NRICH

National Research Institute of Cultural Heritage

Vol.2

ISSN 2765-0669

Research News on Korean Heritage

FEATURED COLUMN: KOREA'S ANCIENT CAPITALS

Earthen Fortification in Pungnap-dong, the Royal Capital of Baekje

Shining New Light on Silla's Moon Palace

Before It's Decline
Sabi, Baekje's Last Capital

2021

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Date of Publication
April 30, 2021

Published by
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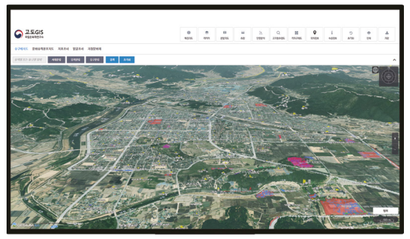
The Royal Capital of Baekje (Aerial view of the Earthen Fortification in Pungnap-dong)

Back
The Royal Capital of Baekje (Excavation site of the Earthen Fortification in Pungnap-dong)

You can also download the magazine at our website.

Featured Column

Mini Essay



NRICH Inside

Director's Message

Greetings from Seoul,

COVID-19 has brought abrupt halt in our lives and created gaps between friendships as well as relationships. In the midst of this unprecedented crisis, we believe that trust and cooperation are the key to combat this global pandemic. Bearing that in mind, I am pleased to announce that the NRICH has released its second issue of "NRICH", an English magazine on Korean cultural heritage research projects. The first issue of "NRICH" was launched on November 2020 with an effort to publicize the values and information on Korean culture and natural heritages with the global society. As "NRICH" began its journey with great support and encouragement from its first release, it will continue to share the latest research achievements and news of the institution twice a year.

Every issue of "NRICH" covers special articles of Korea's cultural heritages through its *Featured Column*, *Mini Essay* sections and *NRICH Inside* which contains various news, archeological reviews and publications. The aim of the each article is to promptly deliver the academic research achievements as well as to give better understanding for the general public and non-professional readers all around the world.

The main theme of the second issue illuminates on the 'Korea's Ancient Capitals.' Korea, also known as the 'country of fortresses,' has built countless unique and distinct fortresses from the ancient times. Theses fortresses were built on the national borders and all regions throughout Korea to provide important protection against invaders. Time to time, three layers of fortress walls are found. They are castle walls, outer walls and inner walls especially surrounding the city capitals. The walls are categorized depending on their structures such as earth mound, stone or the combination of both.

The tradition of building fortresses began from the kingdoms of Gojoseon, Buyeo, Jin and continued throughout not only the Three Kingdoms Period of Koguryo (Goguryeo), Baekje and Silla, but also the post kingdoms such as Goryeo and Joseon in the Korean history. Designated as the UNESCO World Heritage Sites, some of these fortresses are undergoing extensive research and maintenance.

In this second issue, we are proud to present our research results on ancient capitals of Korea which have been revealed through the various archeological network and cooperation. Readers can also find the stories about the ancient capitals virtually restored by the ancient capital Pilot Geographic Information System (GIS) and AR digital technology, reinterpretation and utilization of the mysterious Koguryo (Goguryeo)'s tomb mural and its patterns, and finally the radiocarbon dating which can determine and measure the age of organic matter.

As a 'deliverer' of Korea's cultural heritage, NRICH will strive to pursue the values of both Korea and the world heritages in order to promote and share them with the global community.

Thank you.

Director General of National
Research Institute of
Cultural Heritage

Dr. JI Byongmok

NRICH History

Cultural heritage that have formed naturally or artificially over many years are valuable properties not only for the people of their country of origin but for all humankind due to their historic, artistic, and academic value, and their natural beauty in the case of landscapes. As such, it is every country's duty to survey and study them and to preserve them for future generations.

The National Research Institute of Cultural Heritage has been striving to reveal and spread the value of our culture and history through research for the past 50 years and has become the only research institute in Korea that is in charge of comprehensive research on cultural heritage. It is our responsibility to enhance the value of the country's culture through creating knowledge and promoting cultural heritage and we aim to become a world-class cultural heritage research institution.

1969. 11.

The National Research Institute of Cultural Heritage established (In Seoul)

1970's

1973
Excavation of Cheonmachong Tomb (World Heritage)

1975
Excavation of Hwangnam Grand Chong Tomb (World Heritage)

1976
Excavation of Donggung Palace and Wolji Pond, Gyeongju (Anapji, Historic Site No. 18)

1973
Started research in the field of artistic cultural heritage (*First target: Buddhist bells)

1975
Started research on conservation science for cultural heritage

1980's

1980
Excavation of Mireuksa Temple site, Iksan

1983
Excavation of Hwangnyongsa Temple site, Gyeongju

1984
Survey of all the Buddhist painting in Korean temples

1990's

1990
Expanded excavation in ancient capitals (Gyeongju, Buyeo, etc.) through opening regional offices

1999
Conducted repair and restoration on Iksan Mireuksa Temple stone pagoda

2000's

2004
National Research Institute of Cultural Heritage relocated (to Daejeon)

2005
Implemented cultural heritage restoration technology and materials research

2006
Expanded research to natural heritage

2010's

2005~2019
Established regional research offices and one conservation center

2017
Implemented safety and disaster prevention of cultural heritage in light of climate change and potential disaster risks

NRICH Organization

Director General

- **9 Divisions**
  - Administrative Division
  - Planning and Coordination Division
  - Research Division of Archaeology
  - Research Division of Artistic Heritage
  - Research Division of Architectural Heritage
  - Conservation Science Division
  - Restoration Technology Division
  - Natural Heritage Division
  - Safety and Disaster Prevention Division
- **7 Regional Offices**
  - **Gyeongju** National **R**esearch **I**nstitute of **C**ultural **H**eritage
  - **Buyeo** National **R**esearch **I**nstitute of **C**ultural **H**eritage
  - **Gaya** National **R**esearch **I**nstitute of **C**ultural **H**eritage
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  - **Wanju** National **R**esearch **I**nstitute of **C**ultural **H**eritage
- **1 Center**
  - Cultural Heritage Conservation Science Center

Featured Column

Earthen Fortification in Pungnap-dong, the Royal Capital of Baekje

Overlooked by modern apartments, a vast earthen fortification in Seoul's Pungnap-dong district provides reams of information on ancient Toru

Ganghwa National Research Institute of Cultural Heritage
Pungnap Earthen Fortification Excavation Team
LEE Boram

Baekje (18 BCE-660 CE) began life as one of the polities of the Mahan Confederacy in the central region of the Korean Peninsula and later developed into an ancient state. Archaeological evidence indicating this transition includes the construction of fortifications, the appearance of large-scale tomb clusters, and the establishment of a distinct earthenware style.

In particular, the appearance of settlements surrounded by fortification walls is considered a crucial indicator suggesting the establishment of a state-level society. In an era when the states of the Korean Peninsula were engaged in often existential rivalries, fortifications served as essential defenses. The construction of a fortification involved the development of science and technology that could support its design and execution, as well as management strategies of the governmental organization that could help mobilize a workforce as needed. In other words, the building of a fortification was a governmental project that required the concentrated investment of state capabilities, in terms of large-scale earthen work projects, forced labor mobilization, and the operation of a governance system.

During the transition from Baekje-guk (the member polity of a confederacy) to Baekje (the ancient state), a royal fortification of Baekje was built in the Hangang River basin between the third and fourth centuries. The extant site is today known as the Earthen Fortification in Pungnap-dong (Historic Site No. 11) located in present-day Pungnap-dong, Songpa-gu, Seoul. As the ancient remains from the Hanseong Period (18 BCE- 475 CE), it is a fortification built in the even ground located along the Hangang River. The main channel of the river flows to the west of the fortification, whereas the Mongchontoseong Earthen Fortification is located to the southeast.

Built along the riverside, the fortification was believed to have a circumference of some 2.1 kilometers. The eastern, southern and northern walls have remained. More recent archaeological excavations have identified the remains of the western wall, which was long thought to have been completely lost. The excavation campaigns have revealed that the original fortification was probably 3.5 kilometers in circumference, some 43–50 meters wide and more than 11m high. This makes it larger and more majestic in scale than Koguryo (Goguryeo)'s Gungnaeseong Fortress (circumference: 2.6 kilometers) or Silla's Wolseong Palace (circumference: 2.4 kilometers). In particular, one distinguishing feature of the fortification is that, unlike the neighboring Mongchontoseong Earthen Fortification, which took advantage of the area's natural hills, or Wolseong Palace in Gyeongju, it was created using the stamped earth technique, where walls are built by tamping soil and stacking it layer by layer.

The fortification holds vestiges of the royal capital of Baekje, from the time of Baekje-guk, before its construction, to the end of the Hanseong Period, in 475 CE. Archaeological excavations over the years have identified diverse remains, including a

The remains of an "elaborate but not extravagant" fortified palace represent a 500-year old Baekje capital in the heart of Korea's modern capital

1. Baekje Builds a New Capital

> ***"... will relocate the capital to that area and devise a plan to achieve extended prosperity."***
> *– The record from the 13th year of King Onjo's reign, the Baekje bongi (Baekje's Records) of Samguk Sagi (History of the Three Kingdoms)*

❶ Pungnap Earthen Fortification

dwelling site enclosed by ditches belonging to the Proto-Three Kingdoms Period, a large-scale hexagonal dwelling feature, warehouses, a well, a special-purpose temple site, and a ritual site. The ritual site, in particular, is unique to this fortification among historical remains from the same period. The fortification's unique artifacts, such as convex eave-end roof tiles, bricks, foundation stones and clay pipes, are objects that were not seen in residences of the commoners at the time, suggesting the importance of the fortification.

This archaeological evidence clearly proves that it served as a royal fortification of early Baekje. In terms of being a royal capital, the essential elements of this fortification include the royal palace, government buildings, a royal shrine area within the palace for royal ancestral rites, a centralized road network connecting the fortification's gates and inner areas, and a residential zone for high-ranking officials.

❷ Pungnap Earthen Fortification surrounded by moat (1997)

2. Raising the Walls

"... a fortress and a royal palace were built."
– The record from the 13th year of King Onjo's reign, the Baekje bongi (Baekje's Records) of Samguk Sagi (History of the Three Kingdoms)

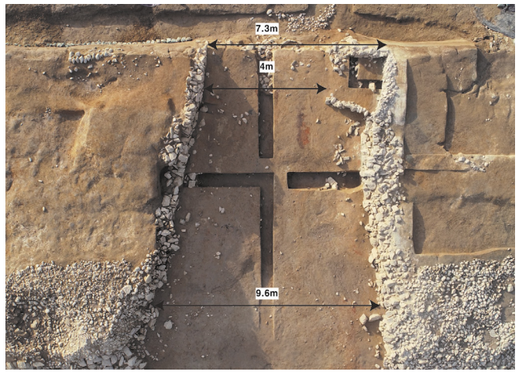
How did Baekje build this earthen fortification? To unravel the mystery of its construction, an archaeological excavation involving a dissection of the eastern wall was conducted in 1999 and 2011, followed by a survey on the moat along the eastern wall in 2015. Furthermore, an archaeological excavation on the western wall has been ongoing since 2017.

The eastern wall was built in four phases. First, foundation work was carried out to reinforce the ground before erecting the wall (Phase 1). Then, the core framework (the first Toru) was built by alternately stacking soil and sand layers, using the stamped earth technique. The sides of this core framework were then shaped into slopes before additional soil layers were added on for the creation of a base fortification wall (Phase 2). Later, the inner side of the wall was once again padded with soil layers (the second Toru) for the expansion of width and height (Phase 3). Afterwards, soil layers were added onto the inner wall once again (the third Toru) for yet another expansion, with the inner wall completed with stonework finishing (Phase 4).

As for the western wall, most of it had been lost and remained invisible. Since the wall does not appear in the cadastral map of the fortification issued in 1911, the controversy surrounding its existence continued until its remains were revealed from the 2017 excavation of the western wall restoration zone. For the first time, the excavation revealed the hidden body section of the western wall, which is linked to the remaining western wall; the inner wall's stonework finishing; and the west gate site. The core of the wall was completely destroyed by the pouring of concrete in modern times, but the inner wall has survived in relatively good condition. The extant remains suggest that the western wall and the eastern wall (on which a cross-sectional excavation was conducted in 2011) feature the same structure.

