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CHEMIST PLANTS

Litmus paper as pH indicator.

A major part of the chemical industry today is based on the production and use of sulfuric acid, nitric acid, acetic acid, and hydrochloric acid. For this reason, whether solutions are acidic or basic is of great importance. These days this characteristic is determined by electronic instruments called pH meters. However, until recently, this measurement was made with special dyes called litmus obtained from plants.

Up to the 20th century, many scientists formulated various hypotheses for acids and bases, but in 1923 Johannes Nicolaus Brønsted established that, regardless of the solution, substances suitable for releasing hydrogen ions are acids and those suitable for receiving hydrogen ions are bases.

Acids and bases produced industrially are used in the fertilizer, plastics, paint, explosives, perfume, pharmaceutical, and food industries. The vast majority of acids are easily distinguishable due to their sour taste. However, because some acids and bases are poisonous, they cannot be determined by taste.

For this reason, substances that change color called indicators are used to determine whether solutions are acids or bases. The substance most commonly used in laboratories for this purpose is a mixture of blue-purple dyes from lichens called litmus. Papers coated with these dyes become red when immersed in acidic solutions and blue when immersed in basic solutions. Thus, it is easily understood whether the solution is acidic or basic.

Litmus was first discovered in the 13th century by a scientist named Arnaldus de Villa Nova. Born in what is now Spain and interested in alchemy, physics, astronomy, and philosophy, he shed light on medieval science with his work in chemistry.

With his in-depth knowledge of chemistry, he used a lichen-derived powder to distinguish solutions such as acids and bases. The powder, which was obtained from a lichen of the genus Roccella for the first time, turned red when it came into contact with acids and turned dark blue when it was applied to basic solutions. Thus, the chemical structure of poisonous or caustic solutions could be determined easily without the need for tasting.

Litmus was obtained only from lichen initially but later started to be obtained from plants as well. The lichen named *Roccella tinctoria*, from which the first litmus was obtained, is yellowish gray and short, branching in the shape of a fork. It is found especially on sea-facing rocks and islands. It was collected and placed in wooden containers containing urine, lime, and potassium. Lichens, when kept in this mixture for a few weeks, rot and ferment. During this process, they turn red and then blue. Blue lichen pieces were obtained by filtering through the wooden container and then dried in brass or steel containers. Lichens were kept in these metal containers for some time and were used as litmus after being turned into powder. The litmus products produced only from the lichens in the Netherlands until the 1500's were started to be produced from plants with the discovery that some dye plants had the same characteristic at that time. The most important of these are the marshmallow, alkanet, hibiscus, elderberry, and violets.

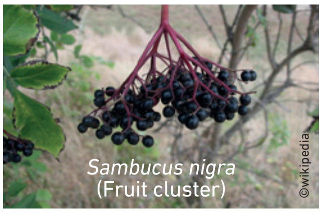
Alcea rosea

Alcea rosea, also known as the common hollyhock, is a tall, thin plant. This plant, which belongs to the mallow family, grows in a wide variety of soils. It produces pink flowers from early to late summer and is grown as an ornamental plant in gardens. It is used as litmus thanks to the color substances called anthocyanins, obtained by drying the flowers.

Another member of the mallow family, the common mallow, is used for the same purpose. With the scientific name *Malva sylvestris*, this plant is common in west Anatolia. In spring, especially on the Aegean coast, its leaves are consumed as a vegetable and it spreads on the ground or climbs and has many leaves. The flowers are 5-petaled and magenta with purple lines on them. The cream, yellow, and green colors from the dye obtained from the flowers of this plant are used as litmus.

Alkanna tinctoria

Alkanna tinctoria, which is a member of the family Boraginaceae, also known as alkanet, is another important litmus plant. This plant, which was used instead of henna and used in the dyeing of carpets as a root dye in Turkey, creeps on the ground. Its small round flowers are dark blue and its leaves are covered with small and dense hairs. While the dye obtained from the roots of this plant is used as litmus, it is also used in thermometers and the staining of marble and wood.



Sambucus nigra
(Fruit cluster)

The elderberry *(Sambucus nigra)*, particularly common in the Black Sea region of Turkey, is another important litmus plant. This plant, which can become a small tree, has cream flowers with five petals. A blue dye is obtained from the ripe berries of the sharply fragrant elderberry.

The most important plants that litmus is obtained from are violets. Yellow, green, and blue dyes are obtained from the flowers of the sweet violet *(Viola odorata)*, frequently used in perfumery, and of the wild pansy *(Viola tricolor)*, used as an ornamental plant in gardens. Methylene blue, which is one of the best known and most widely used litmuses commercially, is also obtained from these violet flowers.

Today, litmus dyes and litmus papers prepared with these dyes are gradually losing their importance, but these dyes are still used, apart from for pH measurement, to determine in practice whether electronic goods have malfunctioned due to a technical error or due to user error, because if you tamper with electronic items, the trace left changes the color of litmus paper.

Bilim ve Teknik (Science and Technology magazine), December 2007

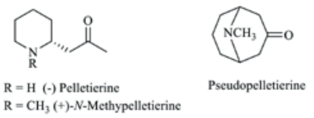
Cenk Durmuşkahya

CYCLOOCTATETRAENE IS ONE OF THE MOST PROMINENT HYDROCARBONS

Pomegranate (*Punica granatum* L.) is a tree of Iranian/north Indian origin and it can be grown in many regions with a mild climate. Today, it is widely cultivated throughout north and tropical Africa, the Indian subcontinent, and Central Asia, as well as parts of Arizona and California. The pomegranate was known in early English as the "apple of Grenada" [1].

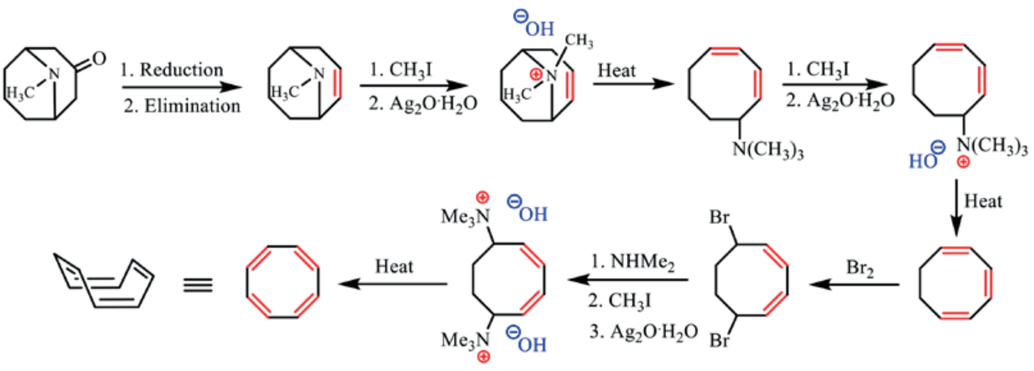
The pomegranate tree, whose fruit we eat with pleasure, is a source of some alkaloids. These alkaloids are pelletierine, *N*-methylpelletierine, and pseudopelletierine, which are deposited in the bark and especially in the root bark. These compounds were named in honor of the pioneer of plant chemistry Pierre J. Pelletier. It was recognized that pelletierine and *N*-methylpelletierine were useful for fighting worm diseases well into the 20th century.

