific works such as those in chemistry, astronomy, geometry, philosophy and other branches. At that time, the eastern and western capitals of the caliphate became centers of civilization, and medical institutions and scientific research were funded by the state.

Islamic physicians have emphasized both clinical and basic medicine in their lectures (21-34). Medical students were required to be educated in the basic sciences and to have appropriate knowledge from the works of medical authorities such as Galen, Hippocrates and Ibn Sina, Ibn Haitham, Al-Biruni, Ar-Razy, El-Zahravi, among others (3, 4, 18, 26). Medical knowledge was compiled into a collection of manuscripts so that clinical tests could be reasoned to a certain extent and students were examined in the basic sciences. Islamic scientists have also improved and perfected pharmacology and chemistry. They described many new medicines such as hay, camphor, nutmeg, cloves, etc., and used new solvents such as rose water and orange water. They also used aldehydes, alcohol and other solvents as well as perfected methods of testing the purity of metals and chemicals. Their persistence in searching for methods of converting metals to gold has resulted in the discovery of several chemicals such as acid metals, bismuth, ammonia and mercury compounds. Arabic words such as alcohol (ar.kuhul), syrup (ar.surub) and others, are widely used. Basic chemical processes including distillation, crystallization and sublimation were also discovered. It is also known that Islamic physicians used cannabis sativa indica (ar. Kunnab hindi; hashishatul kaif) for inhalation as an anesthetic. El-Kindi's work on the method of prescribing and precisely determined dosage of drugs is well known. He applied the law of geometric progression in prescribing drugs. And finally, the word about Muhammad ibn Abdullah al-Ash'at from Mosul in Iraq as an expert in medicine and pharmacology brought students from far and near cities to hear his lectures. This sea of knowledge, which lasted for almost four centuries, was later stopped by the Mongol invasion of the Eastern Caliphate and the decline of the Western Caliphate in Spain (5).

Pharmacy became an independent science under Islam, although embodied in medical science. The pharmacy reached its status around 801, under the patronage of the Abbasid caliphs (2, 4, 11-15). The first privately owned and operated pharmaceutical stores opened in the early 9th century, in Baghdad, the capital of the Abbasids, where medicines and spices from Asia and Africa were regularly available. In a short period of time, pharmaceutical activities spread to other major cities in the Islamic world. Pharmaceutical products were produced and distributed in markets and used by doctors and pharmacists in various forms: as ointments, electuaries, preservatives, lozenges, pills, elixirs, syrups, tinctures, suppositories and inhalations. Instructions for the preparation of such dosage forms have been included in Arabic texts and unofficial pharmacopoeias (4). Sabur b. Sahl (died 869) was the author of the first known collection of formulas in Islam.



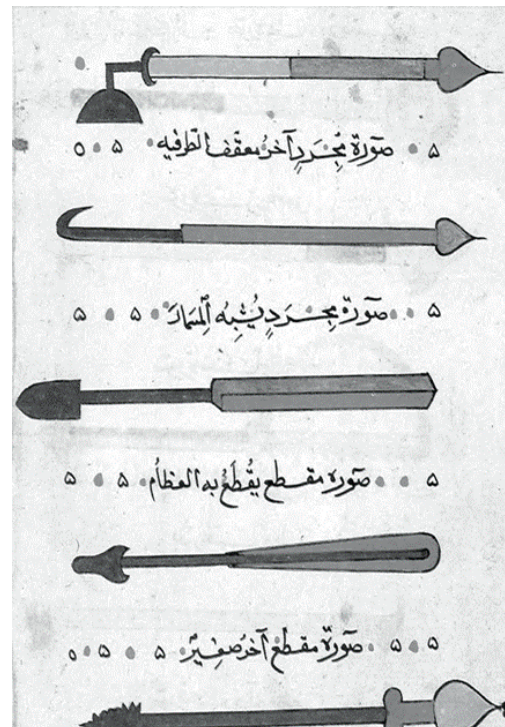
This miniature (and the one that follows) are two individual manuscript leaves in the possession of the Metropolitan Museum of Art in New York. They belong to a unique manuscript of the Hagia Sofia Library that is now in the Topkapı Sarayı Museum in Istanbul, containing the fourth and fifth books of the *Materia Medica* by Dioscorides and a work by Hunayn, *Kitab al-Karma*. Only a single miniature remained in the Istanbul manuscript; thirty leaves with miniatures are scattered throughout fifteen public collections in Europe and America. They are of particular interest because they depict not only the plants and animals found in all illustrated Dioscorides' manuscripts but also persons and techniques of drug preparation in use at the time (A.D. 1224). "The manufacture of an aromatic (strongly spiced) wine against cold and coughs: between two trees, a funnel is suspended on a tripod over a large vessel placed on the ground. A physician, his right hand lifted to his face while he handles a mortar with his left, is seated on a stool to the right. A large jar stands at the left." New York, The Metropolitan Museum of Art. Dioscorides and Hunayn, Baghdad school of miniaturists, dated Rajab 621 AH (June–July A.D. 1224). Calligrapher and miniaturist (?) 'Abdallah bin al-Fadl. Inv. No. 13.152.6



This illustration and the one that follows depict the manufacture of drugs. It is said that the ancient Egyptians discovered chemistry as well as astrology, indeed, the root of the word "chemistry" has by some been traced back to the Egyptian "kem", meaning black (nowadays we refer to sorcery as "black magic"). Once the al-chemists realized that they were unsuccessful in producing precious metals or the panacea, many turned to chemotherapy, a science neglected in the writings of the Ancients who had devoted their energy in the main to investigating drugs of vegetable and animal origin. The pharmacists also adopted production processes from the alchemists. The oldest distillate of organic matter is probably alcohol (production of which is theoretically forbidden by an interpretation of the Quran, but permitted for medicinal purposes). Many technical terms have been assimilated by modern European languages. The alembic and aludel, a distillation still and sublimation pot invented by the Arabs and first produced in Syria, are but two examples. Our illustration shows the preparation of a compress against a tarantula bite. Presumably from Pseudo-Dioscorides' book on poisonous animals. From an Arabic Dioscorides manuscript of Mesopotamian origin (Baghdad School), A.D. 1224. Washington, Freer Gallery of Art.



The iatric "sciences" of the Middle Ages go back to the writings of the mythical Hermes Trismegistos. Our particular interest in this context is iatric chemistry rather than iatric mathematics and physics ("iatrike tekhnē" is Greek for the "art of healing"). Only mathematics can be traced back to ear-liest times. Synonymous with "astrological medicine", it is apparently of Babylonian origin and was passed on by the Greeks and their His-pano-Arab and Jewish translators. Iatric chemistry and physics began in the 16th and 17th centuries when medicine was being underpinned by scientific disciplines. Iatric chemistry was doubtless a product of the alchemists who also supplied the necessary accessories for a doctrine that was later declared a "science". It was founded partly on traditional theoretical beliefs and partly on traditional theoretical beliefs and partly on empirical discoveries. There is no byproduct or waste product from the refining process of stone or metal that has not been tested for its pharmacological properties at one time or another. Here we have the origins of modern chemotherapy! Our illustration shows the production of an ophthalmic medicine from the buds of the wild vine or oinamthe mentioned by Dioscorides. From an Arabic Dioscorides manuscript dated A.D. 1224. Mesopotamia; Baghdad School of Miniaturists. Washington, Freer Gallery of Art.



Abu'l-Qasim's writings on instruments show a plethora of artefacts adapted for use in the medical field. It is possible that the author did not go beyond the pictorial representation of these instruments. Practical textbooks in medieval Islamic countries were inconceivable without illuminated lettering and illustrations. But just as the artist had to dispense with the most effective of the decorative elements, i.e. the representation of human beings and animals – turning instead to calligraphy, arabesques and geometrical designs – so, too, did the scientist apparently limit himself to reproduction of medical and surgical instruments. Just as the artist went on creating new arabesques, so, too, may the scientific author have contented himself with the purely pictorial creation of ever different



They followed a treatise on pharmacy from ar-Razi and Books II and V from Ibn Sina's al-Qanun. The fifth volume of the Canon is especially important for pharmacy, because it summarizes all the ancient knowledge from *Materiae medica*, supplemented with new knowledge from that field. The most significant text on pharmacy at the time was as-Saydanah fit-Tibb, by Abu ar-Rayhan al-Biruni (died 1052). The author gave a detailed definition of pharmacy and pharmacology and described the function and duty of a pharmacist as a healthcare professional. About a century later, Ibn at-Tilmidh wrote al-Aqrabadhin, a pharmaceutical text that explains how to prescribe and prepare a large number of medicines. This text has become a reference for pharmacists practicing in private shops, as well as in hospitals. Some of these hospitals had pieces of land reserved for the cultivation of medicinal plants (1). Muslim pharmacists and physicians showed a special interest in natural products and medicines (Figures 1–20). Many Muslim doctors have experimented with drugs in order to learn as much as possible about their effects. Useful experiments with drugs and diet that have proven useful in the treatment of certain diseases are the collection in booklets, known as al-Mujarrabat and have been used in medical schools. Other manuals of the time include maps, diagrams and tables, and deal with drugs and specific diseases, listing the causes and symptoms of the disease, the seasons when they occur, and the doses of drugs administered. Other manuals contained mathematical calculations related to drug potency and recommended doses, according to the age and sex of the patient and the degree of the disease. Under Islam, the science of toxicology is developing in response to the increasing number of cases of accidental poisoning or premeditated poisoning. Court physicians and counselors were encouraged to write about the subject and to recommend precautions as well as to provide open information. Toxicological manuals and treatises were teeming with prescribing drugs such as specific and general antidotes. There was a tradition of using a large teriyaki – a universal antidote. The introduction to Indian toxicology and the proliferation of Arabic plants and pharmaceutical formulas resulted in further modifications until the 13th century when the Arabian teriya was introduced to the West (1).