❸ Eastern Wall of Pungnap Eearthen Fortification (2011)

❹ Western Wall of Pungnap Earthen Fortification (2021)

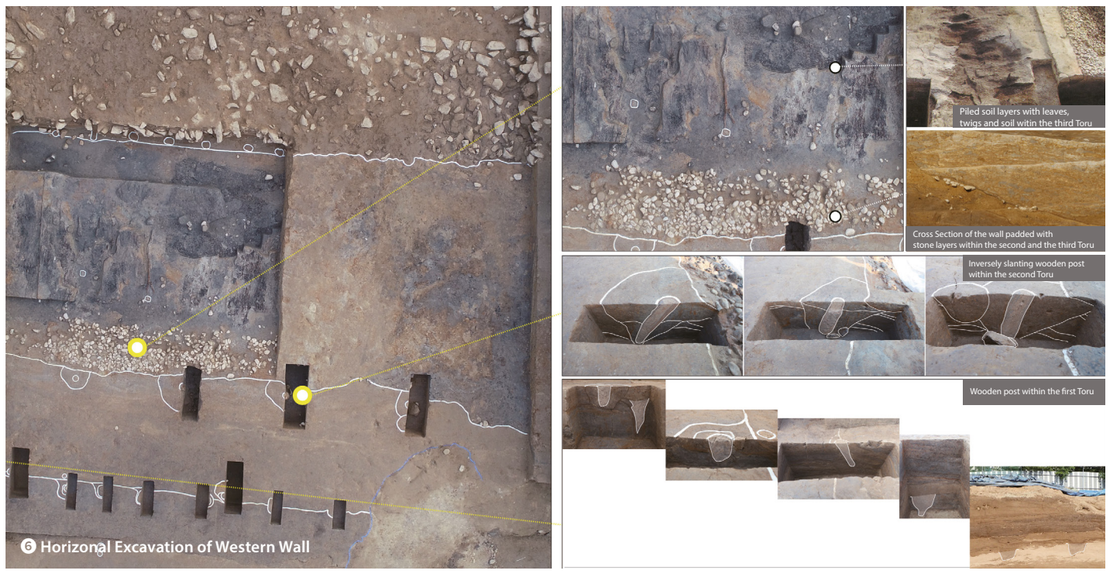


❺ West Gate Site of Pungnap Earthen Fortification (2021)

In 2020, a horizontal excavation was conducted to clearly identify the fortification's building techniques. The excavation uncovered wooden posts that had been installed to construct each Toru. It seems that they were stamped into each layer of a Toru, from the bottom-most layer to the top, to help with heaping soil. Currently, a total of six wooden posts have been discovered from the first Toru. Similarly, wooden posts were placed in the second and third Toru to build the fortification. Notably, along the boundary between the second and third Toru, wooden posts slanting in the opposite direction of the slope of the fortification wall with the stones that provided their foundations, have been identified. Such inversely slanting wooden posts were first identified in fortress sites in Korea. Presumably, they were either used to build fortification walls or were a wall-related facility. In this regard, wooden posts discovered on the western wall provide important clues toward understanding the fortification's construction technique and process.

On top of this, the area excavation method produced clear evidence of the fortification's phased expansion. Excavators of the site believed that the fortification steadily expanded into a gigantic earthen fortification with a width of 40–50 meters. Indeed, the 2020 excavation has identified in the soil layers some evidence that, first, the base of the fortification (first and second Toru) was finished with stone layers, then used for a certain period, before being expanded by creating the third Toru on top of a stone layer.

The wooden post technique for stamping earth has been identified only in this fortification in Pungnap-dong, Seoul. The excavation team will continue to engage in the study of the fortification walls, with the goal of better understanding the earthen work technology of Baekje.



❻ Horizonal Excavation of Western Wall

❼ Na-10 Mirae Village Dwelling Site of Pungnap Earthen Fortification

3. Baekje's New Beginnings in Pungnap

"... a new royal palace was built, and it was plain but not shabby, elaborate but not extravagant."
– The record of the 15th year of King Onjo's reign, the Baekje bongi, the Samguk Sagi

The essential elements of this fortification that highlight its role as a capital are the royal palace, administrative offices, a venue for royal ancestral rites, a residential zone for high-ranking officials, and diverse infrastructure (e.g. road, water and sewage systems). As the excavation of the fortification's inner area continued, it became possible for the places like Mirae Village and Gyeongdang District sites to visualize and imagine the fortification as the ancient capital.

At the Mirae Village Reconstruction site (hereinafter "the Mirae Village"), located in the western part of the fortification's inner area, a large number of remains were found including pit features containing a heap of dumped roof tiles, large-scale semi-subterranean pit dwellings, and ground-level building features, enabling the identification of ancillary

❽ North-south and East-west roads of Pungnap Earthen Fortification (2006)

facilities inside the fortification. One notable discovery from the village is north–south and east–west roads that crisscrossing each other, which were built to divide zones within the fortification and to utilize spaces in a planned way. Remains of many other facilities were also discovered in the Mirae Village, including a building feature with a stone foundation, and a rectangular pit possibly related to a cluster of ground-level warehouses. These features suggest that the area was a densely packed hub for major facilities within the fortification.

A royal palace and a royal shrine are the key facilities within an ancient capital. Even the *Samguk Sagi* mentions that a royal palace, shrine and altar were built when King Onjo established his royal capital.

In the Gyeongdang House Reconstruction site (hereinafter "the Gyeongdang District"), located in the northern part of the fortification's inner center, archaeological excavations identified a special building feature (presumably a royal palace or a shrine for ancestral rites) as well as many artifacts. The Gyeongdang District was designated the core facilities zone by the institute. Staffs of the institute will continue to survey and excavate the zone in a systematic way to explore traces of Baekje's royal palace, that was historically known as "elaborate but not extravagant."

4. A 500-year Capital Coexisting with Modern Residents

Archaeological excavations and studies over the years have promoted the understanding of early Baekje culture and its restoration. On the other hand, the unraveling of Baekje's long-forgotten past is also posing a range of aggravating inconveniences to the local residents (e.g. the invasion of property rights and a lack of residential infrastructure). Recently, with an emphasis on the importance and historical identity of the Earthen Fortification in Pungnap-dong, Seoul, a policy supporting the active preservation and promotion of the fortification has been implemented under the slogan "Pungnap, the historical and cultural capital of Hanseong Baekje." A long-term preservation policy, coupled with systematic survey and research projects on the fortification, will contribute greatly to the study of not only early Baekje culture but also of royal fortifications in East Asia.

⑨ Mirae Village ground-level warehouses

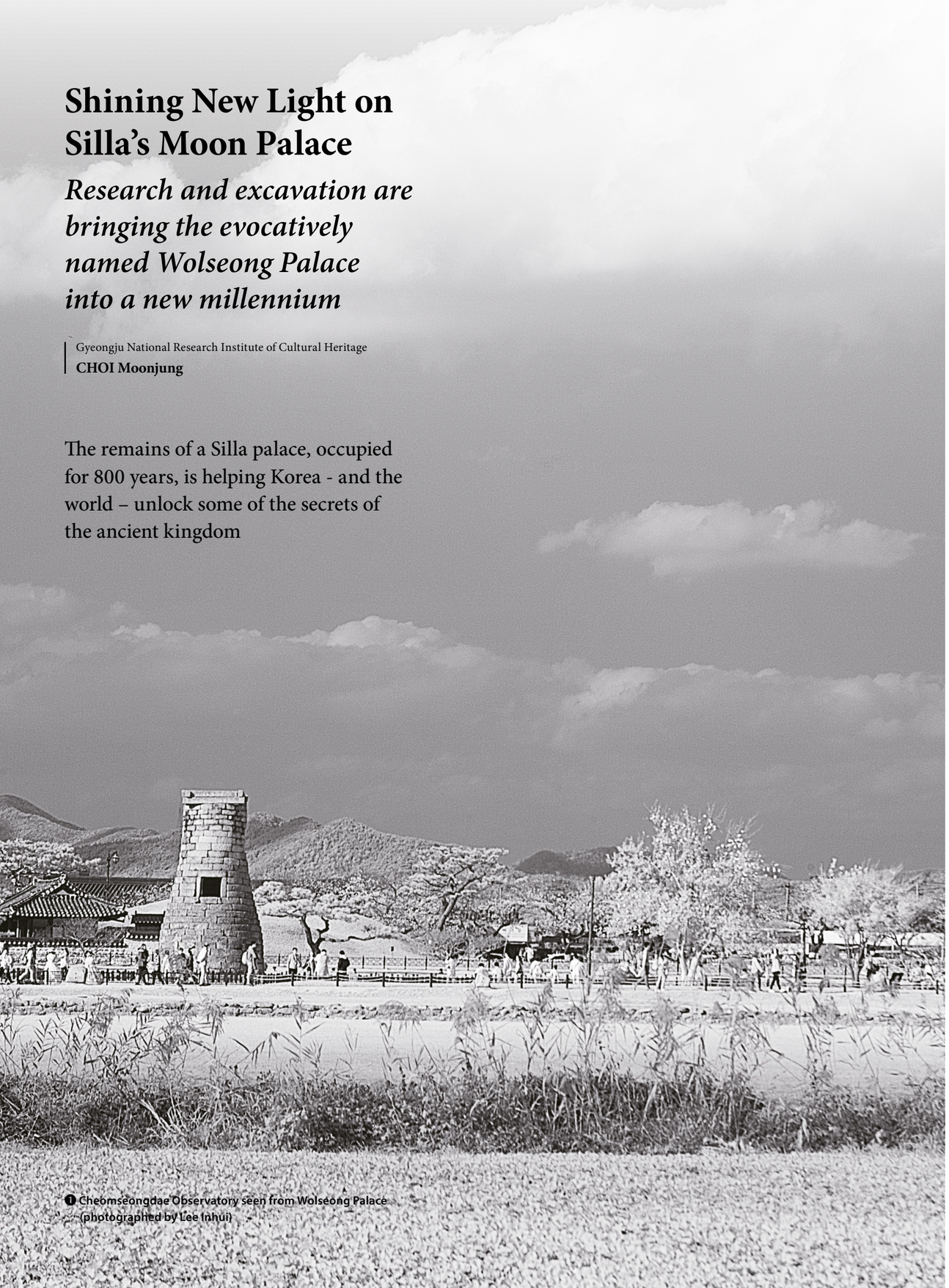
⑩ Gyeongdang Row House Reconstruction Site No.44 (2008 Excavation by Hanshin University Museum Center)

Shining New Light on Silla's Moon Palace

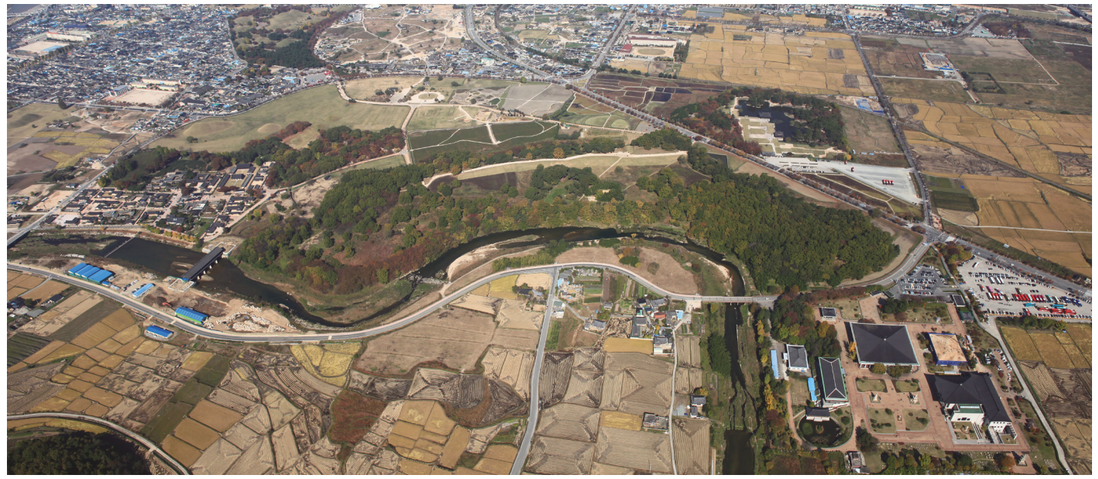
Research and excavation are bringing the evocatively named Wolseong Palace into a new millennium

Gyeongju National Research Institute of Cultural Heritage
CHOI Moonjung

The remains of a Silla palace, occupied for 800 years, is helping Korea - and the world – unlock some of the secrets of the ancient kingdom



❶ Cheomseongdae Observatory seen from Wolseong Palace (photographed by Lee Inhui)



❷ Wolseong Palace and its surroundings in Gyeongju

At the Heart of Silla

Gyeongju, a small city situated some 274 kilometers to the southeast of Seoul, evokes the ancient kingdom Silla (57 BCE-935 CE), which formerly occupied the southeast of Korea. At the city's center there once stood a royal residence known as Wolseong Palace, or "The Moon Palace ."