The structure elucidation of pseudopelletierine took less than 20 years, a remarkably short period in the pre-spectroscopic era. Ciamician and Silber [2] investigated the structure of pseudopelletierine. They confirmed the empirical formula $C_9H_{15}NO$ using numerous transformations. Piccinini [3], a colleague of Ciamician's, found the correct connection of the atoms in pseudopelletierine in 1899 when he managed to oxidatively break down the skeleton of the alkaloids to suberic acid (octane-1,8-diacid) by further steps. Finally, it was recognized that pseudopelletierine is an aza-bridged cyclooctatetraene.

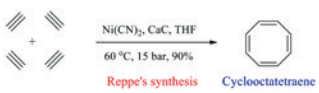


Richard Martin Willstätter (1872-1942) was awarded the Nobel Prize for his research on plant pigments, especially chlorophyll, in 1915.

Willstätter recognized its potential as a wonderful starting compound for a carbocyclic eight-membered ring. Furthermore, he expected that a cyclooctatetraene would have similar properties to benzene as COT is vinylogous with benzene. Willstätter synthesized 1,3,5,7-cyclooctatetraene in 1905 using pseudopelletierine as the starting material and the Hofmann elimination as the key transformation as shown below [4]. After the successful synthesis of cyclooctatetraene, unfortunately, the product did not show the properties of benzene; it behaved like a polyolefin. Some groups started to suspect that Willstätter had synthesized COT. These groups began to repeat Willstätter's experiments. However, when they could not achieve the same results, they began to take a more suspicious approach to COT synthesis.

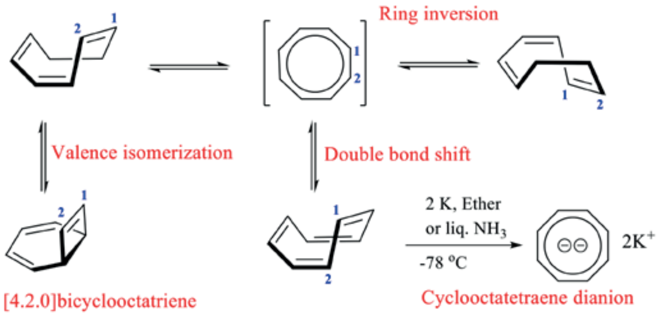


However, the fact that reduction of the molecule formed cyclooctane was much more confusing. Cope and Overberger [5] repeated Willstätter's COT synthesis in 1948 and they demonstrated its accuracy. The problems were not solved until the synthesis of the molecule by BASF (Badische Anilin & Soda Fabrik) chemist Reppe [6] as a result of tetramerization of acetylene under Ni catalysis. This made COT accessible in any quantity and confirmed Willstätter's historical achievement. Reppe's synthesis of cyclooctatetraene involves treating acetylene at high pressure with a warm mixture of nickel cyanide and calcium carbide, with chemical yields near 90%. As mentioned above, unlike benzene, COT is a nonplanar but tub-shaped molecule.



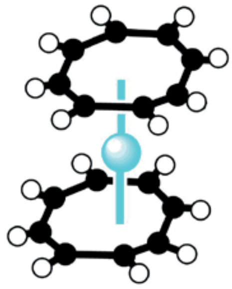
COT undergoes three fundamental structural changes. The first of these processes is termed ring inversion and the second one is the double bond shift. Both of these processes take place presumably via a planar transition state. The ring inversion barrier has been measured by various methods and was found to be 10-13 kcal/mol, while the barrier for the double bond shift is 2-4 kcal/mol higher than the inversion barrier. The third process is valence isomerization to [4.2.0] bicyclooctatriene, which does not require a planar COT for the transition state.

According to Hückel's theory, the cyclooctatetraene dianion, which has 10 p-electrons, should be aromatic if it has a planar structure. Katz reacted cyclooctatetraene with potassium metal (a good electron donor) in ether or liquid ammonia and obtained an aromatic dianion [7]. The structure of the potassium salt of a 1,3,5,7-cyclooctatetraene dianion has been determined by X-ray analysis. The eight-membered ring is planar, with C-C bond lengths of 1.407 Å without significant bond alternation. Spectroscopic and structural studies show that the cyclooctatetraene dianion is stabilized by the delocalization of the p-electrons and it is aromatic.



Why is cyclooctatetraene not antiaromatic? Cyclooctatetraene must have a planar structure to be antiaromatic. The reason for this lack of planarity is that the internal angles in a regular planar octagonal structure are 134°. To avoid angle strain, the molecule adopts a nonplanar tub-shaped conformation. Furthermore, if cyclooctatetraene has a planar structure, the p-electrons will delocalize due to the parallel orientation of the orbitals.

Therefore, the energy level of the molecule will also increase because of the negative resonance energy. Antiaromaticity and angle strain will make the molecule very unstable. That is the reason why cyclooctatetraene does not have a planar structure and tends to have a tub-shaped conformation.



Organometallic complexes of cyclooctatetraene with some metals, including yttrium and lanthanides, are commonly known. The COT ring behaves as an effective π-type ligand in metal complexes and very often in such complexes it adopts a planar structure, which is not the most favorable conformation. Such planarization is usually considered an effect of COT ring aromatization due to charge transfer from the metal center into the COT ligand and reorganization of the π-electron structure from 4n to 4n+2. Eu–COT sandwiches have been described as nanowires [8].

References

[1] Heß, G.; Haiss, P.; Wistuba, D.; Siehl, H.-U.; Berger, S.; Sicker, D.; Zeller, K-P. Pseudopelletierine from Pomegranate Tree to Cyclooctatetraene. *Chemie In Unserer Zeit* **2016**, *50*, 34-53.

[2] Ciamician, G.; Silber, P. Über das Pseudopelletierin, ein Alkaloid aus der Granatwurzel. *Ber. Dtsch. Chem. Ges.* **1892**, *25*, 1601-1604.

[3] Piccinini, A. Studi interno alla strutta degli alcaloidi del melograno. *Gazz. Chim. Ital.* **1899**, *29*, 104-114.

[4] Willstätter, R.; Waser, E. Über Cyclo-octatetraen. *Ber. Dtsch. Chem. Ges.* **1911**, *44*, 3423-3445.

[5] Cope, A. C.; Overberger, C. G. Cyclic Polyolefins. I. Synthesis of Cyclooctatetraene from Pseudopelletierine. *J. Am. Chem. Soc.* **1948**, *70*, 1433-1437.