Among the first known Islamic scholars in the field of pharmacy and medicine was the philosopher Razes (Abu Bakr Muhammad Ibn Zakariya al-Razi (850–923). His great encyclopedias „KITAB AL MANSURI“ and „CONTINAUS MEDICINE“ cover certain medicines and their applications (3, 4). His major work „EL-JUDARI VEL HASBA“ deals with the difference between smallpox and measles and is considered the earliest work of its kind. A brilliant follower of Razi was Abu Ali Husayn Ibn Abdullah

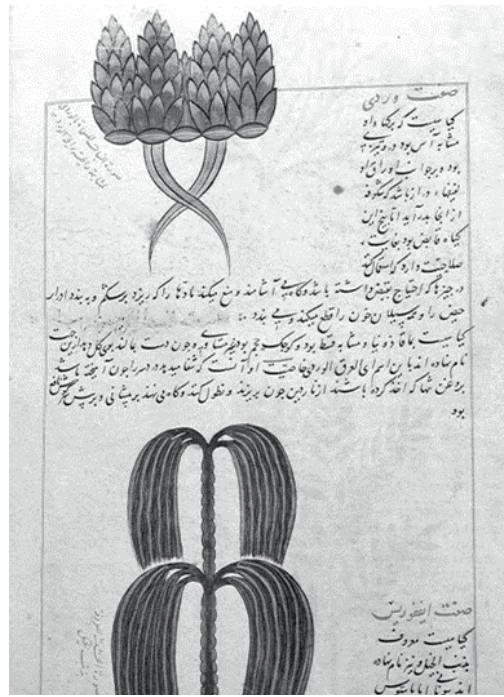
Ibn Sina (980–1037) who with his work „AL-QANUN FIT-TIBB“ systematically summarized the complete medicine of that time (3, 19). Ibn Sina's contemporary, Abu Rayhan Muhammad Bin Ahmed Al-Biruni (975–1050), made a huge contribution to the knowledge of drugs in Asia with his work „DRUG SCIENCE“ (3, 25). Biruni derived the Arabic name for pharmacy under the name „SANDANIN or SANDALAN“. The first manual on poisons and a manual on medicinal herbs with synonyms was given by Rabbi Moses Ben Maimon (1135–1204). Al-Idrizi, who, both in the Islamic world and beyond, was primarily known for his book of geographical maps, wrote a book on simple medicines called „KITAB-AL ADWIAL-AL MUFRADA“ (2, 3). Another very important part of Arab pharmaceutical science is covered by the Arab Pharmacopoeia, which is the work of many authors and contains four areas: a) therapy based on the human theory of Hippocrates and Galen, ie. of the four basic elements of nature; b) measures and measurements, which represents the improvement of accurate dosing and production of pharmaceutical forms; c) drug identification; and d) pharmaceutical forms (3).

The great Arab scientist, Razes, in his work “The Secret of Secrets” pointed out that alchemical procedures, e.g., distillation can be used to prepare medicines (3, 22). Thus, Arab alchemists introduced new drugs into medicine and pharmacy: alcohol, camphor, amber betel, etc. Then the belief arises that the means that clean metals also cure diseases. The Greeks called the philosopher's stone “xerion” (powder for sprinkling), from which the Arab writers made the name “al-iksir”, i.e., elixir, and they believed in its extraordinary medicinal properties – a “panacea” or cure for everything. It goes on to describe Paracelsus who sought to find healing elixirs using alchemy. In the 20th century, it turned out that knowledge in alchemy has great importance for both medicine and pharmacy. A demonic pharmacy was also described in which it was believed that demons were the cause of diseases and that these diseases could be cured by exorcising demons, i.e. witchcraft. This book also mentions a demonic-magical pharmacy in which human illness arises as a punishment from the gods and can be cured by prayers, sacrifices, etc. (1, 3).

It should be emphasized that with Islam there was a revival, not only in the field of science, but in the field of public health. A series of Islamic religious obligations, they had to come up with the construction of facilities in which they will be implemented, then establish a whole series of legal regulations and control systems for the implementation of these regulations. Islamic religious regulations on hygiene and cleanliness of the body, teeth, places where they will worship, way of life, have encouraged the creation of special control services. Already



The illustrations of the present manuscript are, in part, copies of the Arabic original, which was illuminated in Mesopotamia towards the end of the 12th century. The text was translated into Persian at the command of Il-Khan Mahmud Ghazan (1295-1304), the Mongolian ruler of Persia. Drugs of animal origin utilize a broad variety of creatures: insects, freshwater and saltwater fish, amphibians and reptiles, birds, rodents, mammals, venison, domestic animals, artiodactyla and perissodactyla. The restrictions of Islamic dietary laws extend not only to pork but also to various other mammals (in particular perissodactyla) and especially to reptiles, insects, birds of prey and all carnivorous animals; they do not apply to the medical field. It would appear that the medicinal use of animal species forbidden as food was intended as a kind of "irritation therapy" (as it is still practiced today in the traditional medicine of India, China and Japan). The illustration shows a rhinoceros. New York, The Pierpont Morgan Library. Manafi' al-Hayawan, by Bukht Yishu". Tabriz 1295. MS 500, folio 14 verso.



The lower illustration shows a plant that is called dhanb al-khayli in the Dioscorides text (Equisetum arvense L.), and which belongs to the Equisetaceae family, the horsetails (or scouring rush). It was known as pherpha to the Egyptians, hippuris to the Greeks, and equisetum to the Romans. It grows upwards by attaching itself to neighboring stems, and then hangs down, surrounded by dark hair-like structures, similar to a horse's tail. The medicinal plant is rich in silicic acid, and contains a saponin - equisetin. Pliny provides a precise description of the horsetail, and reports that the plant possesses such potency that merely touching it control hemorrhage. Dioscorides gives a more detailed description: the root is wooden and hard in consistency; the foliage acts as an astringent, and hence the plant's juice arrests severe bleeding from the uterus. When taken as a potion with wine, the plants are an aid in dysentery, and also promotes urinary output. The leaves, when sprinkled on the affected area as a finely ground powder, seal bleeding wounds; the root and foliage exert a healing action in cough, orthopnea, and internal ruptures. "It also said that when the leaves are taken with water, they can heal trauma of the viscera, rupture of the bladder, or hernia." Istanbul, Topkapi Sarayi Museum, Dioscorides, "De Materia Medica", dated 866-869 AH (1461-1464 A.D.). Ahmet III, 2147. Folio 388 verso.



The plant depicted here is called hauk yahudi in the text of Dioscorides, and is identical to Acanthus mollis L. (Acanthaceae) - the white acanthus. It also goes by the name of "bear's-breech" or "bear's-paw"; the designation "bear's-breech", however, is applied as well to an entirely different plant, viz. Heracleum sphondylium L. (Apiaceae family, formerly Umbelliferae); both plants are described in the writings of Dioscorides and of more ancient authors. The use of the popular name for different plants is not important, since this occurred in a wide variety of plants, including medicinal herbs. Pliny and Dioscorides distinguish between two different "species" of acanthus: the one reproduced here, and the so-called wild acanthus - a "species" that likewise belongs to the Acanthaceae family, but which has been described in differing terms by a number of authors. In antiquity, Acanthus mollis was cultivated in gardens, partly also as an ornamental plant. According to Vitruvius IV, 1, 8, the leaves were used by the sculptor Kallimachos as a model for the capitals of Corinthian columns, where we still find them today. In the pharmacognosy of the ancient Egyptians, the acanthus is apparently not described, and is absent too in the pharmacology of the Copts. In Islamic medicine, it plays a specific, but not prominent, role. The Dioscorides text states that the roots of these plants serve as a poultice in burns and sprains; when taken as a potion, they promote the production of urine and alleviate diarrhea. They are also highly effective in tuberculosis, internal ruptures, and spasm. Detailed medical formulations are not given. Thus, the plant, which today has such significance as a model in art-historical ornamentation and which has become generally well known, enjoys comparatively less significance in medical terms. But like many varieties of this tie it was used as a decorative plant in antiquity; and this fact most likely explains why the plant was to play such a significant role in the ornamentation of buildings. "De Materia Medica", dated 866-869 AH (1461-1464 A.D.).