德業日新 網羅四方
"Virtue is renewed day by day and covers all directions."
– Samguk Sagi (History of the Three Kingdoms)

As if to realize the national wish embedded in the aforementioned adage and its abbreviation as conveyed in the name "Silla," the ancient kingdom grew outwards from Wolseong Palace into a major axis of East Asia by annexing neighboring kingdoms and continuing to expand. Silla served as the hub of cultural exchange that connected with the Silk Road and civilizations across the sea.

Wolseong Palace was a royal palace of Silla located within its capital Seorabeol, present-day Gyeongju. As the center of politics, culture, and the economy, it would be home to countless kings and queens, associated royalty, and historical figures throughout the millennial history of Silla.

Wolseong is rich in legends. One story has it that within Wolseong Palace was a royal treasure trove known as cheonjongo, where manpasikjeok - a mythical flute capable of curing diseases and soothing ocean waves - was stored. As if enclosed by a folding screen, the palace was surrounded by Gyerim Forest. There, another legend tells that a person passing by the forest heard a rooster crowing and discovered a boy born out of an egg.

But it is also rich in tangible heritage. Nearby stood Cheomseongdae Observatory where ancient astronomers observed the stars; Donggung Palace and Wolji Pond featuring gorgeous landscape; and Hwangnyongsa Temple, the greatest Buddhist temple of Silla that featured a nine-story wooden pagoda that was a staggering 80 meters high.

Wolseong: The Moon Palace

The site of Wolseong Palace (Historic Site No. 16) is a hill in the southern part of an alluvial fan formed within the Gyeongju basin. The top portion of the site is flat land, with its periphery surrounded by fortress walls that are 2–7 meters high. The overall land slopes downward from north to south as well as from east to west. The palace thus stood on a vantage point overlooking the entire Gyeongju basin.

Donggung Palace and Wolji Pond are located 150 meters to the northeast of the palace's East Gate Site. Wolseong Palace is 890 meters wide from east to west and 260 meters long from north to south, with an outer circumference of 2,340 meters and a total site area of 193,845 square meters.

Presumably, Wolseong Palace was named after the fact that its overall appearance resembles the moon. For the same reason, it was also referred to as Banwolseong, or "Half-moon Palace." Some history and geography books from the Goryeo and Joseon periods also mention it as Sinwolseong and Manwolseong, meaning "New Moon Palace" and "Full Moon Palace," respectively.

In the Pages of History

Records of Wolseong Palace appear in history books, such as the *Samguk Sagi* and the *Samguk Yusa* (Memorabilia of the Three Kingdoms), as well as geography books, such as the *Sinjeung dongguk yeoji seungnam* (Newly Expanded Geographical Survey of Korea) and the *Donggyeong japgi* (Miscellaneous Records of the Eastern Capital, Gyeongju).

Notably, the *Silla Bongi* (Silla's Records) of the *Samguk Sagi* states that in the 22nd year of Pasa Isageum's reign (101 CE), a palace was built and named Wolseong and in July of the same year, the king moved to the palace. Until the collapse of Silla, Wolseong Palace played the role of a royal palace. In 676, Silla achieved the unification of the Three Kingdoms. From that time, Silla's royal capital began to transform into a city built on a well-designed planned grid, serving as the center of the millennial kingdom's cultural bloom. A record from the 6th year of King Heongang's reign written in the *Samguk Sagi* says, "Along with his subjects, the king went up to Wolsangnu Pavilion, looked around, and saw that the houses of his people in the capital were all connected, with the sounds of singing and music never ceasing." According to the *Samguk Yusa*, Silla in its heyday administratively consisted of 1,360 bang (坊) 55 ri (里) with 178,936 households and 35 aristocratic houses known as geumiptaek (a house decorated with gold).

Moats: Wolseong Palace Defense Facilities

In general, moats are created near and adjacent to the outer walls of the fortresses. They are designed as barriers against enemy attacks, using an artificial ditch or a natural river. In the southern part of Wolseong Palace, the Namcheon Stream served as a natural moat, whereas the eastern, western, and northern parts were surrounded by human-made moats, which were confirmed to have been steadily managed. Wolseong's moats were first created in the 5th century and reinforced with stacked stonework after Silla's unification of the Three Kingdoms in the late 7th century. The ancient engineers created a ditch that connected to Namcheon Stream, enabling the uninterrupted utilization of Wolseong Palace and its neighboring spaces.

Wolseong moats also played an important role of separating the inner and outer spaces of the palace, controlling water levels, and landscaping the area.

❸ Wolseong palace and its moat (post restoration)

Eastern Defenses of Wolseong Palace

As the creation of the moat system suggests, Wolseong combined the functions of a palace with the defenses of a fortress. To build the palace walls, Silla engineers must have taken advantage of all the best available methods to protect the sovereign.

The walls themselves are earthen ramparts. For construction, the earth foundation was packed down, the central part was built, and firm layers were added horizontally to create the inner and outer surfaces of the walls. To reinforce the foundation, the bottom-most layers were created by alternately stacking a soil layer and a layer consisting of tree branches and leaves that could help secure the adjacent soil layers. Wooden structures used as supports were also found. The core parts of the walls were reinforced by stacking varying types of soils held in different pouches, or by inserting layers of burned straw in between layers of soil.

Underneath these layers were the remains of human sacrifices - a custom that embodied the Silla people's wish to ensure the robustness of the walls. Two instances of human sacrifice were discovered. One is a man in his 50's lying on his back with neatly placed limbs, and the other is woman in her 50's lying on her back with her face facing the man. Tree bark was also discovered around their skulls. There were no extra pits to bury their remains, and four pieces of earthenware, including cup-style earthenware were discovered around the remains.

800 Years of Remains

According to the *Samguk Sagi*, Wolseong Palace was occupied for more than 800 years (101–935 CE). As such, building features within the palace and the remnants of spatial use are densely packed and often overlapping. Currently

❹ Excavated human remains

❺ A researcher examining the palace wall

under excavation is a 6,400-square-meter area, where 17 small and large building features have been identified.

Notably, a large number of roof tiles, as well as more than 100 shards of inkstones and inkstone legs, have been uncovered. Inkstones are valuable artifacts demonstrating the existence of a literary culture in Silla. Though not everyone was able to read and write at the time, the inkstones suggest that people in the royal palace were engaged in literary activities. At the same time, the fact that the discovered inkstones are not ornate in design indicating that they served as practical tools used for drafting documents.

Reimagining Silla's Flowers, Trees and Landscapes

One major resource in the Wolseong moats is ancient organic matter that can be used to infer information about the environmental and living conditions at the time - for instance, what staple foods were consumed, what types of meats and vegetables were eaten, what kinds of flowers grew around Wolseong Palace, and what trees stood there. The shape of a seed, animal remains, and other clues can help unravel the mysteries of ancient life in Silla.

At the same time, diverse wooden artifacts and the remains of wooden defensive facilities related to the moat are keys that help us unlock the mysteries of the past. Most notably, a model ship (Length: 38.6 centimeters; Width: 5 centimeters; Height: 4.2 centimeters) was recovered from the moat - helping us imagine what vessels looked like in that period. In Korea, remains of actual ships and wooden ship models are rare; this model ship is probably the oldest among them. It is in the form of a semi-structured ship, a halfway form between a dugout canoe and today's structured ship designs, featuring a distinct bow and stern as well as structures on a deck. Interestingly, the inner and outer surfaces of the model ship's middle portion show signs of fire damage.

From a folkloric perspective, as a mode of transportation on rivers and seas, ships symbolize communication between spaces. Fire, on the other hand, symbolizes forestalling calamity (extinction), purification, and renewal. In this light, the burn marks suggest that the model ship was used for rituals related to the royal palace and water to fulfill the wishes of the Silla people.

❻

❼

❻ Excavated inkstone shards
❼ A researcher removing dirt from a wooden artifact

Wolseong Palace: Gyeongju's Millennial Time Capsule

In 2000, in recognition of Wolseong Palace's historical and cultural value, UNESCO designated the palace and its surroundings a World Heritage site, under the name Gyeongju Historic Areas. Since the designation, Wolseong Palace, one of the major archaeological sites within the Gyeongju Historic Area, has been recognized as precious cultural heritage shared not only by the Korean but also by the global community.

In 2014, the excavation team of the institute began to dig up soil from Silla with a goal to uncover the mysteries of a millennium that had been buried deep. Through this effort, invaluable cultural remains including ceramic vessels used by the Silla people, clay figurines reflecting daily life of the time, wooden tablets with inscriptions, bones of animals that once roamed in Wolseong Palace and the seeds of a lotus flower that must have bloomed beautifully have been uncovered. This journey will continue until the day we can unravel the millennial riddles of Silla and genuinely recreate the actual conditions of the ancient kingdom.

❽ A tree inside Wolseong Palace (photographed by Lee Inhui)

❾ A scene from the excavation site (photographed by Lee Inhui)

The final days of the ancient Baekje kingdom are coming back to life through new research conducted on the mighty earthen defenses that have been preserved in the town of Buyeo

Jeongnimsa Temple Site at the center of Sabi
(Source: Baekje World Heritage Center)

Before It's Decline
Sabi, Baekje's Last Capital

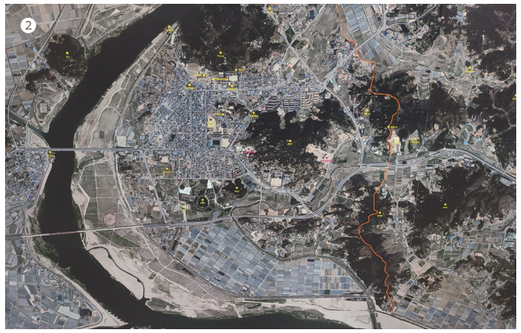
Uncovering the new findings within the superb fortifications of Baekje's final days

Buyeo National Research Institute of Cultural Heritage
GIM Daeyoung

Baekje (18 BCE–660 CE) was one of the ancient kingdoms of Korea that occupied the southwestern region of the Korean Peninsula. During its reign, Baekje relocated its capital twice and based the names of three capitals on the regions which divided Baekje into the Hanseong period (18 BCE–475 CE), the Ungjin period (475–538), and the Sabi period (538–660).

During the Ungjin period, Baekje restored its previous power, and in 538 (the 16th year of King Seong's reign) relocated its capital to Sabi (present-day Buyeo). For a hundred and twenty-three years until the fall of Baekje, the Sabi capital served as the ancient kingdom's political, economic, social and cultural hub.

The most prominent characteristic of Sabi is that it was surrounded by the Baengmagang River to its north, south and west. Moreover, its outer wall which originated from the Busosanseong Fortress located at the center of Sabi's northern area, was built along its eastern boundary in a way that took full defensive advantage of the area's topography. Since the shape of its wall resembled that of a half-moon, the capital was also known as Banwolseong (Half-Moon Fortress).