[6] Reppe, W.; Schichting, O.; Klager, K.; Toepel, T. Cyclisierende Polymerisation von Acetylen. I. Über Cyclooctatetraen. *Liebigs Ann. Chem.* **1948**, *560*, 1-92.

[7] Katz, T. The cyclooctatetraenyl dianion. *J. Am. Chem. Soc.* **1960**, *82*, 3784-3785.

[8] Dominikowska, J.; Palusiak, M. Cyclooctatetraene in metal complexes - planar does not mean aromatic. *New J. Chem.* **2010**, *34*, 1855-1861.

Metin Balcı

A rotary evaporator (or rotavap/rotovap) is a device used in chemistry laboratories for the efficient and gentle removal of solvents from samples by evaporation under a partial vacuum.

HISTORY OF THE VACUUM

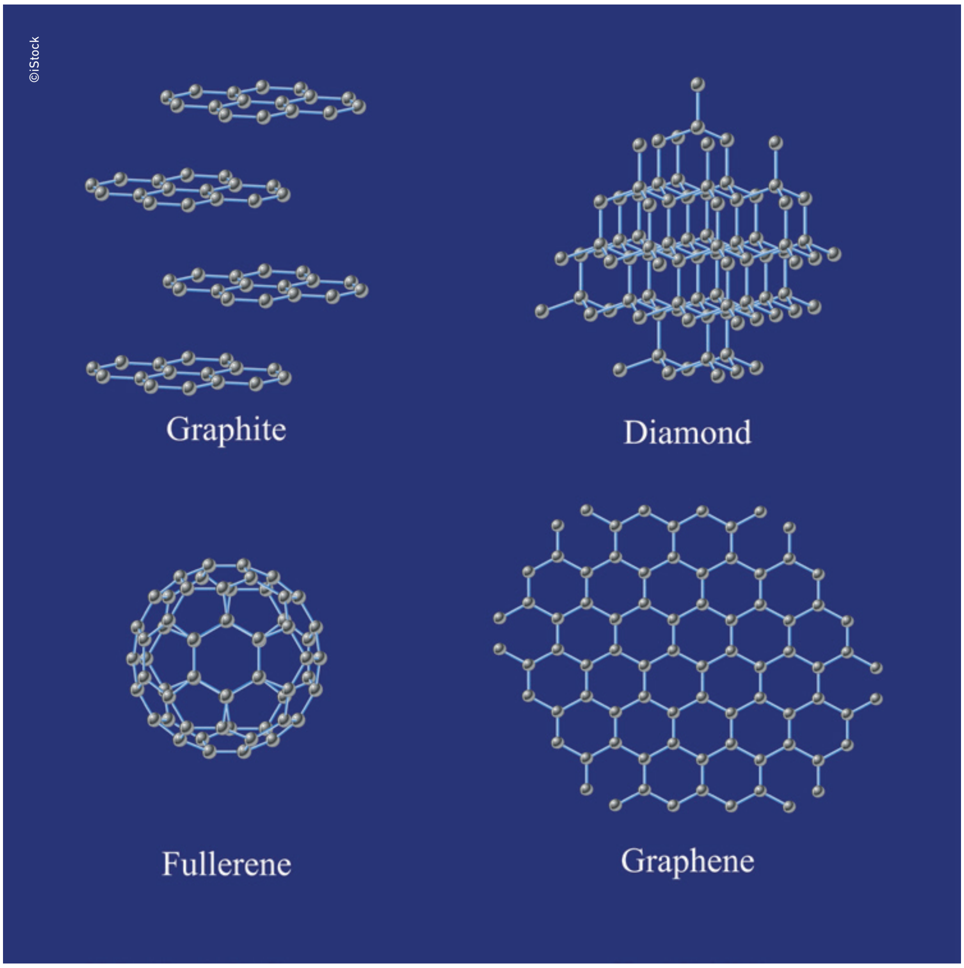
In Ancient Greece, Aristotle believed that in a vacuum an object could go at infinite speed. However, he did not believe that infinite speed could exist. Thus, a vacuum could not exist.

Although artisans proceeded to make pumps, scientists generally agreed that a vacuum could not exist in nature. These pumps had a cylinder tightly fitted in a tube. The water moved upward in the tube when the cylinder was raised. Aristotle explained this phenomenon saying that water had to rush into the tube because nature did not like a vacuum.

Galileo was told by a workman that they could not raise water more than about 10 m. He found it odd that nature did not like a vacuum up to 10 m and then changed its mind. He asked his assistant Torricelli to investigate this phenomenon, who soon realized that a real vacuum could be there. Shortly after Galileo's death, Torricelli produced a near-vacuum with his mercury barometer, which was the first vacuum known to science. Pumps could not exceed the limit (10 m) as their action depended on air pressure, which could lift water 10 m. Above 10 m, a partial vacuum can exist because air pressure will not lift the water to fill it.

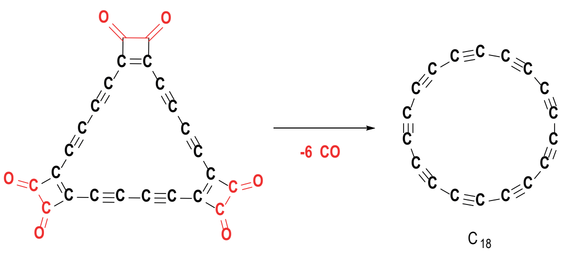
In the second half of the 17^{th} century, the interest in vacuums continued. Otto von Guericke (1602-1686) developed an air pump more powerful than 50 men or two teams of horses. More importantly, he showed that sound could not travel in a vacuum, flames could not burn, and animals could not live. Boyle (1627-1691) demonstrated that a feather and a lump of lead fall at the same speed in a vacuum. On the other hand, the production of a good vacuum was difficult until the 19^{th} century. In 1854, a hard vacuum was produced in a glass tube, which led to the discovery of X-rays, the electron, and, indirectly, radioactivity. In the first half of the 20^{th} century, vacuum tubes powered radios and televisions, computers, and some other electronic devices, which were then displaced by solid-state devices, such as transistors and chips.

Turan Öztürk



A NEW ALLOTROPE OF CARBON : CYCLO[18]CARBON (C_{18})

A new allotrope of carbon was synthetically obtained by a collaboration between two research groups. The new allotrope, cyclo[18]carbon or cyclooctadeca-1,3,5,7,9,11,13,15,17-nonayne, is an sp-hybridized molecular carbon allotrope with the molecular formula C_{18}.



In 1989, Diederich's research group at the University of California, Los Angeles reported evidence for the generation of cyclo[18]carbon via laser flash heating of a stable organic precursor [1]. Despite of the fascinating efforts by several research groups to obtain carbon allotropes built from rings of two-coordinate atoms, cyclo[n]carbons could not be isolated or structurally characterized because of their high reactivity for long years. In 2019, two research groups from IBM and the University of Oxford reported the synthesis of cyclo[18]carbon (C_{18}) as the first cyclic carbon allotrope using atom manipulation on bilayer NaCl on Cu(111) at 5 Kelvin on-surface decarbonylation from a cyclocarbon oxide molecule, $C_{24}O_6$ [2]. This spectacular molecule has a circle of 18 sp-hybridized carbon atoms, held together by alternating single and triple bonds.