These are leaves from the plant lovage, which over a number of decades have been rediscovered in northern and central Europe as a spice for flavoring sauces and soups. In the Dioscorides text it is called kasham (ka'am) (in Greek, Lugstikon; in Latin, Levisticum officinale, or "genu-in lovage"). However, only the root of the lovage herb - Radix levistici Koch (Umbelliferae) - has been used for medicinal purposes ever since ancient times. Cultivated as a pot-herb in cottage gardens, above all in Germany, its original habitat cannot be determined with complete certainty (most likely southern Europe). As with most pot-herbs that are also used for medicinal purposes, the plant's content in essential oils, resins, and bitter constituents is decisive, with the leaves and the root exhibiting highly differing concentrations and proportions of these substances. The root of the biennial-to-triennial plant is used, whereas the plant itself is cultivated from strip cuttings. Even today, Radix levistici is mentioned in pharmacopias and pharmacognosy textbooks. Dioscorides equated the effect of the root with that of the seed. He wrote that the root's potency exerted an effect of warmth, aided digestion, and also helped in intestinal diseases, in digestion, and in edema and flatulence, particularly in the stomach (i.e. as a carminative, in modern parlance, just as are many essential oils) - and for the treatment of bites from poisonous animals. When drunk as a potion, these plants promote urinary output and aid menstruation; the root, if inserted as a suppository, achieves the same effect. As digestants, both the root and the seed are often admixed with the constituents from other medicinal herbs. The natives of Liguria, a region in northwestern Italy, use the seeds of the plant instead of pepper to add to their meals. Istanbul, Topkapi Sarayi Museum, Dioscorides, "De Materia Medica", dated 866-869 AH (1461-1464 A.D.). Ahmet III, 2147. Folio 384 recto.

Figures 1-20. Pictures and their legends are taken from the book Arabic medicine, written by Izet Masic and published by Avicena, Sarajevo, with confirmation of both, publisher and author (3)



in Abbasid (749-1242) there was a supervisory service subordinated to a single authority called *ih-tisab* or *hizba*. At the head of the *ih-tisaba* stood the *muh-tesib* or president. The scope of work of each *muh-tesib* was precisely determined by individual manuals. The most significant and generally the oldest work of its kind is *Nihajjet-ur-rutba* by Abdullah bin Nasr bin Abdullah bin Muhammad Ash-Shizari. This work, among other things, deals with the manner of forgery and identification of genuine counterfeit drugs, spices and foodstuffs (3, 4). It deals in detail with the method of controlling the work of pharmacists, doctors, ophthalmologists, etc. Chapter 17 deals with the control of the work of pharmacists. Medicines are prescribed according to the disease, they must have a specific composition and dose. Therefore, the author recommends the *muhtesib* to check pharmacies, medicines and herbal work every week (3). In the course of the 19th century the medicine of the countries of the setting Sun has become known in almost all the Islamic countries. So the Arabic medicine has of course still nowadays (*tibb yunani*, *unani* medicine) has become the location of the IndoMoslim modernism, which is introduced 1927 year at the University Aligarh Muhamedan Anglo-Oriental College. Year 1938 was opened there, also the hospital in which could be applied this medicine. Also in Dacca, the capital town of the East Pakistane was opened, not as on University, then as the private medical school (*Tibbia* College), and that the thirthies years, hoping to wake up the old art of the treatment, leaning at the European medicine (3).

## 2. OBJECTIVE

The aims of the paper are: to present the organizations that study the history of pharmacy and medicine and describe historical facts published and deposited in the publications (books, monographs, articles) that are available on the scientific on-line databases, or collected and stored in pharmaceutical history museums around the world.

## 3. MATERIAL AND METHODS

The study was retrospective and prospective and the collection of literature was mainly via the Internet. Our intention was to describe all organizations that deal with the history of pharmacy, and to consult books available in scientific on-line databases that deal with the history of pharmacy (11-40) and museums of the history of pharmacy that are located in famous university cities in different parts of the world (1).

## 4. RESULTS

### 4.1. History of medicine and pharmacy in published books

On Figures 21 and 22 are shown cover pages of published some of influential books about history of medicine pharmacy in the world. One of most

interesting book is Kremer's book (Figure 22) in which is described the history of pharmacy from the very beginning – that is, the creation of pharmacy until today (1). In the early beginnings, pharmacy was connected with medical science because every doctor performed both medical and pharmaceutical duties at the same time by treating patients and at the same time preparing their medicines immediately. The history of pharmacy can be divided into two periods: the period when it was part of medicine and the period when pharmacy became an independent science. Pharmacy has existed as long as humanity has existed, because since the existence of man, there have been various diseases, epidemics and various pathological conditions, due to which man's need arose to search for medicines that would eliminate diseases or reduce pain (1).

This book also describes the centers of pharmaceutical culture, where we distinguish three main centers, namely: China and India, the second is the Mediterranean Sea area, and the third center is in America. The medical-pharmaceutical culture in the early Middle Ages, the origin of European pharmacy, regulations on determining the pharmaceutical service in Europe, the improvement of pharmacy during the Renaissance and in the seventeenth, eighteenth and nineteenth centuries are also described, Yugoslav pharmacy, and pharmacy in Bosnia and Herzegovina are also described, the period of old Yugoslavia and the periods in which Bosnia and Herzegovina was under Turkish and Austro-Hungarian rule, as well as the period from liberation to the present day (1, 3, 31-34)).

Over time, a man taught by experience began to use certain means in treatment, when he noticed that they helped him, he used them more and more and spread his knowledge (29). That's how he got to know the effect of cold water, which removed various inflammations, while the effect of the sun alleviated his pain. Man came to know that one plant relieves pain, another induces sleep and the third cleans the intestines, but also that one plant can burn the skin, and another can absorb or create rupture. A man's experiences with drugs that had already helped him in treatment encouraged him to collect such drugs and to use them again in similar conditions. The acquired experience was passed on from generation to generation, while over time people started to stand out who knew how to help other sick people, i.e., persons who had more experience than others. Those people helped other people, who turned to them more and more for help in times of trouble, and that's when the first doctors and pharmacists were born who kept their knowledge and did not give it to others. The cradle of medicine and pharmacy is in the East, which is rich in the most diverse herbs. astrology played a major role in the preparation of medicines and prescriptions



The plant on the right is identified as a species of anemone (Ranunculaceae), while that on the left as a species of orchis (Orchidaceae). Dioscorides distinguishes two types of anemones, a wild and a cultivated one. The root can be variously employed to lean the head, loosen sputum, heal different ocular conditions and clean ulcers. The leaves and the stalk improve lactation, aid menstruation and also cure leprosy. The remarks of Dioscorides on the orchis are, apparently, based on "hear-say". He claims that the large roots, if eaten by a man, will bring about the birth of a boy, while the small roots, if eaten by a woman, will cause the birth of a girl. It was variously ascribed aphrodisiac and antiaphrodisiacal properties. Moreover, it has the power to cure edema, clean ulcers and arrest serpiginous ulcers. It removes fistulae and soothes inflammations. In dry form, it stops putrefaction and ulceration, while, when taken with wine, it cures diarrhoea. Istanbul, Topkapi Sarayi Museum. Dioscorides, "De Materia Medica", dated 866-869 AH (1461-1464 A.D.). Ahmet III, 2147. Folio 319 recto.



This and the following illustrations of medicinal plants were chosen for their artistically pleasing composition, combining plants and animals. This illustration represents a plant called britanike or bretannika or bet-tonika in Dioscorides. The identity of the plant, which is similar to and yet different from wild sorrel, cannot be ascertained. It is also mentioned by Pliny, who calls it britannica and says that it cured thrush and paralysis of the knee in a soldier on Caesar's campaign beyond the Rhine. Dioscorides or one of his students has this to say about the indication: "Freshly pounded and laid on a head wound caused by a blow, it relieves pain. It also closes wounds and extracts broken bones if it is changed every day until healing takes place. It cures headaches if it is boiled in water which is then poured over the head; alternatively, it may be rubbed with asphalt into the temples or the latter may be treated with the smoke of the root".



This illustration shows four species of the Batrachium, an Asiatic Ranunculus (butter-cup). Dioscorides too distinguished four species, which later commentators have identified as Ranunculus asiaticus, Ranunculus languinus, Ranunculus muricatus and Ranunculus aquatilis. The indications for these four plants seem to be essentially identical. The leaves, blossoms and stalk have scab-forming properties. They cure scabby nails and the itch, remove stigmata and warts, and correct alopecia. They can also be employed in a warm poultice for frostbite. Furthermore, the roots were used against toothache and to cause sneezing. Later herbals ascribed a hyperemic, astringent and, in particular, keratolytic action to this drug. Istanbul, Topkapi Sarayi Museum. Dioscorides, "De Materia Medica", dated 866-869 AH (1461-1464 A.D.). Ahmet III, 2147. Folio 322 verso.



This illustration is taken from a manuscript of the Khawass al-Ashjjar (The Properties of Plants) by Dioscorides. It is of Mesopotamian origin (Baghdad) and dated A.D. 1240. The copyist was Al-Hasan bn Ahmad bn Muhammad an-Nashawi. This miniature shows the same plant in two different stages: before and after flowering. The family is called luffah or yaqtini in Arabic and resembles the eggplant when the latter turns yellow. However, to judge by the unmistakably anthropoid form of the rootstock, the plant presumably was a mandrake (Mandragora officinalis). Mandrake, along with the other Solanaceae, played a key role in Oriental and Western mysticism and pharmacology from the Middle Ages right up to modern times because of this resemblance and its efficacious alkaloids. Al-Biruni (A.D. 973-1051) provides a long description in his treatise on pharmaceuticals: "Two forms appear when it (mandrake) is cloven in the middle: the male and the female shapes." The flower, he continues, resembles the mask of an actor sticking out his tongue. Mandrake "brings sleep within three or four hours". Prior to the discovery of anesthesia, a "soporific sponge", consisting of extract of mandrake compounded with other medicines, was used to induce insensitivity to pain. Oxford, Bodleian Library, MS. arab. d. 138, gift of Sir William Osler, 1926. Folio 120 a. By courtesy of the Curators of the Bodleian Library, Oxford, England.



for their use (2, 3).