❶ Sabi and Baekje's other capitals
❷ Aerial View of the Sabi capital

❸ Naseong City Wall (Source: Baekje World Heritage Center)

❹ Busosanseong Fortress

❺ Large Building Site at the Archaeological Site in Gwanbuk-ri

❻ Archaeological Site in Ssangbuk-ri (building site)

The outer wall of Sabi is now referred to as the Naseong City Wall with its remains clearly present in the Neungsan-ri area to the east of Buyeo-eup.

The core of an ancient capital was typically its royal palace. Unfortunately, the current understanding of Sabi's original palace site is limited. The only certain factor is that the Busosanseong Fortress, located at the center of the northern part of Sabi as well as the Gwanbuk-ri and Ssangbuk-ri areas to the south of the fortress, are known to have been the location of the royal palace.

Busosanseong Fortress is situated behind the archaeological site in Gwanbuk-ri, which is thought to have been used for royal palace facilities. Judging from this location, the fortress likely played multiple roles of a royal fortress, a defensive fortress, or the rear garden of the royal palace.

As for Gwanbuk-ri which is located on a foothill to the south of Busosanseong Fortress, archaeological surveys identified historical remains showing connections to a royal palace. From 1982 to 2008, researchers conducted 13 surveys which identified numerous archaeological features and artifacts including a large building site the size of a royal audience hall, a large reclaimed land area, the remains of a grid road and a pond.

Major archaeological features, namely the large building site in Gwanbuk-ri, date to the late Sabi period (late 6th – early 7th century). Such findings led to the question of where the royal palace and other central facilities existed during the early Sabi period.

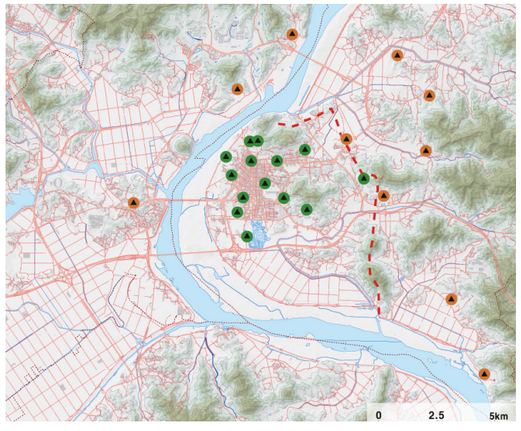
Recently, the Buyeo National Research Institute of Cultural Heritage conducted an archaeological excavation on a site located at 525-1, Ssangbuk-ri, Buyeo-eup to the east of the Buyeo Girl's High School. Here, a large building site, a building site resembling the Chinese character 品, and Daegaya-style earthenware from the early-to-mid 6th century were discovered. These findings raised the possibility that during the early Sabi period, Baekje's royal palace and other central facilities were located in today's Ssangbuk-ri area rather than the Gwanbuk-ri area.

A major element that constitutes the Sabi capital's landscape are its temples. The *Biographies of Baekje* in the Book of Zhou states, "There are a large number of Buddhist monks,

❼ Royal Tombs in Neungsan-ri

temples and pagodas." As indicated in this excerpt, Baekje was a land of devoted Buddhists. Even today, some 20 Buddhist temples exist in the inner and outer areas of the former capital.

Most Baekje temples feature the "one pagoda, one prayer hall" style, in which the two structures are aligned on a north–south axis. This style differs from other contemporary styles that can be found on the Korean Peninsula, specifically, the Koguryo (Goguryeo) style featuring one pagoda and three prayer halls and the Silla style featuring two pagodas.



❽ Distribution of temples around the Sabi capital

Jeongnimsa Temple served as Baekje's central temple, and the site is located at the center of Sabi. The Jeongnimsa Temple site, to this day, houses a five-story stone pagoda, recording more than 1,500 years of preservation. The pagoda's first story has an inscription by Su Dingfang, a general of the Tang Dynasty of China, which tells of the historical circumstances surrounding the demise of Baekje.

In terms of its architectural style, Jeongnimsa Temple's middle gate, pagoda, prayer hall, and lecture hall were all aligned along the north–south direction, with roofed corridors surrounding them. The same Buddhist temple layout has been identified at Shitennoji Temple in Osaka, Japan, suggesting that the Jeongnimsa-style temple layout served as a model for early Japanese temple architecture.

Outside the Naseong City Wall, the eastern boundary of Sabi are the Royal Tombs in Neungsan-ri, a cluster of royal tombs from the Sabi period and the Neungsan-ri Temple Site. These royal tombs are representative sites that showcase changes in tomb style that occurred during the late Baekje period. In particular, Tomb No. 1 (also known as Donghachong) has interior wall murals featuring the Four Guardian Deities as well as lotus flower and cloud motifs painted on the ceiling. Initially, seven tombs were restored. However, after a recent archaeological excavation, four more tombs were restored in the western part of Neungsan-ri.

The Neungsan-ri Temple Site, on the other hand, is located in the valley area between the outer edge of the capital (Naseong City Wall) and the Royal Tombs in Neungsan-ri. The temple is known to have served as a royal memorial temple during the Baekje period. At the site, the Great Guilt-bronze Incense Burner of Baekje was unearthed in 1993. Designated a National Treasure of Korea, the artifact highlights Baekje's highly sophisticated artistry and culture.

In 2015, Baekje Historic Areas, including the Sabi capital, was inscribed on the UNESCO World Heritage List. The inscription is a testament to the outstanding universal value of the culture, religion and aesthetics of late Baekje as well as global recognition of Baekje's contribution to the prosperity of East Asian culture via exchanges with ancient nations in China and Japan.

For the research, conservation, and enhancement of the Baekje Historic Areas, the Cultural Heritage Administration (CHA) has set up a master plan for major archaeological sites in former Baekje capital regions and is striving to systematically manage these regions. Along the same lines, the Buyeo National Research Institute of Cultural Heritage will continue its efforts to restore the appearance of Baekje during the Sabi period, the heyday of its cultural development, through research on Sabi - the final capital of Baekje.

❾ Great Gilt-bronze Incense Burner of Baekje
(Source: Buyeo National Museum)

Mini Essay

Mini Essay

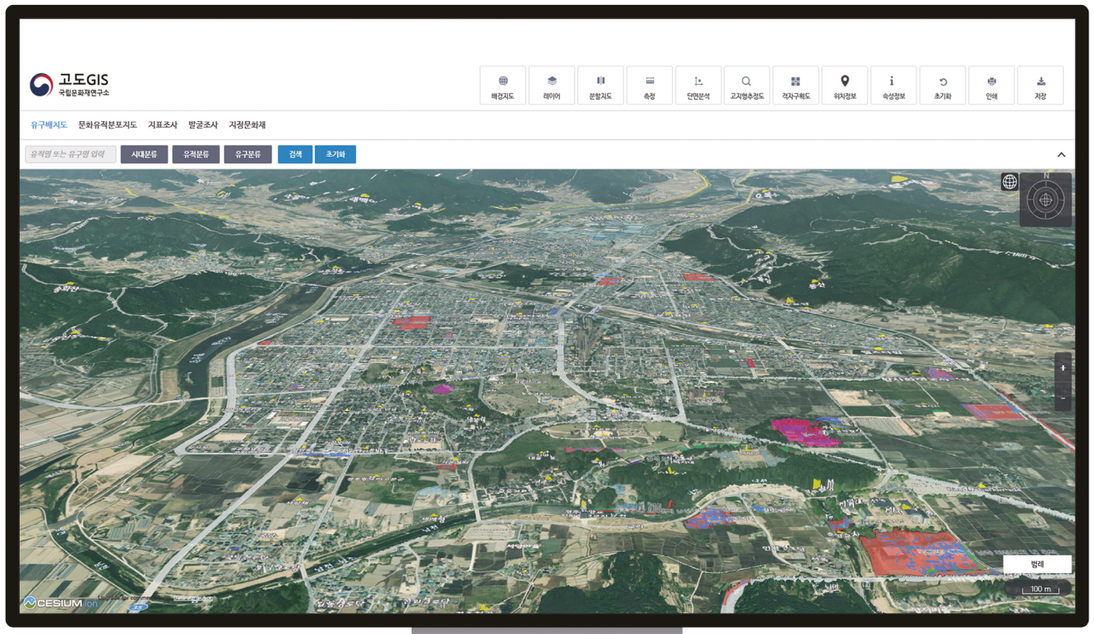
Research Division of Archaeology

LEE Heejun

Returning the Capitals of Long-Dead Kingdoms to Life

A new digital platform launched in 2020 to enable the mapping and reimagining of long-lost cities

The Ancient Capital Pilot Geographic Information System (GIS) can reveal what archaeology cannot: The full extent, and layout, of the legendary cities of yore



❶ The main page of the Ancient Capital Pilot GIS developed in 2020.
The system was designed so that the user could see the locations of ancient city sites and their features on a single 3D map.

The many ancient capitals that once existed on the Korean Peninsula remain mysteries. Although archaeological surveys conducted during the 20th century partially identified vestiges of ancient royal fortresses, no ancient capital that encompasses a royal fortress has been clearly or fully identified in terms of the city's overall shape and structure. Meanwhile, historical records leave us to conjecture.

Given this opacity, we hope that the launch of the Ancient Capital Pilot Geographic Information System (also called GIS) in 2020 will bring new transparency – and permit us to reimagine these ancient cities in an entirely new way.

Unfathomable Mysteries, Unanswered Questions

The Korean word "godo" literally means "old capital." The capitals of ancient kingdoms are mostly located in today's Gyeongju, Buyeo, Gongju, and Iksan regions. In ancient times, the Korean Peninsula was home to a number of kingdoms, including Koguryo (Goguryeo), Baekje, Silla and the Gaya Confederacy, with their capitals built throughout the peninsula. Historical records frequently mention the names of ancient capitals and royal fortresses, inspiring curiosity. Today, however, there is not a single ancient Korean capital that is clearly understood. Without a single map remaining, it is virtually impossible to figure out what those ancient capitals looked like as they fell into ruin and disappeared. Despite the relentless efforts of scholars, research based on just a few document resources and archaeological surveys has remained limited. Researchers have only been able to surmise the locations of ancient capitals, major royal palaces, and administrative buildings.

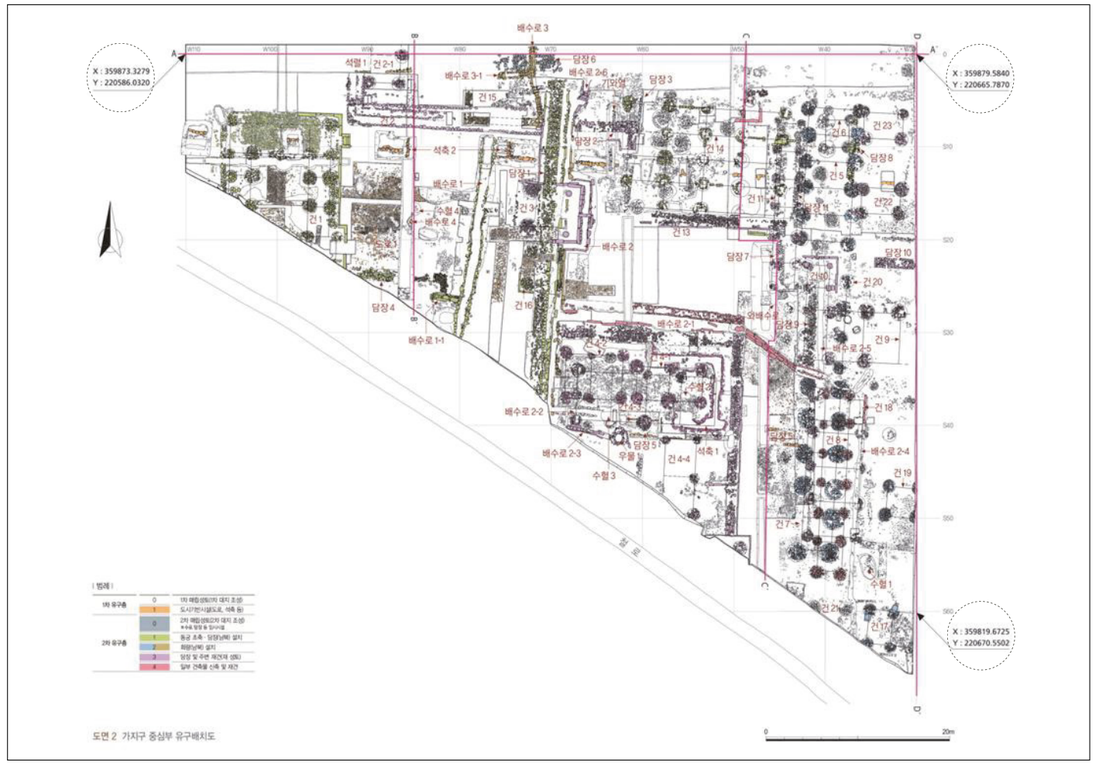
To quench this thirst for knowledge, the Korean government has steadily supported archaeological excavations in Gyeongju, Buyeo and other major ancient capital regions. However, since the target areas were mostly confined to political and ritual spaces such as the sites of royal fortresses, Buddhist temples, and royal tombs, such research efforts played only a limited role in unveiling the overall and much wider structure of cities that inherently had multiple functions. For this reason, studies on the layouts of ancient cities conducted in the 20th century after the liberation of Korea were limited to hypothetical maps. These were based on the road networks seen on maps printed during the Japanese colonial period, with modifications made when the remains of ancient roads were newly discovered through archaeological excavations.