References

[1] Diederich, F.; Rubin, Y.; Knobler, C. B.; Whetten, R. L.; Schriver, K. E. et al. All-carbon molecules: evidence for the generation of cyclo[18]carbon from a stable organic precursor. Science 1989, 245(4922), 1088-1090.

[2] Kaiser, K.; Scriven, L. M.; Schulz, F.; Gawel, P.; Gross, L.; Anderson, H. L. An sp-hybridized molecular carbon allotrope, cyclo[18]carbon. Science 2019, 365(6459), 1299-1301.

Nurullah Saraçoğlu

TURKISH CULINARY CULTURE

Culture comprises all kinds of material and spiritual characteristics produced by a society during the historical process that have been passed on from past to present and will be passed on from the present to the future. Culinary culture, as a dimension of culture, is the nutritional habits shaped by the lifestyles of societies. Turkish culinary culture was born in Central Asia, developed during the Seljuk period, and reached its peak during the Ottoman period. It has attained its current form through the effects of globalization and industrialization.

Turkish cuisine is of considerable importance among the world's cuisines. The Turks' long history, their traditions and culture, and the possibilities of the geographical region they live in have had an impact on the development of Turkish culinary culture. Furthermore, the interaction of Turks with many cultures around the world is regarded as a factor enriching Turkish cuisine.

When the characteristics of Turkish cuisine are examined from the perspective of historical development, it can be concluded that Turks settled on the steppe between the Ural and Altai mountains in Central Asia during the Neolithic period and the culinary cultures formed in that region. Livestock breeding suitable for the climate of the steppe is one of the opportunities offered by this geography. For this reason, their diet was mostly animal products, and they benefited from the meat of sheep, goats, camels, cattle, and especially horses. In addition, milk and dairy products, which are secondary products obtained from animals, were important food sources. Another reason for their meat-based culinary culture was the fact that a large part of Central Asia is not suitable for growing crops. In Central Asian culinary culture, horse milk, which was consumed as well as horse meat, was fermented and turned into a light alcoholic drink called "kımız". Due to the influence of the new cultures, climates, and geography that the Turks encountered over the centuries, the culture of kımız is not part of the cuisines of those who settled in Anatolia and Rumelia. When the Turks migrated to Anatolia, they brought their food cultures with them and also started to grow crops and included cereal products in their diet. During the

Figure 1. Doner kebab is a very popular food in Turkey.

period of the Great Seljuk and Anatolian Seljuk states (1037-1308), with the effect of Islam, horse meat consumption was reduced and sheep and goat meat became dominant. The crops can be divided into grains and vegetables; of the former wheat, barley, and millet were consumed, and of the latter spinach, radish, courgette, carrot, onion, garlic, and cabbage.

During the period of the Ottoman Empire (1299-1922), there was a palace cuisine in addition to folk cuisine in the Turkish culinary culture. The most vibrant period of food culture occurred in palace cuisine especially during the rule of Sultan Mehmed II. The continuous expansion of Ottoman territory, the existence of many different ethnic origins within that territory, marriages of the sultans with women from other nations, and relations with Europe led to enrichment of the palace cuisine. In general, in the Ottoman palace cuisine, sheep, chicken, and goose meat, fish, milk, eggs, yoghurt, tripe, sheep's head and foot soup and other soups, all kinds of dried and fresh fruits and vegetables, kebabs, salads, pickles, and various sherbets were consumed. The difference of the folk cuisine from the palace cuisine was that there was only a small variety of products, including, in general, cereal products, milk and dairy products, and beef.

The most prominent elements of today's Turkish cuisine include every type of bread as the main food ingredient on the table; the predominant consumption of pastries; the preference for kebabs, including doner kebabs (Figure 1), and juicy meat dishes such as stew; the great importance given to oils such as olive oil, butter, and fat from the sheep's tail; the consumption of yoghurt and ayran (a drink made of yoghurt mixed with water) as important foods; the addition of small amounts of meat to vegetable dishes; the consumption of wild greens; and the common use of bulgur as a filling ingredient in vegetable dishes, meatballs, and soups.

Figure 2. Keşkek is a traditional Turkish dish.

Turkish cuisine is known not only for its variety of dishes, but also for its dinner table culture. Table manners have an important place in Turkish cuisine, being regarded as an important tool of social life. The main examples of the customs of Turkish cuisine are the father being at the center of the family table, the older family members sitting cross-legged and the women and children kneeling and eating at a floor table, the table cloth spreading onto the floor to stop pieces of food falling on the floor and a round serving tray being placed on it, finishing all the food on the plate, washing hands before and after the meal, being serious while eating and not speaking much, everyone eating from their own bowl in front of them, and hospitality. In addition to these, meals have symbolic roles on important days such as births, circumcisions, engagements, marriages, deaths, Bairams, and nights of religious importance. For example, as a tradition in many regions of Anatolia today, keşkek is made at weddings (Figure 2), and halva is served between meals distributed to neighbors and guests in memory of family members who have died; during the circumcision ceremonies for boys, pilaf is cooked, and Kandil simits are made and given out on nights of religious importance (Figure 3).

Keşkek is an important Anatolian dish that has many varieties and is associated with some symbols. Birth, circumcision, soldier, wedding, pilgrim, death, Ramadan and Sacrifice Bairams, Nevruz, Hıdırellez, Christian feast, devotional, charity, and festival are among the types of keşkek. Moreover, the keşkek varies according to the ingredients, for example, red meat keşkek, chicken keşkek, turkey keşkek, pastrami keşkek, corn keşkek, fake keşkek, and ground meat keşkek. In this case, the keşkeks differ in terms of both the ingredients and the method of cooking. In Anatolia especially in keşkek made at weddings meat is used. Since making it is long and involved, the work is divided between men and women. While women usually boil and shred the meat and boil the wheat, men help to mix these two ingredients over a dung fire and serve. In general, keşkek is made as follows: meat and wheat are washed, salt is added and they are usually cooked in a pressure cooker. The cooked meat is separated from the bone and shredded, wheat is added, and they are mashed together with a spoon. During this long process, when the ingredients turn into a paste, powdered pepper is burned in butter and poured lightly on top, and then the dish is eaten.

Figure 3. Sesame seed simit.

Bibliography

Akbaba A.; Çetinkaya N. (Eds.). *Gastronomi ve Yiyecek Tarihi*, Detay Yayıncılık, Ankara, 2018.

Çekiç, İ. *Geçmişten Günümüze Törensel Bir Yemek: Keşkek*, Yüksek Lisans Tezi, Gaziantep Üniversitesi, Sosyal Bilimler Enstitüsü, Gaziantep, 2015.