The basic premise of astrology is that there is harmony and an inner connection between man and the universe, and the most important astrological procedure is the compilation of a horoscope, i.e., determining one's destiny in life according to the position of the heavenly bodies at the time of birth (2). This book also mentions Hippocrates, the founder of Greek medicine, and Galen, a Roman physician and apothecary, who believed in medical astrology and stated that acute diseases depend on the Moon and chronic diseases on the Sun. The Romans did not particularly appreciate astrology, while Christianity treated it hostilely. Astrology spread in Western Europe in the period from the tenth to the twelfth century through Latin translations of Arabic astrological parts. From the thirteenth to the sixteenth century, astrology occupies a dominant position, it was even studied as a separate subject at medical faculties. In the system of medieval medical astrology, the properties of the organism, individual parts of the body, temperaments, physical symptoms as well as the critical days of illness are connected with the position of the seven planets of the Ptolemaic system in the twelve zodiac signs and interplanetary relationships (1).

In the Middle Ages there were outbreaks of epidemics and today's name "influentia" for influenza epidemics is a reflection of the old belief about the influence of the stars. The prevailing opinion was that Saturn was particularly responsible for the outbreak of the plague. The scientific understanding of celestial mechanics and the gradual adoption of the heliocentric system deprived astrology of its theoretical basis, and it was discovered in the late seventeenth and early nineteenth centuries that astrology is a false science. Alchemy is also described in this book, as an effort to convert base metals such as copper and mercury into noble ones: silver and gold (1). English physicians and the chemist John William Draper (died in New York 1882 year) wrote in his work "The history of the intellectual development of Europe" for Moslems Arabs: "*The Arabs have become the true protectors of the science and with right was told that they have knocked down the neighbour empires. By their halifs was the custom that the great honour in the state give only those people who were qualified with the knowledge*". Speaking about the libraries, he says that each more distinguished man had in his lodging a library, that the Moslems rulers by themselves were engaged in all the branches of the science.

#### 4.2. History of medicine in the Middle Ages

The history of medicine in the Middle Ages (Figure 22) is a book that talks about the history of medicine in the Middle Ages, that is, the emergence of medicine as a result of people's basic need to maintain good health and overcome various diseases, in

order to maintain the population and their existence through health. Scientists have researched the past of medicine and how early human civilization dealt with health problems. All this research contributes to today's medicine, because only by understanding and learning about the past can something be done to make things better in the future. This book includes 8 chapters. Each unit is interdisciplinary and connects discussions on the issue of history, biology, chemistry, medicine and economic and public policy. Many contributions of the Greeks and Romans are mentioned here, including Hippocrates in the development of medicine and how the Romans improved public health. In the Middle Ages, there was a strong religious influence on practical medicine, and later the growth of universities was described in order to improve medical education and provide better service to patients. In the Middle Ages, a major problem arose, the infertility of women, which was improved and this brought a great contribution to women's health. In scientific revolutions, it is described how disease spreads due to population growth. Medicine became a science in the age when scientists discovered that bacteria are the cause of disease, which led to an evolution in the development of medicine in the discovery of vaccines, antibiotics and the concept of cleanliness (1).

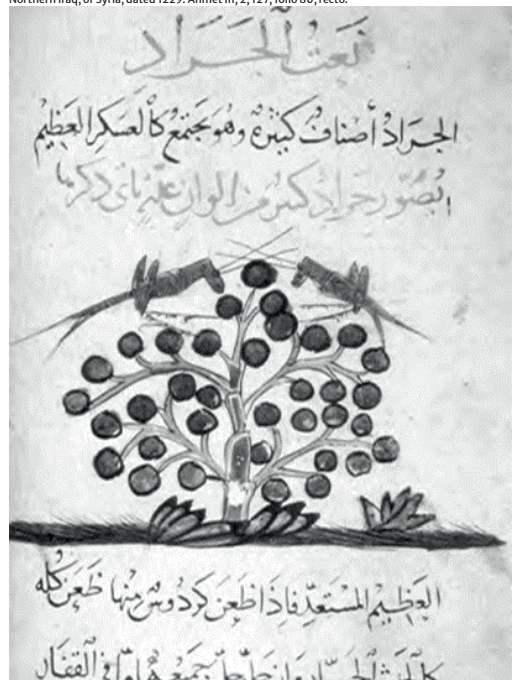
Creative research in Arab medicine begins approximately one hundred years after the conquest and consolidation of the Arab empire (2, 3, 11, 13). Arab medics very quickly directed their research activities towards productive work and fruitful writing. According to Fonahn, more than 150 works were published from the "Treasury of Islamic Science, which was just beginning to open" (as Max Meyerhoff says) from the medicine of that period in the Persian language alone. Numerous medical collections were written in the cities of Cairo, Damascus, Baghdad, and in Constantinople itself there are more than tens of thousands of manuscripts in more than 80 mosque libraries. Arab doctors translate and use old medical books, give their brief reviews, comment on them, enrich and supplement them. Custom states: "For a long time it was thought that the Arabs slavishly copied the Greeks without making any medical advances of their own (2, 3). This is a wrong notion, because when the Arabs entered the scene, Greek medicine completely disappeared and spells and magic were practiced everywhere. At that moment, the Arabs not only saved Greek knowledge from destruction, but also popularized Greek medicine with their commentaries and improvements, thereby creating a basis for scientific study in Europe. Even if the Arabs had limited themselves only to the collection and translation of Greek medical books into Arabic and had handed this knowledge back to Europe, it would have been no small achievement. But they moved on and wrote original



This is an illustration of the lentil plant (*Lens culinaris* or *Lens esculenta*). It is astonishing to note the pharmacological importance Dioscorides attached to the common lentil. He says, among other things: "It (the lentil) arrests diarrhea when eaten with the pods. Its effect is manifested in gastrointestinal peristalsis, when vinegar, wild succory or purslane, beetroot, myrtle berries, pomegranate bark, dried roses, medlars, mountain-ash berries, Theban pears, quinces, chicories, plantain, or whole nutgalls are admixed, or sumac for that matter. The consumption of thirty lentils 9pods removed helps to alleviate upset stomach. Boiled with barley and applied as a poultice, they relieve podagra (gout). When mixed with honey, they seal fistulous openings, loosen scabs and cleanse ulcers. When boiled with vinegar, they soften indurations and decrease glandular swelling. Boiled with white clover or quinces, and added to rose oil, they can cure tumors of the eye and anus; when larger body apertures are affected, honey is admixed to the lentils. The addition of sea water is recommended: in corrosive, gangrenous ulcers; for pustules, serpiginous ulcers, rosette-like inflammations and frostbite, and indurated and swollen breasts." But Dioscorides also warns about the occurrence of meteorism and bad dreams if lentils are eaten to excess, above all when the initial decoction is not discarded. Hence lentils served partly as a vehicle for other ingredients, but partly too as a type of wound paste or healing plaster, just as honey, or in a mixture with the latter. Istanbul, Topkapı Sarayı Müzesi. From an Arabic translation of Dioscorides, *De Materia Medica*. Northern Iraq, or Syria, dated 1229. Ahmet III, 2, 127, folio 80, recto.



This illustration shows the medicinal plant sadji. The Islamic prohibition against images, so often misjudged in the Occidental literature, theoretically refers to likenesses of men and animals. The historical development, however, has witnessed widely disparate interpretations of this prohibition by the various rites and orders of Islam. Nevertheless, even the most rigorous religious observance excepted scientific representation from all these restrictions. This is even true of those laws which are directly derived from the Qur'an. A single example will suffice: the consumption of alcohol - or rather wine - is freely permitted if its use is justified for medical reasons. In this event if it is considered a drug as any other.



Like the preceding illustration, this picture comes from one of the most interesting manuscripts in the possession of the British Library: An Arabic "bestiary" that represents a compilation made in the 13th century, based on Aristotle (and other authors of Antiquity) and writings by Ubayd Allah bin Gibr'il ibn Bukht Yishu. We have already explained the significance of the Bukht Yishu' family in connection with the foregoing plate. Like his ancestors and his brother, Ubayd Allah i served as the personal physician and court doctor of an Abbasid caliph, reputedly al-Muttaqi, while his father, Gibr'a'il I, had performed these duties in Baghdad for Harun ar-Rashid, al-Amin, and al-Ma'mun (after Browne's *Chahar Maqala*, page 145). The subject of animals as a source of therapeutic agents was scarcely ever discussed, since plant and mineral preparations were chiefly employed, whereas those of animal origin were of secondary importance. The illustration does not focus on the medicinal plant, which it seems can no longer be classified, even today, while the cicadas shown in the picture are immediately discernible as such. If nowadays we compare the pharmacology known in Antiquity with, for example, the "Jnanani" system of medicine in India, which - like its name - is based on the tradition of the ancient Ionians, then we note that animal ingredients were employed above all in compounded drugs and antidotes, which in themselves were hardly more than aphrodisiacs (e.g. pulverized sea-horse, such as is still used in traditional Chinese medicine). London, The British Library. MS or. 2,784, folio 60, verso. Reproduced by permission of The British Library.