An Avalanche of Archaeological Data

Excluding the ancient capital restoration studies led by the government and academics, land development projects have expanded the number of salvage excavations. This, in turn, led to a surge in excavation data obtained from many areas within ancient capital regions. These excavations revealed clues indicating the existence of urban zoning, for instance, straight avenues and fences lining these thoroughfares, and the remains of a drainage system crossing a village. On top of this, a 15-year excavation survey of the Silla royal capital (1987–2002), conducted by the Gyeongju National Research Institute of Cultural Heritage, identified an entire ancient city district featuring a planned grid. This was empirical evidence of a planned ancient city and led to great strides in ancient capital studies.

However, the ever-accumulating amount of excavation data on ancient city sites had one critical flaw, which limited their extensive use in ancient capital restoration studies. The problem was that feature distribution maps produced from archaeological excavations did not contain accurate spatial information. Until 10 years ago, the purpose of creating a feature distribution map was to record the actual sizes and forms of a site's archaeological features. At the time, compass directions and the scale marked on survey maps drawn on the spot were the only spatial information available on feature distribution maps. Recording the geographical coordinates of a site was not seen as an essential part of an archaeological excavation. As such, finding accurate coordinates of archaeological features appearing on the existing feature distribution maps and matching them on a numerical map has become a new task that can help in restoring the structure of an ancient city.

❷ Traditionally, feature distribution maps were created by placing archaeological features on a survey drawing that displayed grids arbitrarily spaced for an archaeological excavation.
(Bureau of Cultural Property, 1984, Excavation Report on Anapji Pond, attached drawing)



도면 2 가지구 중심부 유구배치도

❸ It has been less than 10 years since spatial information (GPS coordinates) began to be marked on feature distribution maps.
(Gyeongju National Research Institute of Cultural Heritage, 2014, Excavation Report on Donggung Palace and Wolji Pond, Gyeongju II, p. 43)

The Paradigm Shifts: Mapping Spatial Information onto Archaeological Sites

A paradigm shift in archaeology began to occur when, with the rapid pace of land development projects in the 21st century, the need emerged for systematic and integrated governmental management of the surge of excavation data. The need to obtain accurate location information for each archaeological site was also widely recognized, and researchers began to introduce spatial information technology to archaeological sites to produce feature distribution maps marked with GPS coordinates.

Against this backdrop, governmental research on ancient capital restoration came to actively incorporate spatial information technology. First, in the late 2000s, researchers began to collect excavation information related to ancient capital regions, particularly Gyeongju and Buyeo. Based on this information, they initiated a project to establish a spatial information database for archaeological sites, by assigning absolute coordinates to archaeological features and converting feature distribution maps into electronic formats.

The Birth of the Ancient Capital GIS

It was the Buyeo National Research Institute of Cultural Heritage (BCH) who, based on this database, first attempted to develop a geographical information system (GIS) for ancient capital restoration research.

The institution commenced a series of studies in 2007, that led to the production of the Baekje Capital Archaeological Sites Map GIS. The system was developed based on archaeological information about ancient Baekje capital regions (i.e. Gongju, Buyeo, and Iksan), and is a simple independent system not linked to networks. Meanwhile, the Cultural Heritage Administration (CHA) established the Cultural Heritage GIS Service as a way to facilitate the preservation and management of cultural heritage and archaeological sites across the country. Since 2011, this GIS service has provided information on excavation sites.

In 2015, based on this infrastructure, the National Research Institute of Cultural Heritage (NRICH) took up the challenge of developing the Ancient Capital Region Archaeological Sites GIS (hereinafter "Ancient Capital GIS"). This was done to ensure integrated management of excavation information accumulated by the NRICH and its regional branches, and to support ancient capital restoration studies.

Made available to the NRICH and its branches in 2016, the system featured a spatial information database of some 600 archaeological sites associated with ancient Baekje and Silla capitals. After its initial release, however, the subsequent expansion of the database and an overall system upgrade came to a halt. As such, the initial version of the system was not developed further.

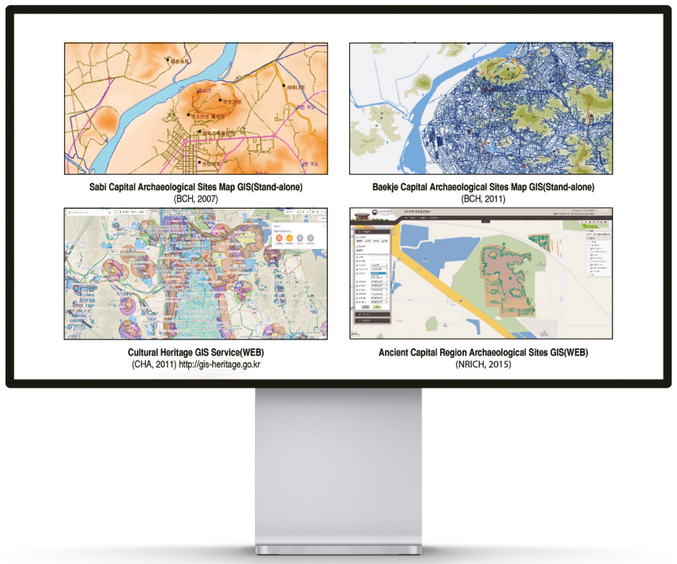
Five Years on: What Has Been Achieved? What is Next?

It has been five years since the Ancient Capital GIS was first developed. During this period, obtaining digital spatial information (e.g. taking GPS coordinates and producing electronic feature distribution maps) has become a common practice at archaeological sites. Academics also came to acknowledge spatial information technology-based GIS systems as the path archaeological research must take, moving forward.

In 2020, the NRICH's Research Division of Archaeology set out the task of revitalizing the Ancient Capital GIS development project. The original 2015 version was designed to provide the location information of each archaeological site by simply mapping each site's feature distribution map on a numerical map. The pilot GIS developed in 2020 will serve as a basis for a new enhanced version of the Ancient Capital GIS, which will be steadily established over the next five years as an integrated archive providing diverse spatial information data (e.g. 3D scanning results, geophysical survey information, soil layer information, and orthophotos) via a single platform.

From then on, the system will be upgraded further by applying AI technologies to the spatial information-based archaeological site database. The adoption of AI technologies will enable system analysis functionality that offers constant updates of city structures and ancient topography conjecture models. The system's basic user interface design will be completed in 2022, from which the Ancient Capital GIS will gradually become available to archaeologists via an online platform.

We hope to see, in the near future, a day when spatial information databases for major archaeological sites in ancient capital regions become fully linked to the Ancient Capital GIS. Then, the original layout of ancient capitals, which have long piqued the curiosity of both professionals and the public, can be fully restored on maps.



Sabi Capital Archaeological Sites Map GIS(Stand-alone)
(BCH, 2007)

Baekje Capital Archaeological Sites Map GIS(Stand-alone)
(BCH, 2011)

Cultural Heritage GIS Service(WEB)
(CHA, 2011) http://gis-heritage.go.kr

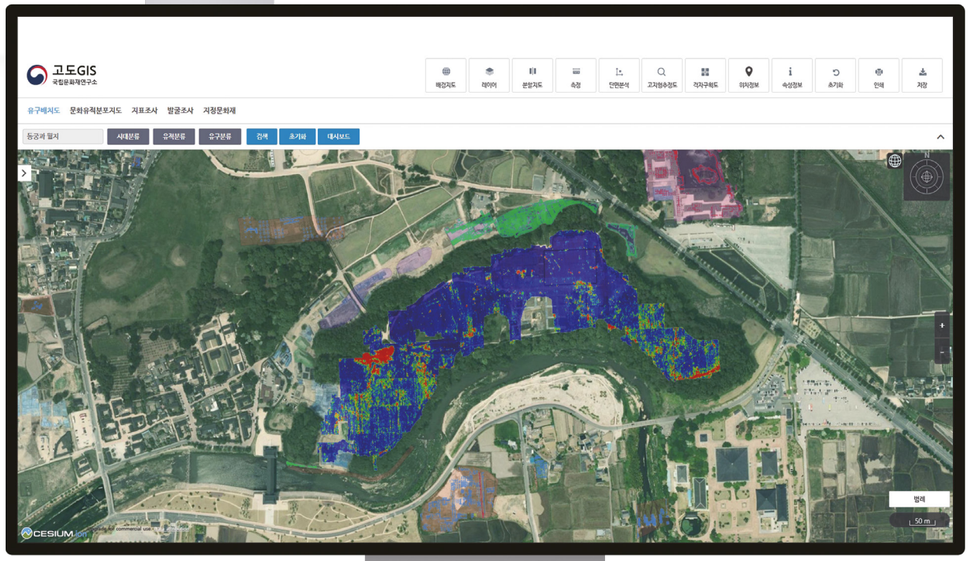
Ancient Capital Region Archaeological Sites GIS(WEB)
(NRICH, 2015)

The User Function of the Ancient Capital Pilot GIS

GIS enables the user to upload their own files and see the information on a map. This allows user-created layers to be superimposed on diverse themed maps (e.g. an original cadastral map, a topographic map produced before the liberation of Korea, a soil/geologic map, etc.). A feature distribution map and other information can also be shown on the screen, allowing the user to better identify the status of an archaeological site.

❹ Detailed search results of archaeological sites
This page allows the downloading of excavation reports.
The system also provides links to the NRICH's other content services (e.g. Korean Archaeology Dictionary, Korean Archaeology Journal, 360-degree VR of archaeological sites).

❺ Page providing information by archaeological site
The Ancient Capital GIS provides an overview of each archaeological site and its feature distribution that has been mapped.



❻ Page providing geophysical survey information
In addition to providing excavation-related information, the Ancient Capital GIS seeks to establish an integrated service and management platform for diverse spatial information on ancient city sites.

Mini Essay

Research Division of Architectural Heritage
CHOI Hyangsun

Hwangnyongsa, Silla's Greatest Temple, Virtually Restored by the AR Digital Technology

Augmented reality provides an exciting new tool for heritage restoration, edutainment and exploration

❶ AR restoration of the Middle Gate and Southern Roofed Corridor at Hwangnyongsa Temple

With the advancement of digital technology, augmented reality (AR) and virtual reality (VR) are being widely adopted in many academic and professional fields. VR technology, for example, provides a realistic visual and immersive environment accessible from anywhere, and AR technology shows 3D virtual images superimposed against the background of real-world images. In this respect, AR technology is expected to be of great use for virtual restoration of ancient ruins.

Marrying Modern Technology and Ancient Heritage in Digital World

Restoring lost architectural heritage is an extremely challenging task, but the demand has been steady because restoration can satisfy a natural human curiosity about our past and help expand the utilization of cultural heritage.