Çetinkaya N. (Ed.), *Yemek, Kültür ve Toplum*, Nobel Yayıncılık, Ankara, 2020.

Gezmen Karadağ, M.; Çelebi F., Ertaş, Y.; Şanlıer, N. *Geleneksel Türk Mutfağından Seçmeler: Besin* Öğeleri *Açısından Değerlendirilmesi.* Detay Yayıncılık, Ankara, 2014.

Kurgun H.; Bağıran Özşeker, D. (Eds.), *Gastronomi ve Turizm (Kavramlar-Uygulamalar-Uluslararası Mutfaklar- Reçeteler)*, Detay Yayıncılık, Ankara, 2016.

Sarıışık, M. (Ed.). *Uluslararası Gastronomi (Temel* Özellikler-Örnek *Menüler ve Reçeteler)*, Detay Yayıncılık, Ankara, 2013.

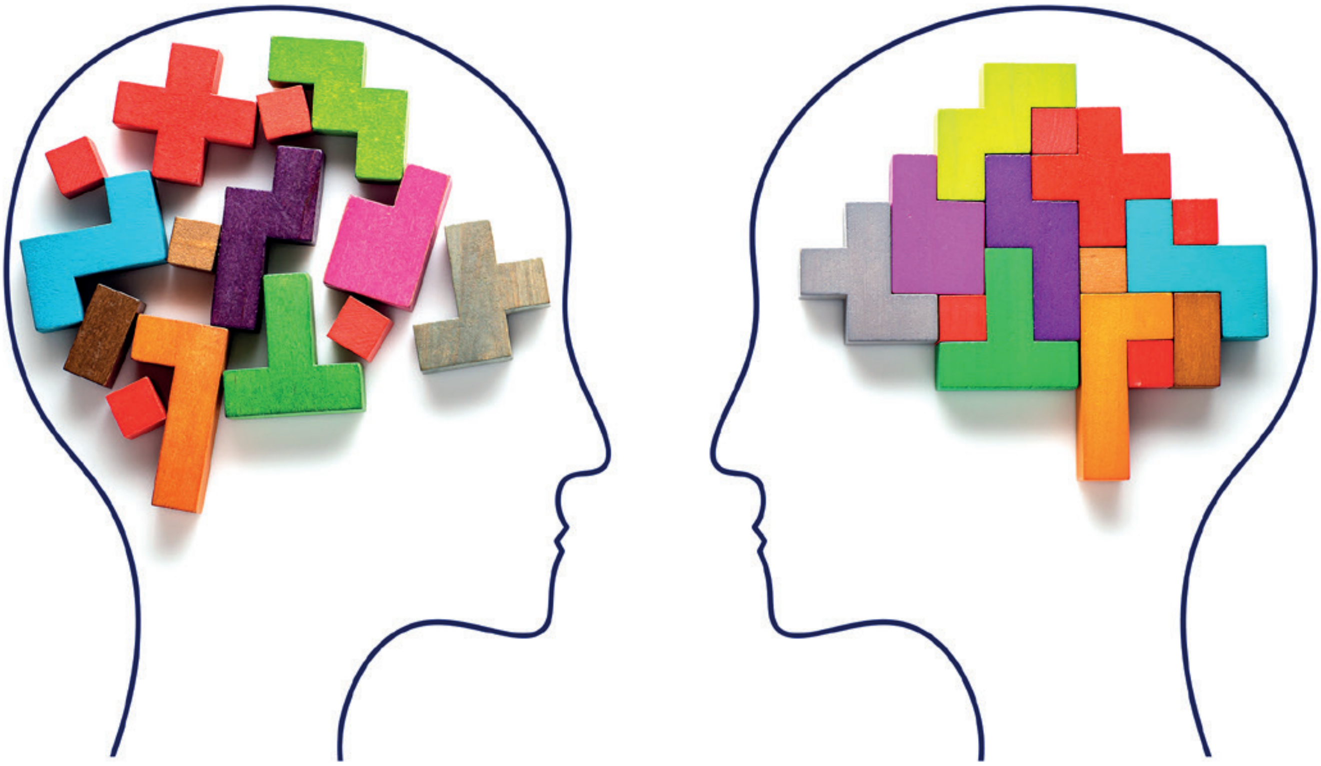
Neslihan Çetinkaya

TODAY'S PROBLEM AND YESTERDAY'S ANSWER

Problem 2.

There are 7 students in the class numbered 1,2,...,7. For each student the instructor chooses 99 problems from the exercise book. It turns out that for each k=1,2,...,7 there are at least k problems from the book not assigned to student number k. What is the minimum possible number of problems in the exercise book?

Azer Kerimov



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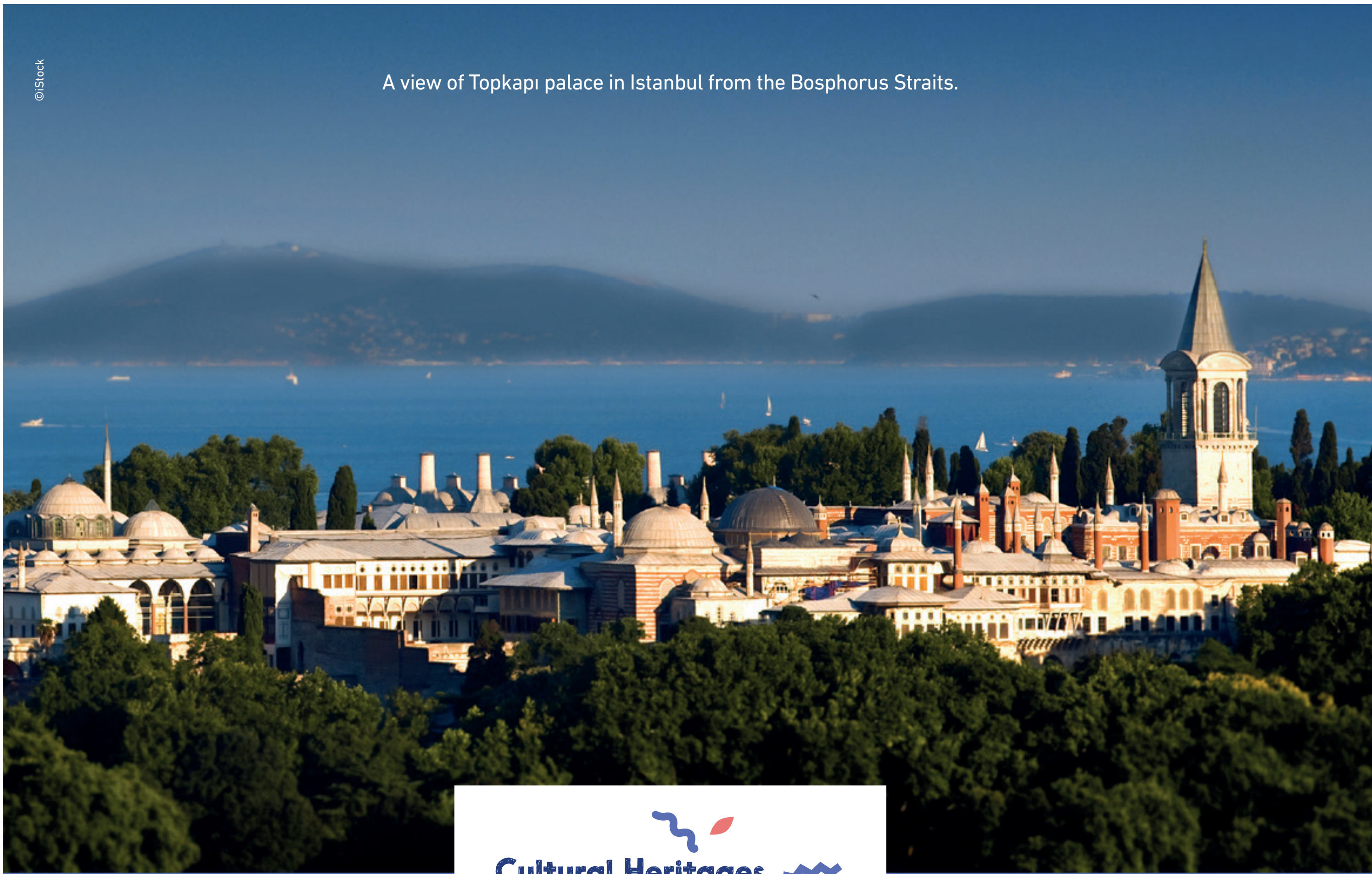
Answer of yesterday's problem :