The illustrations reproduced here show three "species" of the halfa or alfa (needlegrass) plant, as explained in the text. This so-called needlegrass, or "halfa grass" is what the Spaniards know as "esparto", a designation given to several varieties of grass, in particular *Stipa tenacissima* L. (*Macrochloa tenacissima* Kunth) and *Lygeum spartum*, both of which are very common in Spain and northern Africa. The leaves, measuring 30-50 cm in length, display a greenish colour, and are yellowish after they have lain a long time on the ground; they are also blade-like and cylindrical (the two more or less semicircular halves of each leaf fit tightly together). The leaves are extremely delicate and flexible, yet tough and sinewy, and do not break easily; they have been used since earliest times in weaving and in the manufacture of ropes. By treating the raw fiber with chemicals, a slender, white fiber is obtained, which consists of intact epidermal and bast-fiber cells. From about the year 1890, this raw material became a commodity much in demand; England in particular imported it for the manufacture of paper (needlegrass paper) in large quantities from Spain, Algeria, and Tunisia. As early as 1870, the dried leaves were utilized in Austria to produce "draught straws" for Virginia cigars. Needlegrass as an actual medicine does not enjoy prominent position; however, it may be assumed that the grass has been used since earliest times as a bandaging material when suitably processed. The use of needlegrass for dressings is probably older than mankind itself. Halfaya (Dar Halfa) is the name of the region in southern Nubia, situated on both sides of the River Nile, below the confluence of the White Nile and the Blue Nile. This area abounds in bird life, and numerous species of birds are fond of using needlegrass to build their nests. A certain number of species in this region, displaying behavior obviously derived from their nest-building instinct, have also been observed to apply genuine bandages fashioned from needlegrass to wounds or injuries on their "legs" (extremities). Istanbul, Topkapı Sarayı Müzesi. Dioscorides, "De Materia Medica", dated 866-869 AH (1461-1464 A.D.). Ahmet II, 2147. Folio 390 verso.



books. According to Sarton, Arabic medical works written in Arabic were “the most original, valuable and fruitful”, and Arabic itself became the most advanced and scientific language between the 8th and 17th centuries.

The Arabs are said to have extracted the most important material from the medical works of Hippocrates, Galen and Dioscorides and other Greek medical records, preserved it in reserve, and freed it from everything superfluous (2, 3). The best example for this is the comparison of the works of two great men Galen (1st century) and Ibn Sina - Avicenna (11th century). The difference is remarkable. Galen is almost vague and Ibn Sina is perfectly clear. The first lacks order and methodicality, while the second brought them to perfection.

Unfortunately, most of the Arabic books and medical manuscripts have been lost to this day, because many Arab libraries were destroyed or burned during the campaigns of other civilizations due to the fanaticism of the new invaders (2, 3). But most of the classical works still survived. Also, the translations of many of the important medical manuscripts, which reached European and our areas, were distorted or disfigured by bad copying or forged editions. Rarely in existing collections of medical manuscripts can one find two identical copies of the same medical work with the same text. The poorly and carelessly done Latin translations of those parts also contributed to this, because the Latin translators very often appropriated what they translated. Campbell states that “Latin translations failed to communicate the true ideas of Arabic medicine to medieval scholasticism”, and Browne notes “... it must be said once and for all that no idea of Arabic medicine can be extracted from imperfect translations of standard Arabic books” (2, 3).

At the end of the 9th and the beginning of the 10th century, medicine called Arabic began to develop and flourish, whose main representatives were (18-29): Ali at-Taberi, Ahmed at-Taberi, ar-Razi (Latin Rhazes), Ali ibn al-Abbas al-Magusi (Latin Haly), ibn al-Baitar, ibn al-Qasim al-Zahrawi (Latin Abulcasis), ibn Sina (Latin Avicenna), ibn al-Haitam (Alhazen of the West), ibn Abi al-Ala Zuhr (Latin Avenzor), ibn Rushd (Latin Averroers) and ibn Nefis. Doctors Taberi, Medjusi and Razes were Persians by descent (2, 3).

Each of the listed giants of Arab medicine in their own way has burdened medical science and the profession and left a lasting mark in the history of medicine. It would take too much space to describe the specifics of each of them in detail. Most of them are well known in the West and are included in the textbook literature as donors of significant medical treasures, without which probably medicine, especially of the Middle Dark Ages, would be pale and prosaic, insufficiently studied and incompre-

hensible. However, Abdullah ibn Sina (Avicenna) remained unsurpassed in the galaxy of enumerated ones. He can be approached by Alauddin ibn al-Nafis, who in the middle of the 13th century will refute some of the theories of Avicenna and all his predecessors, from whom he bought material for his great *al-Qanun fit-tibb*. The canon will be commented on and supplemented with new knowledge for centuries. One of the numerous and perhaps the best commentaries - excerpts (Excerpts) is Nefis - “Mugaz al-Qanun” (3-8).

There is no doubt that translation schools, established in the great medieval Arab cities, played an exceptional role in collecting the rich medical treasures of previous eras and civilizations. Medical translators, who spent days and nights doing the difficult, painstaking but significant work of translating the most important works from Greek, Persian, Syriac, Indian, Hebrew and other languages, will leave an indelible mark in passing on the knowledge and experiences of previous generations. Among them there are several doctors who are significantly prominent with their contribution to medical science and the profession.

It should be pointed out that Arab medicine in principle represents a bridge between classical Greco-Roman and European medicine that will come in the renaissance of European science and art. The most significant contribution of Arab doctors and philosophers is reflected in the fact that by translating the best medical philosophical works of previous civilizations, they preserved their medical and cultural heritage, and then significantly supplemented it with their own experiences, in the period of medieval obscurity in which the church inhibited all development and progress. In addition, Arab medicine significantly enriched pharmacology with a series of new drugs through a series of important encyclopedic works, followed by a series of theoretical and practical discussions from almost all medical professions and disciplines. Many tinctures, syrups, ointments, then alcohol, distilled water, etc. were first used thanks to Arab medicine. In addition, the hygiene of living, food, housing, etc., and the establishment of the first modern hospitals, pharmacies, medical schools, city medical services and real hospital services dates precisely from the time of the rise of Arab medicine and Arab culture.

Arab medicine, which greatly contributes to the development of pharmacy. In the field of biomedical sciences, Muslims built upon the early legalities of the Indians, Syrians, Romans, and most of all the Greeks. Medicine was defined by famous Muslim physicians such as ar-Razi and Ibn Sina (2-4, 8, 9). The Arabs improved chemistry and pharmacology, and good trade relations and the availability of new plant species resulted in the enrichment of Pharmacognosy. It is important to note that we find the first



Figure 21. Cover pages of the books: a) Masic I.. Arabic medicine, Avicena, Sarajevo (2001); b) Mašić I. et al. Medieval Arabic medicine (2010); c) Hadžović S. i sar. Attars and their contribution to the development of pharmacy in Bosnia and Herzegovina (1999); and d) Mašić I. Roots of medicine and health care in Bosnia and Herzegovina (2004).

pharmacies among the Arabs and that the legal regulations related to the operation and management of pharmacies have been improved. In Islam, great emphasis is placed on the importance of developing a cordial relationship between the doctor and his patient. In addition to all the advantages provided by Islamic medicine, as a form of alternative medicine, it should be emphasized that alternative medicine is not, nor can it be, a substitute for classical medicine (28). Modern medicine is a basic and irreplaceable system of health care throughout the world that is continuously improved and uses the most modern diagnostic and therapeutic methods and equipment. Within modern medicine, modern technology gives irreplaceable results in all its segments. Due to the above facts, classical medicine deserves full respect and dedication to treatment.

#### 4.3. Overview of the history of pharmacy in Bosnia and Herzegovina

The term "Avicennian medicine" was titled by the first author of this article 30 years ago (5, 18, 30, 34, 36). Why? The medicine have defined the famous Moslem physicians as are: Ar-Razi (865–925) and Ibn-Sina (980–1037), and that on the following way: that this is the skill which treats the maintainance of good health, by battle with the diseases and the repeated diseases and the repeated establishment of patient health. This was the interpreting in the early thirties years of the ninth century, when in the majority of the medical texts the medical skill seperated onto two parts: the theory and the practice. According to the theory of the medicine, the pupil and the begginning civil-service employee have studied the elements, the body might and spirit, either the animal or vital, the organs and their usefulness and the temperament, but, in the practical part have been learned the following branches: the therapeutics (including the use of the simple and combined drugs and medical receipts), setting of bones and less sur-

gical graps. Also, during the same third of the 9th century valued the basic principles of the physicians skills, establish in the Arabic medicine, which were modifcided Greek manuscripts, with the important additions. It was interpreted six common principles of health and diseases as 6 "unnatural". The Arabic version of these modifcated principles projects that, if these samples which hit the human constitution, correctly and moderately applied, this will result by balance and gets manifested in good health which someone keeps. Anyhow, if in this main principles, or any which from them, unnormaly manages, if they wrongly get applied or achieve, then appear the inhalance in the human constitution which results with the desease. That what is interesting is that the majority of these principles about which seriously discussed and which the Moslem physicians in the middle age are important for the understanding of the scientists at the field of the medical science nowadays. Femous scientists Hamdija Karamehmedovic (graduated medicine in Vienna in 1909) and Sakir Sikiric (professor of Persian language at Sarajevo University) in 1961 translated from Arabic language the book "Mugaz Al-Qanun" one of the best excerpts of the Ibn Sina's book "Al-Qanun Fitt-Tib" which Ibn Sina written in the period 1012–1024 in 5 volumes and this book six centuries was basic textbook for studying of medicine at universities worldwide (19, 27). The book is translated into more than 50 languages. But a lot of excerpts (Mugaz al-Canun) were made by thousands phisicians and one of the best is written by Alauddin Ibn Nafis, professor at Cairo University (1210–1288) who discovered Lung circulation (scientists called him the "Second Avicena") fourth centuries before William Harwey (in 1628). The first author of this paper with Doctor Zoran Ridjanovic in 1995 updated version of Karamehmedovic and Sikiric trnslation and they published the book in 50 copies (during war-