Rebuilding a lost architectural heritage to its original state is virtually impossible. Even when a building is restored, the surviving artifacts, such as foundation stones, platform stones, and several archaeological layers underground, may be damaged during the construction process. Furthermore, even if sufficient protective measures are taken to avoid damage to the existing remains, buried ruins are permanently hidden from view unless the restored building is dismantled and the soil covering removed.

In this case, the issue of authenticity may arise since only the restored building is visible, while real artifacts are hidden. Besides, even if a building is restored as authentically as possible after a sufficient historical verification process, the restoration may later turn out to be inaccurate when new evidence emerges; however an actual building cannot be easily modified once restored.

New technologies do not suffer from these restraints. With an AR-based restoration, an AR model can be conveniently readjusted at any time if new research requires changes. In this regard, AR-based restoration is an effective alternative to real-world restoration as it allows for both the protection and utilization of a cultural heritage item.

❷ AR restoration of the Middle Gate as a single-story building with a gable roof

❸ AR restoration of the Middle Gate as a two-story building with a hipped roof

Restoring a Lost Temple

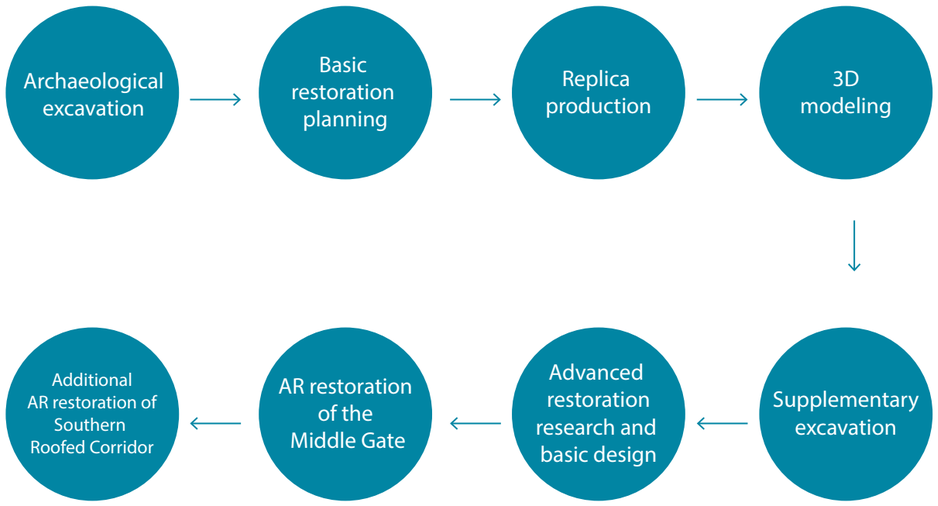
Founded in 553 (the 14th year of the reign of King Jinheung of Silla), Hwangnyongsa Temple underwent changes over a long period of time before becoming the greatest temple of Silla. However, in 1238 (the 25th year of King Gojong of Goryeo's reign), it was completely destroyed during the Mongolian invasion. Only the site (Historic Site No. 6) remains today.

Research on Hwangnyongsa Temple began with the 1976 archaeological excavation, which led to a full-scale research project that started in 2005. From 2012 to 2013, researchers created a small-scale model of the temple to determine the feasibility of restoration. In 2015, the 3D restoration of all buildings, including the Middle Gate, was completed to create an overall picture of the temple. In this process, digital modeling techniques were extensively applied using 3D modeling programs such as Autodesk Inventor. Based on this 3D restoration, researchers began to design the Middle Gate using the building information modeling (BIM) technique. In addition, research on detailed aspects of the structure, such as roof tiles and metal architectural artifacts, was conducted and reflected in the design. In 2018, as an initial task, the Middle Gate was restored, using AR technology, as a two-story building with a hipped roof. Later, from 2019 to 2020, the Middle Gate was restored again as a single-story building with a gable roof, and the Southern Roofed Corridor was also added.

❺ Aerial view of Hwangnyongsa Temple Site

❹ Hwangnyongsa Temple's Middle Gate Site

❻ Hwangnyongsa Temple's Site



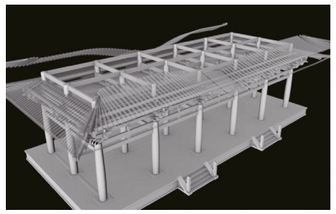
Treasure Hunt

Experiencing the Four Seasons

Docent Tour

Taking and sending photos

Screenshot of an AR-restored archaeological feature



Animation of wooden structure

Information and Edutainment

Visitors to the Hwangnyongsa Temple Site can rent a tablet PC on the spot to experience an AR program that allows them to walk around the Middle Gate and the Southern Roofed Corridor. This AR program also comes packaged with diverse "edutainment" content, specifically, a treasure hunt that requires finding artifacts unearthed from the Hwangnyongsa Temple Site, background effects showcasing the temple's four seasons, and a docent tour led by Gyeongju City's mascot.

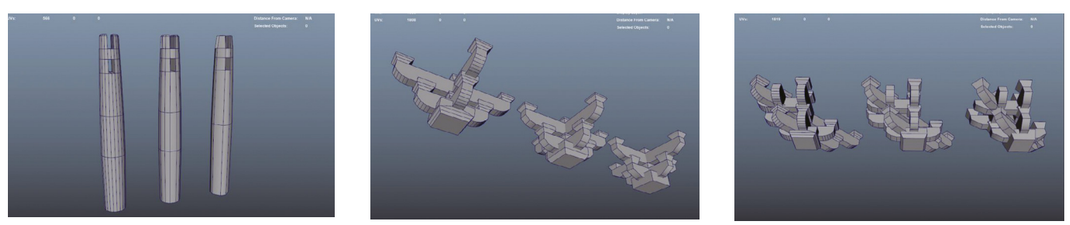
AR program users can take photos using Hwangnyongsa Temple as the background and send them via email. They can also appreciate the Hwangnyongsa Temple Site as it appeared during the 2017 archaeological excavation, a restoration created using 3D scan data of the excavation. Furthermore, they can magnify what they see and enjoy an animation that shows a building's wooden structural elements being assembled in the order of construction. The AR program also provides explanations about construction materials, allowing visitors to learn about wooden materials used in ancient Korean construction.

Upgrading the AR Experience

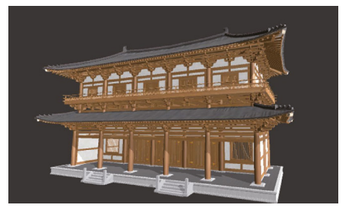
In the past, AR restoration work generally suffered from occlusion and perspective issues where a virtually restored building appears in front of a person even if they are standing in front of the building.

In order to address this problem, our AR restoration team enhanced the sense of perspective and made the experience much more realistic by calculating and factoring in the distance between the user and the virtual buildings. The AR restoration team also implemented time-related changes to shadows and diversified textures to provide the user with the most lifelike experience of roaming around the buildings inside Hwangnyongsa Temple.

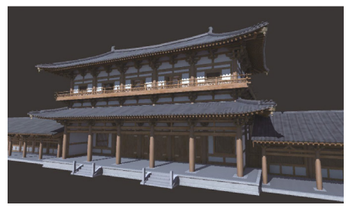
At the same time, by using marker recognition and camera-based location tracking, instead of more commonly used GPS technologies, the team was able to ensure the locational accuracy of virtually restored buildings. Moreover, the level of detail (LOD) technique, which enables the adjustment of rendering workload by distance, was applied for the efficient use of large data sets.



Application of LOD technique (3 phases)



Before adding baked lighting



After adding baked lighting

Image marker recognition

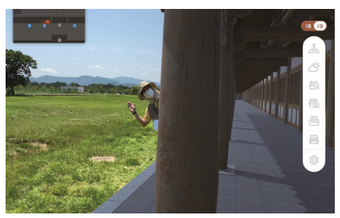


Photo featuring a perspective-corrected AR image

Mini Essay

Research Division of Artistic Heritage
PARK Yoonhee

Capturing the Mysterious Charm of Koguryo (Goguryeo)

Reproductions of hundreds of thousand-year old murals are making ancient art relevant to the modern world

❷ Black Tortoise in Gangseo Daemyo

The entirety of Koguryo (Goguryeo)'s tomb murals are divided by modern frontiers, but a new initiative is centralizing the kingdom's evocative artworks in South Korea

The Research Division of Artistic Heritage (National Research Institute of Cultural and Heritage) began its study on tomb murals from the ancient kingdom of Koguryo (Goguryeo; 1st century BCE–CE 668) three years ago, when it began a joint research project with the Seoul Hanseong Baekje Museum on copied Koguryo (Goguryeo) tomb murals housed at the museum. The copies, painted by the Mansudae Art Studio, home of the best painters in North Korea, provided an almost photographic reproduction of the real-world murals.

At the time, many questioned the utility of studying copied paintings instead of actual tombs. Nevertheless, the research has allowed the accumulation of valuable resources on Koguryo (Goguryeo) tombs that are perennially in short supply because the division of the two Koreas has prohibited visits to related sites in North Korea by South Korean experts.

❶ Red phoenixes in Gangseo Daemyo

A Widely Admired Heritage

Koguryo (Goguryeo), the northernmost of the Korean Peninsula's ancient kingdoms, straddled territory that included both Manchuria and Korea. Since the liberation of Korea from Japan in 1945, North Korea has been actively engaged in the archaeological excavation of Koguryo (Goguryeo) tombs on its territory and the production of copied murals. North Korea continued the production of the copied murals even during the Korean War in the 1950s.

As a matter of fact, avid interest in Koguryo (Goguryeo) tomb murals had its beginnings during the Japanese colonial period. For instance, Oba Tsunekichi who participated in the 1912 archaeological survey on the Great Tomb of Gangseo produced realistic copies of its murals. Similarly, a German scholar named Andreas Eckardt left detailed sketches of beautiful motifs appearing on this tomb. As representative exhibits, their copied Koguryo (Goguryeo) murals were also very popular among visitors to the Japanese Government-General Museum and the Yi Royal Family Museum. Their works were also published in color in the *Pictorial Catalogue of Historical Remains of Joseon* (V.2, 1915) and *Collection of Mural Paintings from Ancient Tombs of Joseon* (1916), respectively.

In this way, Koguryo (Goguryeo) murals garnered public attention through publications and exhibitions and also exerted influence on the world of fine art. At the time, many prize-winning works in the arts and crafts category selected for the annual Korea Art Exhibition featured motifs inspired by the Four Guardians (Black Tortoise of the North, Azure Dragon of the East, Vermilion Bird of the South and White Tiger of the West) and human figures depicted on Koguryo (Goguryeo) murals. It is fair to say that, for many modern painters of Korea, Koguryo (Goguryeo) tomb murals served as a great source of artistic inspiration.

❸ Celestial Motifs: Ancient Tomb Murals of the Koguryo (Goguryeo) Dynasty

You can also download the original text at our portal website.
(https://portal.nrich.go.kr/kor/index.do)

Why Koguryo (Goguryeo) Art Matters

Nearly 100 years after the initial popularity of such murals, the NRICH's Research Division of Artistic Heritage conducted a study on the motifs of Koguryo (Goguryeo) tomb murals using photo resources accumulated over the years. During our study, beautiful motifs and drawings that had weathered away were restored one by one in the form of illustrations. In December 2020, such efforts led to the publication of the book Celestial Motifs: Ancient Tomb Murals of the Koguryo (Goguryeo) Dynasty. It is Korea's first collection of Koguryo (Goguryeo) mural motifs and contains more than 270 illustrations created based on resources we have collected over the years.

Created nearly 1,500 years ago by Koguryo (Goguryeo) artists, these murals are also a treasure trove of narratives, which give rise to endless flights of fancy about ancient cultures that remain a mystery due to insufficient historical records. Since these murals are brimming with mythological content and mysterious motifs, our journey to discover their symbolism and meaning has been particularly interesting.

As such, we went beyond the publication of the book and produced a three-part YouTube video series under the title of "An Online Journey to Explore Motifs of Koguryo (Goguryeo) Tomb Murals."