Alaaddin can take 497 coins with certainty. In each move Alaaddin puts 42 gold coins into the new pouch. Since 1001 = 42 · 23 + 35 after several moves one person will get 12 pouches. If Alaaddin has 12 pouches then he gets 12 · 42 = 504 gold coins; otherwise he gets 1001 - 12 · 42 = 497 gold coins. If the monster takes all pouches containing at least 42 gold coins and gives all pouches containing less than 42 gold coins to Alaaddin then Alaaddin will get either 1001 - 12 · 42 = 497 or 12 · 41 = 492 gold coins.



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A view of Topkapı palace in Istanbul from the Bosphorus Straits.

Cultural Heritages

TOPKAPI PALACE MUSEUM

Hüseyin YURTTAŞ, Esra HALICI, Burak Muhammet GÖKLER, Muhammed Emin DOĞAN

Topkapı Palace was built on the Byzantine acropolis in the Sarayburnu area between the Bosphorus, the Sea of Marmara, and the Golden Horn. Its construction was started by Sultan Mehmed II in 1460 and it expanded with structures added by many monarchs up to the 19th century. The palace is surrounded on the seaward side by Byzantine walls on the land side by walls named Sûr-ı Sultâni constructed by order of Sultan Mehmed II.

Topkapı Palace consists of four courtyards, which are entered through three monumental gates. The first gate, which opens to the square where Hagia Sophia and Ahmet III Fountain are located, is called the Imperial Gate, the second is the Gate of Salutation, and the third is the Gate of Felicity.

In the first courtyard of the palace structures surrounded by gardens and squares are Hagia Irene church, a hospital, bakery, mint, firewood store, and wicker craftsmen's house. In the second courtyard are the Divan-ı Hümayun (Kubbealtı) (meeting place of the Divan council) and next to it the treasury, as well the Justice Tower, the entrance to the Harem, and the stables, and in the third courtyard are the Sultan's Audience Chamber, the Enderun Treasure, and the Privy Chamber. In the fourth courtyard, which is the last courtyard, there are the pavilions and hanging gardens of the Sultan. Here are found the Baghdad and Revan Pavilions and the Iftaree Gazebo, the most distinguished and aesthetically advanced examples of Ottoman classical mansion architecture, which were built on the orders of Sultan Murad IV. In the lower part of the fourth courtyard lie the Mecidiye Pavilion and the Wardrobe Chamber.

Topkapı Palace was opened to visitors for the first time as a museum during the reign of Sultan Abdulmecid. The palace later began officially to function as a museum in the full sense on October 9, 1924.

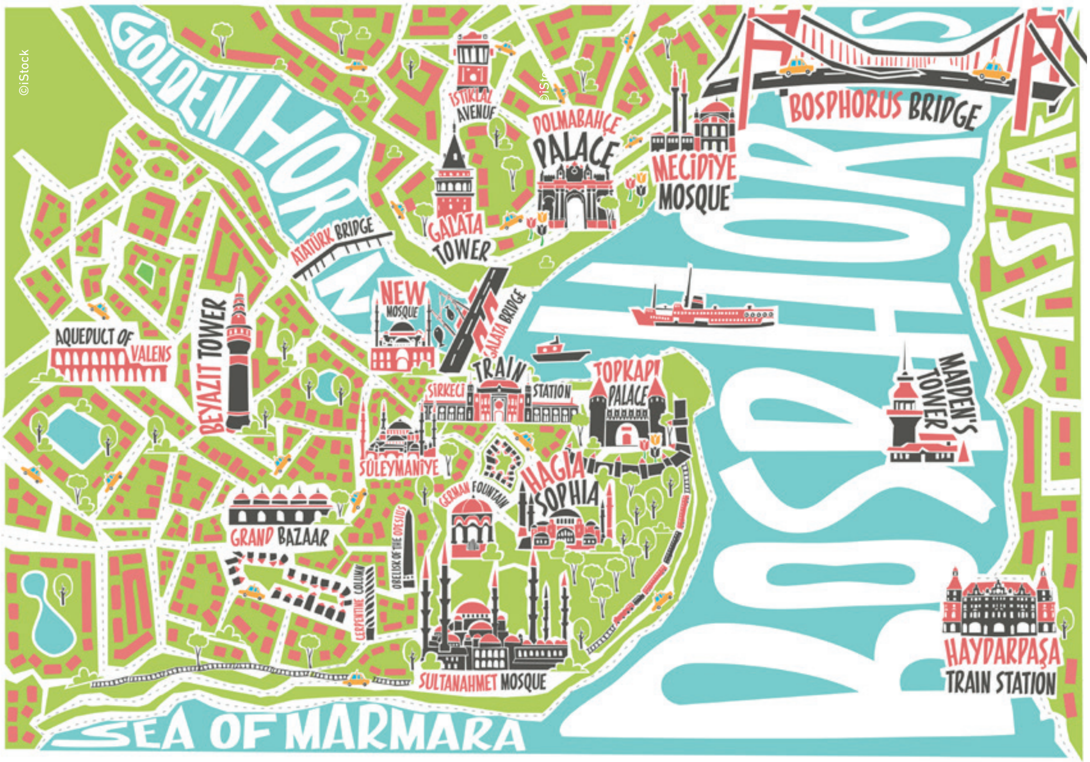
The palace is remarkable due to its extraordinarily rich collections as well as its architecture. Among the valuable collections exhibited in the museum are the Imperial Treasury, European porcelain and glass, Chinese and Japanese porcelain, Istanbul glass and porcelain, Mantle of the Prophet Office, Sacred Relics, Sultans' garments, Sultans' portraits, and weapons.