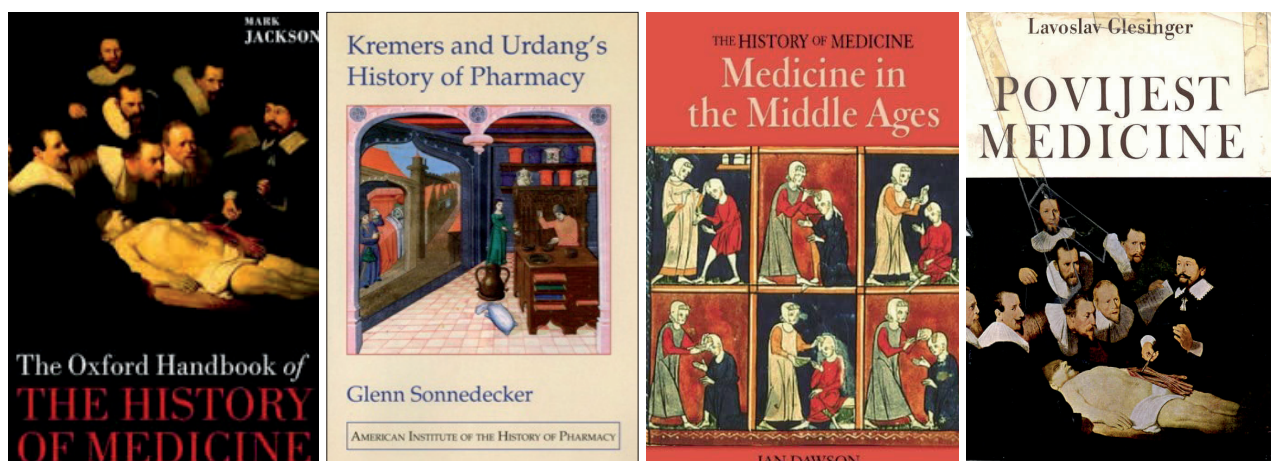


Figure 22. Cover pages of famous books about History of Medicine and History of Pharmacy in English and Croatian languages, from which contents are used descriptions about history of medicine and pharmacy in this article (1)

time in Bosnia - 1992-1995). About other 50 books from Arabic, Persian and Turkish languages were translated by Karamehmedovic and Sikiric (stored in the Library of Public Health Institute of FBIH in Sarajevo (27). We need to mention that small libraries were established in madrassa's, mosques, monasteries, etc. Rich libraries are in Franciscian monasteries (Fojnica, Kresevo, Visoko, etc) where stored very important and very old books in original languages, including in the field of medicine and pharmacy and authors of this article published about it a few monographs and articles deposited in online databases (5, 10). Traditional medicine thanks to described knowledge and experiences of persons who knows languages in which books are written hundreds years treated population in our country, because professionally educated people at universities in Italy, Austria, Hungary, Turkey etc in that time have not so much. The first Bosnian pharmacist graduated faculty in 1973 in Istanbul was Jakov Sumbul, but in Bosnia a lot of attars (who have been very organized in Esnaf's) professionally treated population (5). Also, authors of this text published a few monographs and papers about attars and their shops and, also organized special topic conferences..

Prescription books, known as "ljekaruše", were created by collecting and writing down folk remedies (12, 28, 36). They were written mostly by Catholic priests. "Witch doctors" or "healers" have been preserved in Orthodox monasteries. Doctors are interesting books, they contain folk experience, beliefs, superstitions, they are a reflection of the time in which they were created. They are also interesting from a linguistic point of view. In an old *ljekaruša* from 1843, authored by Toma A. Bratić, we find 117 prescriptions. Most are for the treatment of skin diseases; tuberi, ulcers-furunculi, contagious diseases-pestilentia, by which people mean typhus. In addition to them, wounds are mentioned, scabs on the body, living wounds - those that do not

heal, warts, lichens, mayasil- eczema. The *ljekaruša Medica*, known as "Tri *ljekaruše*". The recipes were collected by three different authors, Budisavljević, Trbojević and Petričević. Budisavljević started collecting medicines around 1811, while serving in Kotor. Although Kotor is on the territory of Montenegro, the recipes are probably a reflection of the way of treatment in neighboring Herzegovina. Diseases are listed in order, and medicines are herbal, animal, and rarely mineral. Apart from herbs, whole living beings, human and animal excrements and the unclean pharmacy of the so-called *Dreckapotheka* are also recommended as therapeutic agents. The most complete and well-organized *ljekaruša* is considered to be "Domaći Ljekar" by Fr. Mijo Nikolić, from Široki Brijeg, published in 1868. It contains instructions for the treatment of 141 diseases and 25 women's diseases. Diseases are listed in alphabetical order. In addition to folk names, Latin names are given. And the medicinal plants are arranged in alphabetical order (5).

#### 4.4. From Old Slavic sorcery to modern medicine

Pharmacy appears in history as an activity, and later, under the conditions of a certain development of civilization, it appears as an independent profession, therefore, based on the existence of a pharmacy in time and space, it simultaneously indicates the cultural development of a certain region or city (5, 10). Pharmacy was developed on such foundations, according to the already established process of development, it was further developed as the art of "ars pharmaca componendi". Further development of this skill led to epoch-making discoveries in the laboratories of individual pharmacies. Over time, the first pharmaceutical societies and academies were formed, and their laboratories eventually developed into large factories of pharmaceutical products, and then professional associations, after which the publication of professional literature, the establishment of higher education institutions, the

creation of pharmacopoeias and other pharmaceutical scientific works began (1).

When the history of pharmacy was enriched by various events, the desire to study events in the history of pharmacy also appeared, and already at the end of the 13th century, pharmacy became an integral part of professional works, when the first articles on pharmacy were published in the more famous magazines of the time. Thus, the first beginning of pharmaceutical historiography was recorded in 1897, when historical documents related to pharmacy began to be collected and published. The first professional journal "Aesculap" was published in Zagreb by the Croatian Pharmaceutical Society. In the initial phase of teaching the history of pharmacy, cooperation with pharmacohistorians of other nations began, and in the period between the two world wars, this work was increasingly intensive. This is how the first collections were created in the Little Brothers pharmacy in Dubrovnik, and in Yugoslavia in 1938, the International Congress for the History of Medicine was held, to which pharmacohistorians were also invited, and then the decision was made to form a scientific institution that would organize the study of the history of pharmacy. Thus, in 1952, the Institute for the History of Pharmacy was founded, which at first was part of the Pharmaceutical Society of Croatia. Professor Ph.D. Franz Minarik is considered the oldest Slovenian historian of pharmacy (1).

#### 4.5. History of pharmacy through museums

A museum is a special institution where various valuable objects of artistic or historical value are stored, preserved and studied. Museums are named according to the type of objects kept in them. The word museum comes from the Greek word *Museion*, which means "house of the Muses". The museum is a non-profit and permanent institution of culture that is at the service of society and its development. The basic activity of every museum consists of collecting and researching, protecting and documenting, as well as presenting tangible and intangible cultural heritage. Therefore, pharmacy museums represent temples of research into the history of pharmacy, and places that represent scientific bases for researching the past and preserving artifacts, i.e. exhibits. often of inestimable value (Figures 26-33).

##### Germany and museum exhibits

In Germany, specifically in the city of Ulm, there is an old monument made by the pharmacists' association of the time, and it was built in front of the monastery church. On the monument there is a drawn image of a woman literally standing on top of a dog, her head resting on a pillow. What is much more important than this (and the very interpretation of what the dog and coat of arms next to the woman's head represent) is what is written in the

inscription: "Margaret died in 1383, Daughter of Hainczen Winkel. Pharmacist" (1).

In Germany, you can also see an illustration of a medicine shop dating back to 1470. This illustration represents a pharmacy that belongs to the oldest drug stores. In the picture, you can see a pharmacist preparing a mixture of substances in a three-legged *avan*. At that time, the "*avan*" (mortar) was the basic vessel for making medicines (1).

In Germany, there is also a work called "*Ortus sanitatis*" (loosely translated means "Garden of Health") in which there is a picture of a pharmacy, that is, a drug store. The work dates from 1486, and is from Augsburg. In the Figure 24 taken from the aforementioned work, one can notice the figures of five people, who at that time were considered the greatest experts in medicine and pharmacy. These are Galen, Avicenna, Pliny, Serapion and Dioscorides (1). Then, from the territory of today's Germany, from the work of Hieronymus Brunschwygk, which dates back to 1505, Strasbourg, the labeling of bowls for medicinal preparations began. In the picture, it can be noticed that already at that time, labeling of the vials containing the medicinal substances had begun and that some sort of classification of the medicinal substances had been carried out (Figure 25) (1). The German Pharmacy Museum (Figure 26) was founded in 1937 in Munich. At that time, all exhibition material was donated by pharmacists or institutions that dealt with pharmacy. The following families were singled out for donations: the Rath family from Frankfurt, the Heinrici family and the Halle family. Museum was closed during of World War II and was then officially opened again in 1958 in Heidenberg in the Ottheinrich Palace, where the museum is still located today (1).