※ ***NRICH YouTube channel:***
https://www.youtube.com/watch?v=nYv37RFZk_Y

❹ YouTube screenshot of "An Online Journey to Explore Motifs of Koguryo (Goguryeo) Tomb Murals"

Prepare yourself. If you haven't come across Koguryo (Goguryeo) murals yet, the moment you click the watch button on the NRICH YouTube channel, you will likely fall under the spell of the mysterious charm of these artworks.

❺ Tea light candle holder with three-legged crow design

Bringing Ancient Artworks to the Modern World

At the NRICH, we have also made diverse attempts to develop cultural products with designs inspired by Koguryo (Goguryeo) murals. We tried to break the stereotype that traditional cultural heritage is inaccessible and incomprehensible to ordinary people, by creating entertaining goods that are inspired by the vast array of images found on Koguryo (Goguryeo) murals and that reflect modern needs and sensibilities. In partnership with the Traditional Culture Product Development Office at the Korea National University of Cultural Heritage (NUCH), such efforts have led to the creation of a tea light candle holder with three-legged crow design and social media postcards.

In this way, the three-legged crow, a mythical animal living on the Sun, was able to fly out of the ceiling mural of a Koguryo (Goguryeo) tomb into our world in the form of an artistic product that presents us with warm light and a pleasing scent.

On the other hand, the social media New Year postcard, which features hope-filled messages inscribed on a Koguryo (Goguryeo) tomb mural, and figures that have been converted into cartoonish characters, was designed to help bring a sense of calm to people traumatized by the COVID-19 pandemic and the strain of social distancing.

Our study on Koguryo (Goguryeo) mural motifs has thus far been about finding their original forms and meanings, but if we can add boundless imagination and narratives to them, it may help enrich Korea's cultural and artistic content moving forward. We hope that, just as Koguryo (Goguryeo) tomb murals had inspired Korea's modern industrial arts at the time of their excavations, our own design motifs inspired by those murals can be reborn through a wide array of applications, thereby paving the way for the research and development of cultural heritage.

❻ Social media New Year's card inspired by Koguryo (Goguryeo) tomb murals

Mini Essay

Conservation Science Division
SHIN Jiyoung

Korean Heritage Research Gets a New Tool for Heritage Dating as Ötzi the Iceman

High technologies that can accurately date ancient humans and archaeological materials bring new accuracy to archaeological dating

The Iceman's reconstruction
(Source: South Tyrol Museum of Archaeology / Ochsenreiter)

Scientific examination of the mummy
(Source: South Tyrol Museum of Archaeology / EURAC / Samadelli / Staschitz)

❶ NRICH's Cultural Heritage Analysis Information Center (2020)

In 1991, a German couple hiking the Alps stumbled across a frozen corpse in the Ötztal Alps along the Italy-Austria border. Initially thinking the body was that of a mountaineer who had died from an accident, the couple reported the discovery to both the Italian and Austrian police.

However, what they had actually stumbled upon was the oldest clothed mummy from the prehistoric period.

❷ Accelerator mass spectrometer

The mummy was named "Ötzi" after the site of its discovery. How did scientists find out when he died?

Researchers at the University of Oxford in the U.K. and the ETH Zurich in Switzerland performed radiocarbon dating using collagen extracted from Ötzi's bones. This revealed that Ötzi had died around 3,300 BCE.

How can radiocarbon dating determine the period of people's deaths? All living organisms absorb radiocarbon (^{14}C) through photosynthesis, the food chain, and other means. While they are alive, radiocarbon is maintained in an equilibrium state, but once they die, radiocarbon begins to decay with a half-life of 5,730 years. As such, by measuring how much radiocarbon is left in remains, researchers can estimate how long someone has been dead. Radiocarbon dating can measure the age of organic matter (e.g. bones, wood, and fibers) that are up to 50,000 years old. A method known as accelerator mass spectrometry can be used for tracing the amounts of radiocarbon isotopes.

As the first step toward establishing the infrastructure for the dating of archaeological materials, the National Research Institute of Cultural Heritage (NRICH) is planning to establish an accelerator mass spectrometer and install it on the first floor of the new Cultural Heritage Analysis Information Center in 2021. Through continued partnerships with experts from relevant academic disciplines such as conservation science, archaeology, and physics, the NRICH will seek to raise the bar in accurate dating - the basis of cultural heritage research.

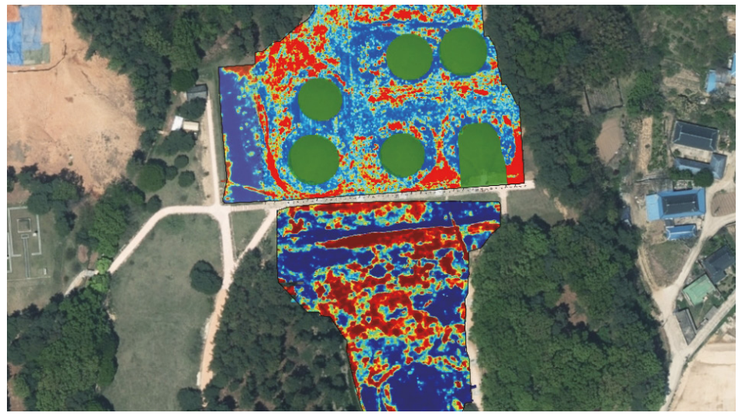
NRICH Inside

NRICH Identifies Valued Traditional Korean Gardens through Cooperation with the KNA

The Research Division of Natural Heritage has identified 24 traditional Korean-style gardens that are part of private homes in Gyeongsang-do and Jeolla-do Provinces, together with the Korea National Arboretum (KNA).

There have been studies on private homes registered as cultural heritages but almost none on gardens attached to private homes. To address this, NRICH conducted a joint project with the KNA, using its expertise on traditional landscaping and the KNA's knowledge on gardens.

The 24 private gardens were identified through two years of joint research following the 2019 agreement between the two agencies for identification, restoration to original state, and conservation of traditional Korean gardens. They include 12 gardens in Gyeongsang-do (e.g. the Choe house in Gyeongju, the Hong Gi-chang house in Naju) and 12 others in Jeolla-do. All are paragons of the beauty of traditional private Korean gardens.



GPR Archaeological Surveys Reveal Actual Appearance of Royal Tombs from the Baekje (Sabi Capital) Period

NRICH performed GPR (Ground Penetrating Radar) archeological surveys over the ancient royal tombs in Neungsan-ri, Buyeo County, Chungcheongnam-do Province, a UNESCO World Heritage Site and ROK Historic Site No. 14. Through the survey, it has confirmed the arrangement and sizes of tombs, which were created while Sabi was the capital of the kingdom of Baekje from 538 until its fall in 660 CE.

As the first phase of the long and mid-term scientific investigations of the Neungsan-ri tombs, GPR surveys were carried out over the central part of and entry to the graveyard from 2014 to 2020. The results confirm the traces of circular anomalies that surround each burial mound at some distance. It is believed that the perimeters of the tombs were much larger than the current 20m or so to which they have been restored. NRICH intends to build upon these findings and perform further surveys of the Neungsan-ri tombs to identify the features of the royal tombs from the later Baekje period and discover the ancient kingdom's system of royal tombs and graves.

Test Furnace for Research on Ancient Iron Production Techniques & Academic Seminar

The Jungwon National Research Institute of Cultural Heritage (Jungwon NRICH) completed its establishment of the Iron Production Technique Restoration Station on November 19, 2020. The new station will provide the experimentations to take place under more stable and organized environment compared to the previously-used temporary station with unfavorable conditions.

A gallery-type classroom ("Musoene Smithy"), expected to open in 2021, was also added, where children and students can learn and experience the history and process of iron production in a fun and easy way.

Also an academic seminar of the "Retrospect on and Prospect for the Half-Century of Studies into Iron-Production Ruins" was held on the day of official establishment of the station to celebrate the completion of the new building and to commemorate the past half century research into Korea's iron-production ruins. The seminar suggested the concepts and methods regarding the studies of iron-production ruins. These efforts are expected to bring together archeology, metallurgy, folklore, and other related fields to promote further research on ancient iron production.

Conservation Treatment Completed of Jagyeongnu (National Treasure) at Changgyeonggung Palace

Jagyeongnu was an advanced clepsydra system that told people the hour by varying levels of water. Made in 1434 (the 16th year of King Sejong's reign) by Jang Yeong-sil upon orders from the king, it was used to keep the standard of time in the Joseon Dynasty. It has been lost through the ages. In 1536 (the 31st year of King Jungjong's reign), it was remade, with three water bowls (pasuho), and two cylindrical water containers (susuho), surviving to this day.

These components were treated for conservation at the Cultural Heritage Conservation Science Center from June 2018 to March 2020. The treatment clearly exposed the hard-to-read inscription on the upper part of the left susuho container. The vertical inscription carved in relief at the time of manufacture includes the names and positions of 12 people involved in the manufacture of Jagyeongnu. Four of the 12 could not previously be identified due to the wearing-down of some of the characters, but this mystery has now been revealed.

This conservation treatment is significant for it successfully preserved the Jagyeongnu components and reveals the missing information about people involved in its manufacture, manufacturing techniques and more.

Southernmost Habitat thus far for Great Bustard (Natural Korean Monument) Discovered in the Mangyeonggang River

On January 17, 2020, NRICH discovered the great bustard (Otis tarda), a Korean Natural Monument, in the Mangyeonggang River in Jeollabuk-do Province. The bird was found by an expert advisor on cultural heritage during his site search and observation for other natural monument animals in the river. In response, NRICH formed a research group to immediately investigate the situation. The group spotted the great bustard onsite and photographed it.

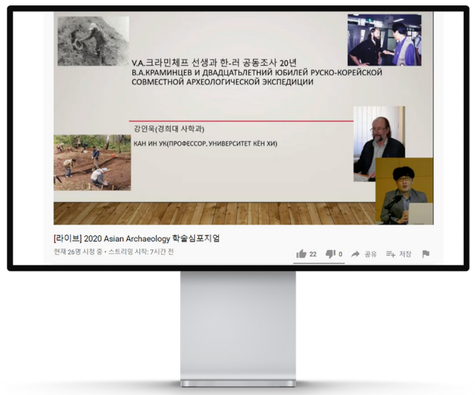
Unlike the previously known areas such as Cheorwon and Yeoju, this is the first time the bird has been found in the southern province of Jeollabuk-do. Also, this is the first time that it has been spotted in the southernmost location in the nation. This discovery was significant for it could deepen understanding of the migratory path of this rare bird.

The great bustard is a large terrestrial bird that mostly inhabits open grassland and farmland in Mongolia, China, Kazakhstan, Ukraine, and other countries. It was a common sight in Korea in the past, but since the Korean War, it has mostly disappeared for a variety of reasons, including overhunting and loss of habitat.

Showcasing the Findings from Joint Excavations involving Six Eurasian Countries

NRICH held its "2020 Asian Archeology" academic symposium at the Daejeon Convention Center on November 24, 2020.

Since 2000, the Research Division of Archaeology has been engaged in joint excavations with archaeological research institutes in Russia, Mongolia, and other nations in Central Asia. It also runs a consultative body with 16 national and public institutions, universities and corporations in Korea that are conducting joint international studies. "Asian Archeology" symposiums have been held every year since 2017 to share what research has uncovered.



The 2020 symposium featured thematic presentations on research findings related to stone-pile tombs in Eurasia, as well as joint excavations conducted at 9 sites in 6 countries during 2019, including the Balhae Fortress in Primorsky Krai, Russia; the ruins of Xiongnu City in Mongolia; and jar coffins in Vietnam.

The Ancient Tombs Site of Shiveet Khairkhan, Mongolian Altai II

This publication features the findings of joint investigations into the Shiveet Khairkhan ruins in Altai City (northeastern Mongolia), conducted over three years from 2016 by NRICH and the Institute of Archaeology under the Mongolian Academy of Sciences.

The investigations surveyed seven Pazyrik tombs and seven Xianbei-period tombs, and discovered the history of the lives led by ancient nomads. Included are DNA analyses of excavated human skeletal remains, reconstructions of diet, zooarchaeological and phylogenetic analyses of animal remains, natural scientific dating of excavated organic matter, and conservation treatments of clothing.