Topkapı Palace, which was added to the World Heritage List by UNESCO in 1985, is one of the most visited historical sites in "Istanbul's Historical Peninsula".

Topkapı Palace Istanbul, Turkey

Topkapı Palace, or the Seraglio, is a large museum in Istanbul, Turkey. In the 15th century, it served as the main residence and administrative headquarters of the Ottoman sultans.

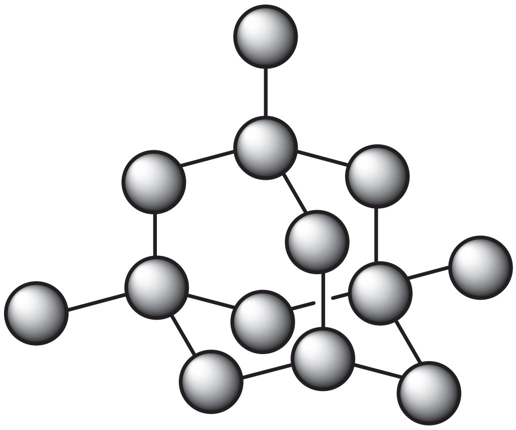
Topkapı Palace, located in Sarayburnu, was used as the administrative center of the state for 400 years of the 600-year history of the Ottoman Empire. It was constructed between 1460 and 1478 by Sultan Mehmed II, the seventh sultan of the Ottoman Empire. Topkapı Palace was converted into a museum in 1924, by the order of Mustafa Kemal Atatürk, the founder of the modern Turkish Republic. Topkapı Palace, which had an area of approximately 700,000 m^2 during its establishment, has an area of 80,000 m^2 today as Topkapı Palace Museum.

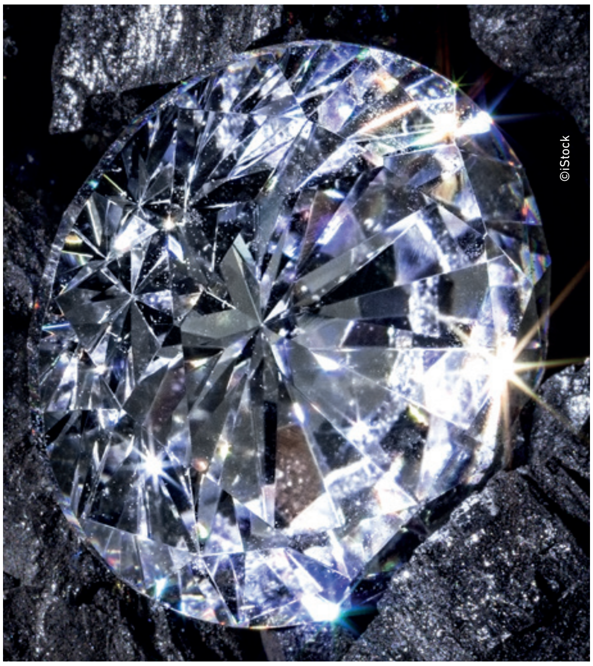


Vector illustration colored Istanbul map with famous landmarks

ONE OF THE MOST FAMOUS DIAMONDS IN THE WORLD IS IN THE TOPKAPI PALACE MUSEUM IN ISTANBUL. DID YOU KNOW?

Diamond





According to the bonding of carbon atoms to each other, the carbon elements have different allotropic structures in which their physical and chemical properties are different from each other. Graphite and diamond are the two most common allotropes in which the properties of carbon are very different.

Each carbon atom in a diamond is covalently bonded to four other carbons in a tetrahedron. These tetrahedrons form a three-dimensional network with a six-member chair conformation. Diamond is the most expensive stone and also the hardest material on earth. The beauty of diamonds comes essentially from their sparkling.

The Spoonmaker's Diamond (Kaşıkçı Elması). The most widely known among the historical diamonds is the Spoonmaker's Diamond, in the Topkapı Museum, Istanbul. It is an 86-carat (about 17.2 g) pear-shaped diamond surrounded by 49 brilliant cut diamonds.