One of the exhibits is a device used to make pills. Talc would be sprinkled on a wooden board, and then sculpted into a longer stick with a wooden handle. After that, the material would be placed on the ribbed part of the plate and cut into equal parts, which would thus obtain pill shapes (Figure 29) (1).

The museum is also rich in numerous objects that were used to store drugs and dry them, as well as to store medicines and liquid substances. These vessels were mostly made of porcelain (ceramic), wood and glass. In the next picture (Figure 30), you can see several ceramic objects that were made in the "*theriaca*" style (1). A symbol of pharmacy from Mannheim can also be found in the museum. Namely, the symbol is made of metal, and you can see how the lion is holding a pistil that is positioned in the *avan*. This sculpture symbolizes how pharmacy is a respectable and "royal" craft (1).

##### Museum of the History of Pharmacy in Ukraine

The first steps in establishing this museum were to develop the very concept of the building and what the arrangement of handicrafts would be. In early





Figure 23. Illustrative view of pharmacist's work with avan in the pharmacy (1)



Figure 24. Focus on the figure of five people: Galen, Avicenna, Pliny, Serapion and Dioscorides who were considered the greatest minds in the field of medicine and pharmacy (1)



Figure 25. Beginnings of labeling and classification of medicinal substances (1)

2009, the staff and employees of the museum approved the project for the reconstruction of the museum and its restoration (1). The grand opening of the museum took place on September 15, 2010, or on the third day of the VII Congress of Pharmacists. In this museum you can see: a) scales dating from the 19th century, which M.O. Valyashko used at the time, b) a German pharmacopoeia dating from 1890, in which the illustrations are hand-made, c) personal records of M.O. Valyashko, d) laboratory medical utensils dating from the 19th century, e) a collection of medicinal plants dating back to the 19th century.

The Museum of the History of Pharmacy has two large halls where exhibits are displayed and through which one can learn about the development of pharmacy, the history of pharmaceutical education in Kharkov and the specific national pharmacy that is associated only with Ukraine. In the first hall, there are exhibits that mark pharmacy and medicine around the world, mostly from ancient times (1).

In the second hall of the museum, there are exhibits that characterize the history of pharmacy from the territory of Ukraine. The education of the first pharmacists in Ukraine began at the beginning of the 19th century, that is, in 1805, when the Kharkov Imperial University was opened. A few years later, in 1812 to be exact, the first pharmaceutical laboratory was opened at this University (1).

#### Museum of the History of Pharmacy and Medicine in Lithuania

The idea of establishing a museum of the history of pharmacy in Lithuania was initiated in 1936 by the Pharmaceutical Society of Lithuania and the Union of Pharmacists of Lithuania. Until 1957, the Society rented a building in Kaunas where they exhibited exhibits related to pharmacy and its history. At the same time, the Institute for the History of Medicine was founded in Kaunas, and in 1985 these two museums merged and were named the Museum for the History of Lithuanian Medicine and Phar-



Figure 26. Oficina apothecia located in the German State Museum. The picture shows numerous drawers in which medicines and medicinal substances are placed. In the middle is the pharmacist's desk (1)

macy. Since that year, various activities have been regularly organized in the museum in order to familiarize people with the history of pharmacy and medicine in Lithuania, as well as on a global level (1).

The museum has a large number of exhibits, including the office. Oficina dates back to the beginning of the 20th century, and was donated to the museum by a pharmacy located in Kauno Street in the city of Vilnius. The drawers in the office are filled with medicines and drugs that are very old (1).

In addition to the officine, the museum can also see the "coctorium", or the room where infusions and decoctions were made, dishes were washed and dried, and water was distilled. From the premises you can see more materials, a laboratory and a warehouse (1).

#### Museum of the History of Pharmacy in Romania

The Romanian Pharmacy History Museum is located in the city of Cluj and exhibits over 3,000 items, some of which date back to the 14th century.



Figure 27. The image shows vessels made of ceramics, wood and glass. Drugs and medicines were stored in them. (1)

A very similar museum is also located in Transylvania, the city of Sibiu (1). The museum was founded in 1954 on the initiative of Professor Valeriu Bolog, who at that time taught at the Faculty of Pharmacy and Medicine at the University of Cluj. The museum itself is housed in an old building dating back to the 15th century, which at the time was the first pharmaceutical pharmacy called "St. George" (founded by the Saxon family). The first items that arrived in this museum came from Transylvania, and were donated by the distinguished professor Iuliu Orient (1869-1940). This was followed by numerous donations from other pharmacists, all of which significantly contributed to the preservation of historically important pharmaceutical items and the preservation of the spirit of pharmacy in those areas (1).

The collections of objects are located in three rooms of the pharmacy and in two laboratories located in the basement, where you can see a large number of objects that were used to make medicines: a distiller for obtaining alcohol, which was used to obtain tinctures from different medicinal plants, containers for grinding substances, large vessels for heating substances and medicines, presses for obtaining juices from plants, pillboxes, bronze and metal pistils and avans dating from the 16th century, old furniture, medicines, recipes, etc. This museum also has a very valuable collection of bowls in which medicines and herbal drugs were kept, dating from the 16th to the 19th century. They are made of wood, ceramics, clay, glass or porcelain, and many of them are unique in Europe (1).

#### **Museum of the History of Pharmacy in Basel**

The Museum of the History of Pharmacy in Basel (Switzerland, is dedicated to preserving the historical significance of pharmacy and this museum has one of the largest collections of pharmaceutical objects in the world. In the museum, ceramic pharmaceutical objects, complete pharmaceutical interiors, an alchemy laboratory, pestles and aprons, first aid

kits, various books, and numerous medicines that have ceased to be used throughout history can be seen in abundance (1).

The museum is part of the national heritage and is of national importance. It was founded in 1925 by the pharmacist Josef Anton Hafilger and he was the first to donate a certain number of pharmaceutical items. His collection is exhibited in one of the museum's historic houses dating back to the 13th century, called Zm Vorderen Sessel, where the famous Paracelsus once lived. In the museum you can also find some books of historical importance such as *Der Gart der Gesundheit* written by Johann de Cuba (Augsburg, 1488) and *New Kreuterbuch* written by Leonhart Fuchs (Basel, 1543) (1).

#### **Museum of the History of Pharmacy in Belgrade**

This museum was founded in 1952 thanks to numerous pharmacists and historians who donated numerous antiquities from the field of pharmaceutical science. In the museum, you can see apothecary utensils, apparatus, manuscripts and books dating from the 16th to the 19th century. In the next picture, we have a view of the pharmacy office, which dates back to the 19th century (1).

As time passed, various antiquities arrived in the museum, so that today in the museum we can see over 700 vessels made of ceramics, wood, glass, porcelain. The museum also has a huge archive and library with books dating between the 16th and 20th centuries. The archive contains pictures of pharmacies, documents, manuscripts, autobiographies of famous pharmacists and a large number of diplomas, which were a prerequisite for entry into this "craft". In the museum, you can also find some works that had world significance, such as which is the document "Qualitative Analysis of Urine" written by Jovan Đurić in 1877 and *Hilfstabeln zur Prufung der chemischen Präparate* written by Luka Panić and published in Vienna in 1895. You can also find the first work that was published in the native Serbian language, and the author was Kosta Nikolić: "An attempt to present the development of the pharmacy profession for the last hundred years" (1904). The collection includes all pharmacopoeias published in this area, including all four Yugoslav pharmacopoeias (1933, 1953, 1972, 1984). What is worth mentioning is the part of the book "De simplicibus medicina" written in the 12th century by Salerno Matheus Platearius (Salerno Matthaeus Platearius) in which the making of hundreds of medicines is described. The following picture shows a small part of this library (1).

#### **Pharmacy museum in Bosnia and Herzegovina**

Although the history of healthcare, that is, medicine and pharmacy, especially in the last 20 years, has been researched by individuals and enthusiasts, the last structured research related to the history of pharmacy in Bosnia and Herzegovina was publi-





Figure 28. The Jewish museum in Sarajevo collected by artifacts from oldest attar's shop in Sarajevo which was property of family Papo (older over 350 years) (5)

mentioned in the book "Overview of the history of pharmacy in Bosnia and Herzegovina" (10) which was published in 1958. The lack of a culture of memory, as well as a systematic approach to the study of the history of pharmacy in Bosnia and Herzegovina, prompted a group of enthusiasts to put the long-term passion of studying the history of pharmacy in Bosnia and Herzegovina, as well as the collection of various artifacts, under the auspices of the museum institution. Thus, in the summer of 2022, the Museum of Pharmacy in Bosnia and Herzegovina was founded, which aims to present, in one place, the rich history of pharmacy in these areas (.

The Pharmacy Museum, whose opening preparations are in the final stage, aims to offer a clear overview of the development of pharmacy in Bosnia and Herzegovina in the form of a journey through five epochs of development; from medieval Bosnia and the influence of the Franciscans, through the influence of Islamic medicine with the arrival of the Ottoman Empire, Western medicine, the arrival of the Austro-Hungarian monarchy through Yugoslavia and finally the modern independent state of Bosnia and Herzegovina since 1992 (5, 9, 12).