Download
https://portal.nrich.go.kr/kor/originalUsrView.do?menuIdx=565&info_idx=8685&bunya_cd=40

Conservation and Restoration of Khmer Stone Cultural Heritage

Technology for the conservation of stone cultural heritage, developed by NRICH, was used between 2016 and 2020 on Khmer stone cultural heritages in Cambodia (e.g. Nokor Bachey Temple, Banteay Chhmar) in need of preservation. This was the first time the conservation technology was used internationally.

This book covers the process of application and diagnosis using Korea's conservation technology, as well as the outcomes of repair and restoration conducted by the Cambodian Angkor Conservation Center, the joint research partner. This is an important step in furthering efforts for effective conservation and management of Cambodia's stone cultural heritage.

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https://portal.nrich.go.kr/kor/originalUsrView.do?menuIdx=608&info_idx=8656&bunya_cd=411

English Edition: The Rebirth of the Big Jar-coffin

Large jar coffins are a burial method unique to the Yeongsangang River basin. This book is the English edition of The Rebirth of the Big Jar-coffin, first published in 2018 in Korean, to assist an international audience with easy understanding of various research findings on the jar coffins. It introduces the characteristics and manufacturing process of jar coffins found in the area, and retells stories from the project to revive the relevant manufacturing techniques, carried out by Naju NRICH. The book also carries accounts from researchers, master craftsmen, and members of the public from a variety of fields who participated in the project.

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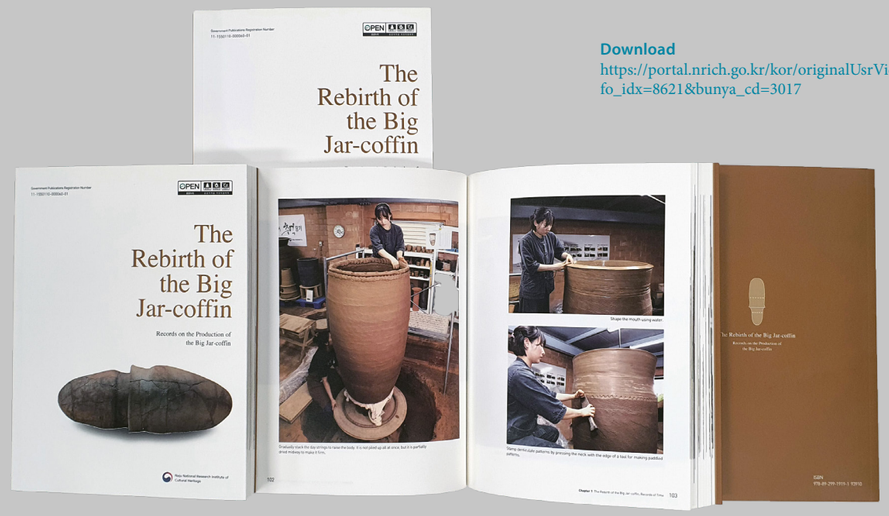


The Rebirth of the Big Jar-coffin (English edition)

Seokguram Grotto in Photos

Seokguram Grotto in Gyeongju, part of the UNESCO World Heritage List, is noted for its unique and extraordinary structure and exquisite sculptures. Regrettably, visitors cannot get an up-close look due to glass walls installed in the 1970s for preservation purposes. This new publication features donated photos and writings to give readers the chance to see the inside of the grotto, up close.

The photos are available to the public at NRICH website:
https://www.nrich.go.kr/kor/donadataDataUsrListView.do?menuIdx=1672&idx=1.

Download
https://portal.nrich.go.kr/kor/originalUsrView.do?menuIdx=502&info_idx=8573&bunya_cd=409

Detailing the Buddhist Cultural Heritage on Gyeongju's Namsan Mountain

The catalog was published to celebrate the 20th anniversary of the listing of Namsan Mountain in Gyeongju on the UNESCO World Heritage list. It mainly introduces Buddhist statues and stone pagodas of the many Buddhist cultural heritages located on the mountainscape. Also included are investigative findings of Buddhist artifacts during Japanese occupation as well as the excavation and restoration details of pagodas and statues by Gyeongju's NRICH in the 1990s and 2000s. Photos taken during Japanese occupation are printed together with those taken in 2020. This is meant to enable comparison and a clear view into the status and trend of restoration and management of the heritage site and artefacts around the mountain. Lastly, it offers summaries of surveys by NRICH in the 1980s to 1990s, those by Gyeongju NRICH in the 1990s and 2000s, and others, in addition to the process of the mountain being added to the UNESCO World Heritage list.

Download
https://portal.nrich.go.kr/kor/originalUsrView.do?menuIdx=863&info_idx=8635&bunya_cd=3014

Perimeters of Ancient Cities in East Asia and the Capital of Baekje

This book offers a comprehensive look at the studies so far on the formation and development of urban perimeters, which are particularly difficult to identify in ancient urban structures. It also deals with the characteristics and roles of urban perimeters in ancient East Asian cities. The book consists of two chapters: the first chapter covers findings on the appearance and development of urban perimeters in ancient cities at home and abroad. The second chapter presents the latest findings from excavations of Naseong city wall in Buyeo, and ways to preserve and manage World Heritage sites.

Download
https://portal.nrich.go.kr/kor/originalUsrView.do?menuIdx=864&info_idx=8660&bunya_cd=3015

The First Possible Choristoderan Trackway from the Lower Cretaceous Daegu Formation of South Korea and Its Implications on Choristoderan Locomotion

A new quadrupedal trackway was found in the Lower Cretaceous Daegu Formation (Albian) in the vicinity of Ulsan Metropolitan City, South Korea, in 2018. A total of nine manus-pes imprints show a strong heteropodous quadrupedal trackway (length ratio is 1:3.36). Both manus and pes tracks are pentadactyl with claw marks. The manus prints rotate distinctly outward while the pes prints are nearly parallel to the direction of travel. The functional axis in manus and pes imprints suggests that the trackmaker moved along the medial side during the stroke progressions (entaxonic), indicating weight support on the inner side of the limbs. There is an indication of webbing between the pedal digits. These new tracks are assigned to *Novapes ulsanensis*, n. ichnogen., n. ichnosp., which are well-matched not only with foot skeletons and body size of *Monjurosuchus* but also the fossil record of choristoderes in East Asia, thereby *N. ulsanensis* could be made by a monjurosuchid-like choristoderan and represent the frst possible choristoderan trackway from Asia. *N. ulsanensis* also suggests that semi-aquatic choristoderans were capable of walking semi-erect when moving on the ground with a similar locomotion pattern to that of crocodilians on land.

Download https://www.nature.com/articles/s41598-020-71384-1

Study of Wall Repair Records for Muwisa Temple's Geungnakbojeon Hall in Gangjin and of Construction Techniques from Different Periods

Wall Repairs in Traditional Architecture: Muwisa Temple Case Study

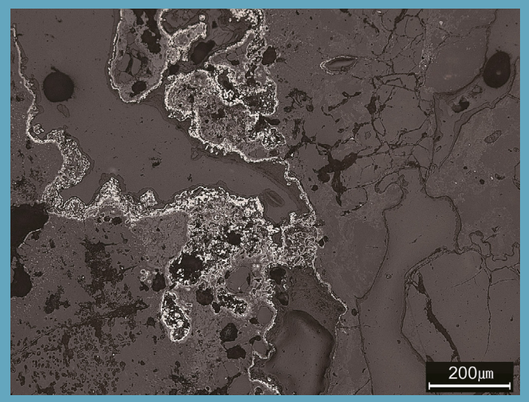
This study looks into the materials and construction techniques used in walls built according to traditional architecture through repairs conducted at Muwisa Temple's Geungnakbojeon Hall in Gangjin (National Treasure No. 13) in the 1900s. It analyzes documents and materials from the Japanese Government-General of Korea, the Cultural Heritage Administration, and other sources on disassembly and repairs done at three different times: 1935, 1956, and 1982-83. It reveals the construction technique used in the remaining wall foundation before the 1900s, where small reinforcing posts and laths were put inside the walls. Lime, terra alba, paper mulberry tree, and other materials were used in the making of plaster, none of which were used at the time of construction. The highest priority in each repair was on preserving the original form. This is still the case in present-day repairs of cultural heritage.

This study is significant because it examines previously-unknown administrative documents about the hall from the Japanese occupation period. It identifies the materials and construction techniques used in the walls as they changed through the different periods.

Download https://doi.org/10.22755/kjchs.2020.53.2.140

Characteristics of Early Iron-Production Techniques in Chungju, Iron Making in Ancient Korea

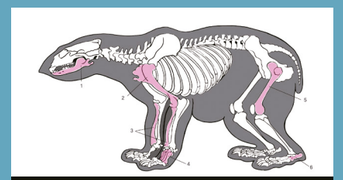
This study organizes and analyzes early iron-production techniques developed in Chungju, the center of iron production in ancient Korea. Direct smelting produced impure iron from iron ore and was the main technique in Chungju in ancient times. This is backed up by tap slag found in large quantities at many ruin sites. Furnace structure and tuyeres were analyzed along with smithing techniques confirmed in the iron production ruins. This has produced an interpretation of overall iron production techniques.



Download https://www.scientific.net/MSF.983.31

Use and Disposal of Bear Bones Excavated in the Wolseong Moat

A diverse variety of animal bones has been found in the moat at the Wolseong palace ruins in Gyeongju. Bear bones have been excavated in larger numbers than at other ruins. Thirteen bones have been confirmed so far, from at least three bears. Their existence in the moat is believed to have been for the making of flags for Silla armies. Historical records show the use of bearskin for this purpose and the parts found match the records. There are also workshop ruins near the palace site. The bones show traces of their skeletons having been dismantled, which suggests the dismantling and usage took place near the ruins.



Download http://www.jungang.re.kr/data/dataroom/antiq/2020/03_154.pdf

Transition of Silla Royal Tombs and Maripgan Tombs

Excavations of Silla royal tombs have produced no tombstones or other decisive information on who was buried there. This study attempts a new interpretation in consideration of the size of burial mounds, their locations, quantity, and quality of grave goods, etc. For instance, it reveals that the diameter of royal tombs shrank greatly from 70 meters in the 5th century to 50 meters, as in the tomb of Maripgan (the title borne by Silla kings) Ji-jeung. This confirms a gradual change in the royal tombs and tomb system through the middle Silla period. Based on these findings, it assumes the existence and locations of major Maripgan tombs among the old tombs across the Daereungwon Tomb Complex in Gyeongju.

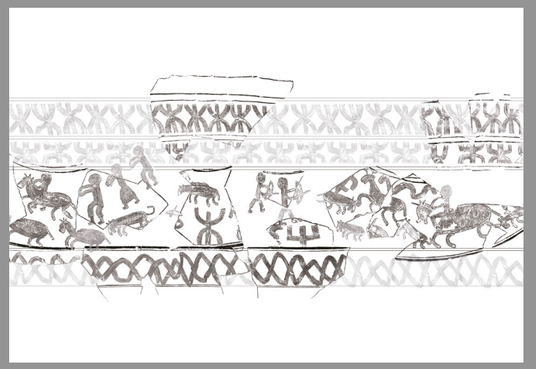
Download http://dx.doi.org/10.47439/JKRAS.2020.116.123

Three Kingdoms-period (Baekje) Tomb in Songje-ri, Naju

This is an important archeological discovery in understanding the situation of the Yeongsangang River area during the Three Kingdoms period. The floor of the stone chamber yielded numerous metal artifacts, including silver crown ornaments. This suggests that the owner of the tomb in Songje-ri must have had close relations to Baekje royalty.

Three Kingdoms-period (Silla) Jjoksaem Stone Mound Outer Coffin Tomb No. 44, Gyeongju

A line-engraved, long-necked jar was discovered outside a northern stone burial marker to the tomb. It had been damaged before unearthing. The jar seems to have been a vessel used for rites. It is decorated with a procession illustration, including scenes of dancing and hunting. This displays similarities to Koguryo (Goguryeo) tomb murals, providing many clues for studies of Silla's external relations.



국립문화재연구소
National Research Institute of Cultural Heritage