Nurullah Saraçoğlu

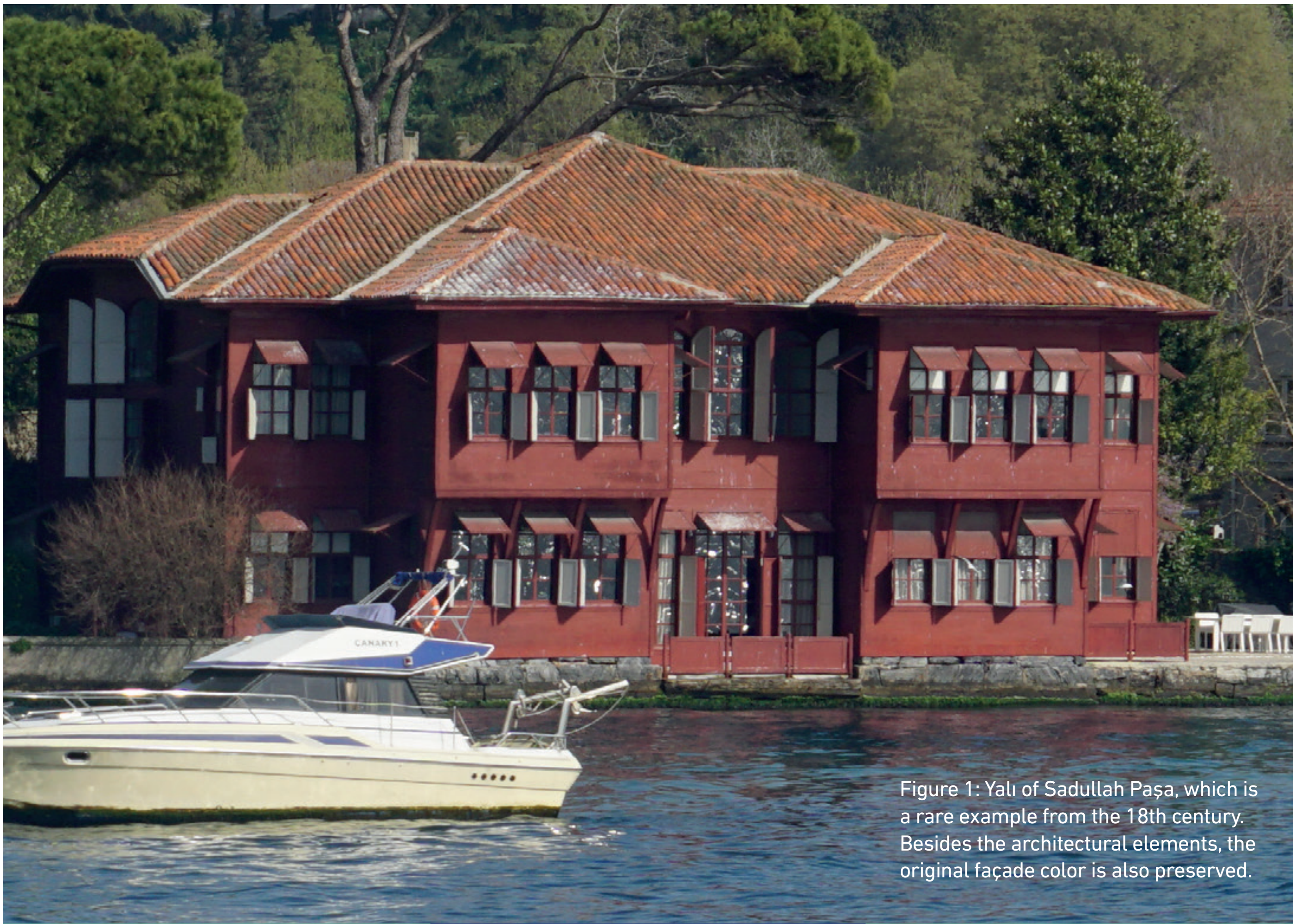


Figure 1: Yalı of Sadullah Paşa, which is a rare example from the 18th century. Besides the architectural elements, the original façade color is also preserved.

Cultural Heritages

WOODEN HOUSES OF ISTANBUL: CONVEYING CULTURE AND HISTORY

S. Feyza ERGÜN

Wooden houses are of special importance in terms of Ottoman architectural heritage. The spatial compositions, relation to nature, and conceptual decisions make the wooden Turkish house unique. Since the earliest examples from the 16th century, the development and transformation continued. The location and the building period contribute to the diversity of the Turkish house. In other words, topographic and climatic conditions, local materials, technical knowledge, the lifestyle of the inhabitants, economic concerns, general architectural trends, and personal tastes have a great impact on the design. As a capital city, Istanbul had the most beautiful examples and a huge variety. Moreover, the houses in Istanbul had always been the precursors of new architectural developments. Timber was a favorite material for construction, especially until the 20th century. Although many of the examples have disappeared due to the changes in socio-cultural structure and urban conditions, there are still plenty of them representing the old style of the city [1]. Wooden structures can be found on the historical peninsula, in former countryside villages, and in the old towns of Istanbul, as well as on the Prince Islands.

Most of the present wooden houses in Istanbul were built after the 19th century. Therefore, they mainly reflect the characteristics of the last period. The influence of European styles became apparent especially between the late 19th century and the early 20th century. Motifs from Art Nouveau and historicism are reflected in the decorations, as well as the architectural decisions like the roof type or façade compositions [2]. Inspirations from diversified styles including empire, neo-baroque, neo-classical, neo-gothic, neo-Ottoman, Victorian, and Swiss chalet-style turn the city into an open-air architectural museum for wooden houses.

The vivid colors of the façades always attracted the attention of many visitors. Although today some of the houses have reverted to the original brown color of the timber due to deterioration, the well-maintained ones are still enlivening their environment. Oriels, sash windows, wooden doors, horizontal cladding boards, narrow street patterns, and the harmonious proportions are the most remarkable elements of the houses in the collective memory. The houses are structured with timber frames without any infill and the wooden skeleton is constructed above a masonry basement or ground floor. Metal nails are used to join the timber pieces.

UNESCO World Heritage Sites

Since 1985, historical areas of Istanbul have been included in UNESCO's world heritage list. Besides the well-known main masterpieces like Hagia Sophia, Topkapı Palace, Süleymaniye Mosque, Hagia Irene, Şehzade Mosque, the Blue Mosque, and the ancient Hippodrome of Constantine, the vernacular settlements in the areas of Süleymaniye and Zeyrek are also mentioned as being of outstanding universal value. The integrity and vulnerability of the timber housing in Süleymaniye and Zeyrek are briefly stated by UNESCO [3].

Bosphorus villages and former summer houses

Yalı is a unique definition for the seaside mansions on the Bosphorus. Owning one of them has always been a symbol of status, because of their location enabling picturesque views and great gardens. Moreover, many of them have an impressive layout and design. They usually reflect the fashionable architectural approach of their period. Arnavutköy, Büyükdere, Tarabya, Kuzguncuk, Kanlıca, Anadolu Hisarı, and Beykoz are among the Bosphorus villages in which beautiful examples of authentic wooden mansions are found. Additionally, several neighborhoods near the Marmara Sea, namely Bakırköy, Yeşilköy, Kadıköy, and Fenerbahçe, were part of the countryside until the mid-20th century. Many splendid residences with gardens were built based on the interpretations of popular western styles according to the personal taste of the owners. Plenty of them are still present but are usually difficult to spot at first glance as they remain in between new constructions and the complex urban landscape.

Largest wooden building in Europe

The Prince Islands have also been a popular location for summer houses. Being away from the crowds of the city, vehicle traffic, and central business districts gives a special status to the islands. Non-Muslims and foreigners constituted a considerable proportion of the population. As they freely expressed their tastes, they brought an intense European influence to the architecture of the islands. Various conserved authentic wooden mansions help to preserve the spirit of the old days. The Greek Orphanage (Prinkipo Palace), which is considered the largest wooden building in Europe, is located on Büyükada. It was designed by Alexander Vallaury as a casino and hotel in 1898 but used as an orphanage between 1903 and 1964. Since then it has been left unused due to political disagreements. In recent years, interest in the building has increased considerably and several types of research have been conducted.

In conclusion, there are still more than 1000 wooden houses in Istanbul, including the islands. They are scattered in a wide range of districts and can be encountered neighboring new concrete construction. Many of the houses are listed as Grade II. Moreover, there are a few Grade I listed structures. Wooden houses are of particular importance in terms of cultural heritage, as each of them represents the lifestyle, domestic life, building technology, and architectural trends of a significant period.

References

[1] Yagci, S. F.; Mazlum, D. Traditional timber houses of Istanbul: Heritage values and preservation problems. *J. Architect Conserv.* **2016**, *21*, 1-18.

[2] Yagci, S. F. Historic wooden houses of Istanbul with influence of European styles. In: *4th WTA International PhD Symposium.* WTA Nederland–Vlaanderen, The Netherlands, 2017.

[3] UNESCO, Historic Areas of Istanbul. https://whc.unesco.org/en/list/356/ (26.03.2020).

Figure 2: Neoclassic decorations on the façade of a mansion, which was built in 1875 at Süleymaniye.

Figure 3: Authentic wooden mansion from the 19th century in Arnavutköy.

Figure 4: Wooden ornaments on colorful houses in Kuzguncuk.

Figure 5: A wooden twin house from Büyükada, Prince Islands.

Figure 6: The Greek Orphanage on Büyükada, Prince Islands.

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