In addition to the permanent exhibition, which should show the key elements of the development of pharmacy in Bosnia and Herzegovina, through the display of over 2000 artifacts that include pharmacy utensils (stands, apparatus, scales, etc.), documents (replicas and originals) that testify to old recipes, administrative data, diplomas of the first pharmacists in this area, through a large number of photographs, medicines and industrial products, the museum was conceived as a gathering place for experts interested in researching the history of healthcare in Bosnia and Herzegovina (Figure 33). Thematic exhibitions related to individual events important for the development of pharmacy in the world and in BiH should bring this field closer to both experts and the general public. Pharmacy, as a natural science, combines chemistry, physics, technology and medicine and as such has made a huge contribution

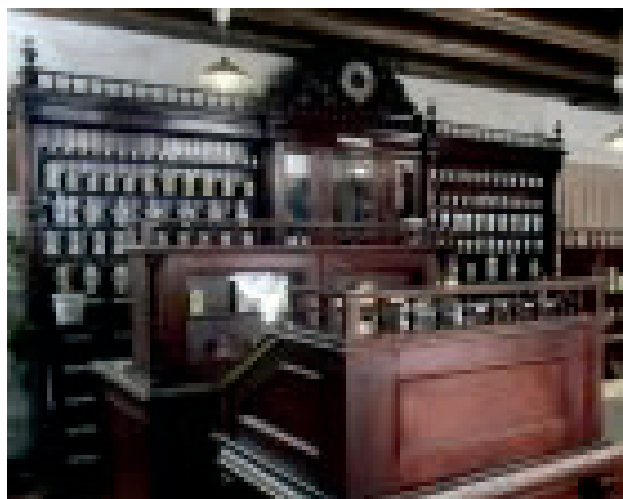


Figure 29. Oficina dating from the 20th century.(1)

to the overall development of natural sciences and medicine in general. In addition to the exhibition part, the Museum of Pharmacy in Sarajevo aims to provide a base for future researchers and to continuously work on expanding the fund as well as information and knowledge about the specifics of pharmacy in these areas.

The importance of this institution for the health care workers of Bosnia and Herzegovina and society as a whole is enormous. In addition to the scientific base, the idea of the Museum is to be a place of education on various health topics and the spread of health culture in general.

## 5. DISCUSSION

One of the most significant periods in the development of medical science belongs to the one that is historically referred to as „Arab medicine“ (2-4, 13-15, 18-26, 32, 34). Towards the end of the 8th century, a translation school was established in Baghdad that would later grow into the Academy of Sciences (1). In this way, thanks to Greek, Indian, Persian, Jewish and with Arab philosophical and medical views on science, Muslims will create an intellect that will become the foundation of Islamic civilization. Arab medicine has made a great contribution to the development of pharmacy. Arab pharmacists have introduced a number of new pharmaceutical preparations such as concentrated herbal juices in pill form, called Roob and Julep, sweetened beverages, mildly chilled syrup, sweet syrup with sugar, then electuaries, purgatives mixed with honey or syrup, and sweetened and silver pills. The Arabs were experts in making clean scents and rose water was especially famous. The word „Al-cohel“ means „all fine components“, and basically refers to a finely ground mixture of galenic and antimony sulfate, which was used for make-up and eye decoration (2, 3, 19). Oil essences extracted from plants were also used and among the most used oils include: olive, almond, sesame, walnut. Balsams, mustard oil extract, var-



Figure 30. View of a page from the New Kreuterbuch (left) and Der Gart der Gesundheit (right) books (1)

ious types of oil extracts of fruits, vegetables, herbs and flowers were also used. They even knew mineral oils and special types of tar. These oil preparations came under special names and were used as anesthetics, for insomnia, as ear and nose drops and to relieve headaches. Oil essences were also used to make suppositories. Fluids were also used in Arabic healing, especially water, the quality of which was considered a key health factor. Milk was considered useful in many diseases, so Arab doctors prescribed skimmed cow's milk and whey for diabetics. Even human milk has been used as a medicine, prescribed in many recipes and given under precisely defined conditions. Medicines of mineral origin were also widely used at that time. The Arabs added minerals of plant or animal origin to the minerals. Most of the minerals were pulverized while the metals were reduced to the level of sawdust and as such were mixed with water. Due to its abrasive properties, sand has been widely used in toothbrushes and for cleaning eczematous skin. Precious stones such as diamonds, emeralds and turquoises were considered mineral medicines and were not worn only as amulets. Red stones, such as ruby and hematite, have been used to treat hemorrhoidal bleeding, ulcers, and menstrual bleeding disorders. It should be emphasized that the Arabs were familiar with and complex formulations of drugs that were combined in books called „AQRABADIN“ and in such books there were special chapters related to the manufacture of drugs, namely a) collection and storage of medicines;; b) preparation of medicines by burning, hardening, merging, mixing; c) preparing oils and ointments as carriers for medicines; d) preparation of animal parts in the manufacture of medicines; e) preparation of teriyak; and f) explanations of Greek and Arabic names and the procedure for making shapes (3, 7, 8, 20)

Various organizations deal with the history of pharmacy (1, 10, . The goals of such Organizations are



Figure 31. Cylindrical porcelain stands with lids from “Pravitelstvena apoteka” (1)



Figure 32. Part of the museum library collection (1)

always the same, namely research in the field of the history of pharmacy, expansion and transfer of new knowledge to pharmacists and all other interested experts. Several societies/associations/foundations are described in the article, including: the German Society of the History of Pharmacy, the Canadian Academy of the History of Pharmacy, the American Association of the History of Medicine, the Royal Pharmaceutical Society of Great Britain (which has its own branch for the history of pharmacy), and Denmark Society of the History of Pharmacy and the Danish Foundation of the History of Pharmacy. A large number of books dealing with the history of pharmacy can be found on the Internet, but most are not freely accessible. However, only a few websites provide historical facts about the museum and their antiquities collections. One of the most beautiful museums is definitely the Museum of the History of Pharmacy in Basel, which has over 3000 exhibits from all areas of pharmacy. For some museums, you can see pictures showing various exhibits related to pharmacy and medicine. A number of states have Societies for the History of Pharmacy whose main goal is to conduct research in the field of history of



pharmacy and to further educate pharmacists and other interested people. One of the societies is the German Society of the History of Pharmacy (1). The society was founded by several pharmacists: Ludwig Winkler from Austria, Fritz Ferchl, George Urdang and Walther Zimmermann from Germany and Otto Raubenheimer from the United States of America. The society primarily had the name “Society of the History of Pharmacy” and by 1929 it gathered pharmacists from 17 countries around the world. After the Second World War, the regrouping of the Society began and in 1949 its name was changed to “International Society of the History of Pharmacy”. Their main goal is to explore the history of pharmacy and pharmaceutical products, as well as pharmaceutical sciences.

The German Society of the History of Pharmacy supports communication between scientific research and pharmaceutical history and is fully interested in the history of professional associates. The society also advocates for the representation of the history of pharmacy in the public. A similar Society exists in Canada and America. The American Association of the History of Medicine was founded at a meeting in Washington on May 5, 1925. The assembled physicians primarily called this Society the American International Section for the History of Medicine. One of the main founders and initiators was Henry Sigerist.

The Royal Pharmaceutical Society of Great Britain was founded in 1841 as the regulatory and professional body for pharmacists and pharmacy technicians in England, Scotland and Wales. The main objectives of this Society are to lead, regulate and promote the pharmaceutical profession. All pharmacists were required to register with the Society in order to practice. A year later, the “Pharmaceutical Journal” published who all participated in the founding of this Society. The Danish Foundation of the History of Pharmacy was founded on January 1, 2002. The main goals of the foundation are to exhibit and preserve museum artifacts that illustrate the history of pharmacy in Denmark and to promote research in the field of the history of pharmacy in Denmark, and to spread knowledge about the history of pharmacy in the same area in cooperation with the Danish Society of the History of Pharmacy.

Museums of the history of pharmacy are the heritage of many countries and they keep a large number



Figure 33. Artefacts of Museum of Pharmacy in Sarajevo, Bosnia and Herzegovina

of exhibits that vividly describe the history of pharmacy.(1) Porcelain, ceramic and clay pots, glass and metal dishes, avans and pistils, as well as various laboratory and alchemical dishes are exhibited in the museums. Many offices are also on display, and some of them date back to the 13th century.

## 6. CONCLUSION

The preservation of the history of Pharmacy and medicine is being worked on very seriously. Numerous Societies, Associations, Foundations and Foundations exist solely to research the history of pharmacy in countries around the world in detail. In addition to research, these organizations, also, transmit knowledge through their own publications. In addition to the Organizations, there are also numerous books, monographs and papers published in scientific publications and deposited in on-line databases which described the history of pharmacy, both through the ages and in different countries. Most of them describe medicine and pharmacy from the time of Greek, Roman, Persian and Arabic times until today. A significant contribution is also made by museums for the history of pharmacy, which represent very valuable public institutions and where you can see all the beauty and luxury of pharmacy through the ages. Museums abound with unique and historical objects, which help you vividly experience the historical spirit of Pharmacy. The Museum of Pharmacy in Bosnia and Herzegovina was founded in 2022 in response to the need to display the available artifacts that were collected in the previous period by individuals, and it contains both personal

collections of distinguished pharmacists, as well as replicas and materials important for showing the development of pharmacies in these areas.

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