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FROM THE HISTORY OF CHEMICAL EXPERIMENTS

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"I pity those who do not understand anything about chemistry. They lack an important source of happiness!"
— Linus Pauling

Abstract: This article highlights the long historical development of chemistry, its division into six periods, the concept of chemical experiment as the examination of the object of knowledge, and the meaning of the term "chemistry."

Keywords: alchemy, experiment, laboratory, "philosopher's stone," chemistry, trial, iatrochemistry

In recent years, due to large-scale reforms aimed at advancing Uzbekistan's development to a new stage, fundamental changes have occurred in all spheres, elevating the worldview and thinking of our people. Attention to education means attention to the future. Education is the most important system in the stage of development. All changes and innovations are directly connected to the progress of education. As our President Shavkat Mirziyoyev states, "We consider it our top priority to improve the activities of all links of the education and upbringing system based on modern requirements."

On November 6, 2020, the President of Uzbekistan issued decree PQ-4884 titled "On Additional Measures to Improve the Education and Upbringing System," which includes a comprehensive program aimed at further improving education, upbringing, and science. It also tasks developing measures to deliver the unique scientific and spiritual heritage of our ancestors, scholars, and clerics to the younger generation in simple, understandable, and engaging forms.

Chemical experiments have been a vital source of life for humanity since ancient times. The work of researchers and seekers of knowledge in the ancient world has played an important role in societal development.

Water boils and turns to steam under the influence of heat and freezes at cold temperatures. Since ancient times, humans have strived to understand all types of changes occurring around them. Through observing phenomena such as combustion, decay, fermentation, evaporation, erosion of rocks, volcanic eruptions, digestion of food, and growth and development processes in living organisms, early chemical knowledge was gradually acquired.

Studying the history of early chemical knowledge reveals that the peoples of the ancient East and Mediterranean coasts — Egyptians, Phoenicians, Arabs, Jews, Iranians, Babylonians, and inhabitants of Transoxiana — had significant influence on the civilization of world cultures through their accumulated knowledge in this field. Our scholars were the first to systematically organize accidentally observed chemical phenomena, conducted additional research to

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understand the nature of these changes, i.e., experiments, and began applying the results practically.

The long historical development of chemistry can be generally divided into six stages:
I. The Pre-Alchemical Period: up to the 3rd century
II. The Alchemy Period: 3rd to 17th centuries
III. The Renaissance Period (Unification): 17th to 18th centuries
IV. The Era of Quantitative Laws: late 18th century to mid-19th century
V. The Classical Chemistry Period: second half of the 19th century
VI. The Modern Period: from the beginning of the 20th century

The progress of chemistry was driven by human needs, production demands, and technological advances. Until recently, empiricism — drawing conclusions based on experiments — dominated the field.

An experiment, as the object of study of things and phenomena and a set of efforts aimed at influencing them for specific purposes, is called an experiment. The term "experiment" comes from Latin and broadly means human sensory-practical activity. In a narrower sense, it refers to testing an object of knowledge, analyzing conclusions and hypotheses, and obtaining verified results for creating or discovering theories, rules, concepts, and laws.

The term "chemistry" itself primarily emerged from experiment, practical activity, verification, and empirical conclusions. Scholars believe that the term "chemistry" ("chimia") was first used in Egypt. Ancient Greek writer Plutarch noted that the original inhabitants of Egypt were called "Khem" (Chemi), meaning "black land" (black soil). It is well-known that the Nile, the longest river in the world, deposits very fertile black soil on its banks.

However, there are other theories regarding the origin of the word. For example, the Greek word "chumos" means "burning" or "melting." The 4th-century alchemist and writer Zosimus associated this term with "Khem," an exiled angel involved in deception and the author of the first chemistry book.

Some researchers believe that "chemistry" comes from the Greek "chēmeia," meaning metal casting. Others connect it with the Chinese word "kim," meaning "gold."

In the 10th century, Muhammad al-Khwarizmi stated that the Arabic word "kimya" means "to hide" or "to conceal." At that time, chemical products were also produced in India, China, and Central Asia.

The alchemist who owned the "kimyoi hunar" (chemistry craft) was engaged in transforming one substance into another. From the second half of the 1st millennium BCE, the Great Silk Road passing through Uzbekistan brought not only trade but also craftsmanship to the region. Numerous historical artifacts found in Uzbekistan indicate that the people living here were aware of chemical craftsmanship from ancient times. A chemistry laboratory dating back to the 8th century was found near Paykend, close to Bukhara. Laboratory equipment included various containers, glass instruments, and crucibles.

The alchemy period holds a special place in the history of chemistry. It should not be understood merely as a time of unsuccessful attempts to turn simple metals into gold or silver or to find the "philosopher's stone," which supposedly causes all miracles. During this period, the techniques and methods of chemical experiments and treatments were created and improved. Heating, melting, distillation, extraction, dry and wet sublimation, filtration, qualitative and quantitative analysis, and metal extraction from ores began to be widely used. Chemistry and its

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technology gained valuable recipes and recommendations, laying the foundation for the chemical language.

Thanks to the long and arduous work of alchemists, it became possible to carry out various experiments purposefully, conduct thousands of chemical reactions efficiently, and obtain and test many important compounds and substances. They produced substances such as sulfuric, nitric, and hydrochloric acids, saltpeter, gunpowder, aqua regia, corrosive alkalis, and wine spirit. They also extracted and studied the properties of non-metals like sulfur and phosphorus, and metals such as zinc, bismuth, antimony, arsenic, cobalt, nickel.

During the alchemy period, foundations were laid for medicinal chemistry (iatrochemistry), phlogiston chemistry, and pneumochemistry, which involved comprehensive study of gases. Laboratory practice was enriched with new recommendations, instruments, and equipment. Measurement and weighing techniques improved. The method of conducting experiments was developed.

In conclusion, conveying the unique and invaluable scientific and spiritual heritage of our ancestors, scholars, and clerics to the younger generation in simple, understandable, and engaging forms is the main duty of all of us.

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