
2017-2018 Research Plan for the IRAW@Bagan Settlement Archaeology Project

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Mission Statement

The world’s tropical zones are witnessing the negative impacts of unchecked population growth, increasing wealth disparities, unbridled agricultural expansion, growing water demands, diminishing biodiversity, environmental degradation, escalating disease rates, and climate change. These are all urban issues. The proposed IRAW@Bagan study will highlight archaeology’s true strength – namely the ability to trace changes in urban forms and lifeways over time, and across multiple climate regimes, technological advances, and socio-ecological changes – to explore the root causes of the myriad issues faced by contemporary tropical metropolises.

The IRAW@Bagan Logo

The IRAW@Bagan logo on the cover of this proposal is derived from Jataka plaque #543 from the West Hpetleik Stupa: Sāma Jātaka (Sāma the Devoted Son). In the traditional Pali canon this story is listed as #540 of 547, but at Bagan three additional stories are often included as #s 497, 498, and 499 (for a total of 550), which pushes this story to #543.

A summary of the story can be found here:
http://usamyanmar.net/Buddha/Article/Sama%20jataka.pdf
Project Summary

The IRAW@Bagan project (Phase I) will generate an integrated socio-ecological history for residential patterning, agricultural practices, and water management at the Medieval Burmese (Bama) capital of Bagan, Myanmar (11th to 14th century CE) across a range of significant ecological, climatic, economic, socio-political, and religious changes. This objective will be achieved through a settlement archaeology study within the peri-urban (mixed urban-rural) settlement zone immediately surrounding Bagan’s regal-ritual epicenter, which is still clearly defined by remnants of its original walls and moat. The importance of the proposed program of survey, excavations, and geo-spatial inquiry is grounded in the fact that our current understanding of Bagan society continues to be biased towards its upper echelons, namely its high-ranking nobles and religious functionaries. A settlement archaeology study within Bagan’s peri-urban zone will: 1) generate a more nuanced understanding of Bagan as a dynamic capital city; 2) provide insights into the unique characteristics of early urbanism in the tropics; and, 3) contribute to considerations of resilience and vulnerability in contemporary tropical metropolises.

One of history’s great Buddhist kingdoms, Bagan’s peri-urban settlement zone covers roughly 80 km² and encompasses over 2800 Buddhist monuments, including temples with decorated interior space, solid stupas containing relics, and monasteries. Given the context, it is understandable that scholarly investigations at Bagan have almost exclusively focused on elite and/or religious architecture, art work, and texts. Nevertheless, inscriptions and retrospective chronicles suggest that Bagan’s peri-urban zone was also home to a large and diverse support population that lived in well-organized (i.e., orthogonally planned) “clusters” or “wards” based on commonalities in status, ethnicity, occupation, and clientage (i.e., formal “bondage” to a patron, such as the Crown or Church). Unfortunately, the veracity of this tightly integrated and highly organized, “cellular” residential pattern has yet to be confirmed on-the-ground. Recent archaeological investigations have also suggested that Bagan’s peri-urban zone was of the “dispersed,” agrarian variety, and included significant green space as well as productive land, in addition to a small-scale, but nonetheless sophisticated water management system. Once again, these suppositions require empirical confirmation. Taking these issues into consideration, the following questions will serve to frame both the methodological approach for the IRAW@Bagan settlement archaeology study, and the integrated socio-ecological history that will result from this long-term research program.

1) How accurate is our current understanding of the commoner population that inhabited Bagan’s peri-urban settlement zone, given the elite-centric focus of our current data sets?
2) Can the posited heterogeneity and cellularity of Bagan’s peri-urban population be materially confirmed, given the diversity in status, ethnicity, occupation, and bondage suggested by the historic records?
3) If such diversity can be recognized archaeologically, what might this tell us about commoner agency, and shifting levels of adherence or resistance to the dominant, merit-based, Buddhist ideology, and the system of bondage that supported it?
4) Did different segments of Bagan’s peri-urban population exhibit varying degrees of resilience to changing socio-ecological circumstances – such as climate change – and if so, why?
5) How were individual Bagan houses, house-lots, and villages configured, what kinds of activities took place in these residential spaces, and did the nature of these spaces change over time?

6) Does the residential patterning in Bagan’s peri-urban zone reflect the orthogonal/compact tradition of China, or the quasi-orthogonal/dispersed tradition found elsewhere in the tropics?

7) Did Bagan’s city-scape transition from being more dispersed and haphazard to more compact and grid-like over time?

8) How extensive and interconnected were Bagan’s peri-urban water management and agricultural systems, how did they develop, and in what ways did different stakeholders engage with them?
December 2017: Ethnoarchaeology Study

In December 2017, the IRAW@Bagan team will conduct ethnoarchaeology studies in ten traditional villages located in the vicinity of Old Bagan, some of which lay inside of what was once the ancient city’s peri-urban settlement zone, others located in more rural settings. The general goal of the ethnoarchaeology study is to explore the material correlates of domestic lifeways specific to Myanmar’s “dry-zone”. This information will enhance our ability to both recognize and interpret the archaeological residues of ancient settlement patterning in Bagan’s peri-urban zone. The project will include site visitations, written and photographic record taking, and strategic questioning of residents concerning any relevant temporal changes in residential practices. Ethics Board approval for the interviews will be obtained through Trent University.

The specific goals of the ethnoarchaeology project will be to:

- Assess the ground plans of villages, house-lots, and individual dwellings and out-buildings;
- Determine the types of activities carried out in these nested spaces, with particular attention to their material residues;
- Examine construction methods and materials;
- Explore the economic, engineering, and socio-spiritual relationships between village residents and their domestic water sources; and
- Investigate traditional agricultural practices, including activities relating to both cultivation and surplus storage.

The villages to be visited as part of this study include the following: 1) Minnanthu; 2) East Pwa Saw; 3) West Pwa Saw; 4) Thuhtaykan; 5) Kon-Tan-Gyi; 6) Kon-Sin-Kye; 7) Hypauk-Seik-Pin; 8) Zee O; 9) Shwe Hlaing; and, 10) Thae Pyin Taw. The research schedule is as follows:

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**Equipment to be brought into Myanmar includes:** 1 lap top and 2 tablet computers.
May 2018: Nat Yekan Sacred Water Tank Study

*Water, Ritual, and Prosperity at the Medieval Capital of Bagan, Myanmar (11th to 14th Century CE): Exploration of the Tuyin “Water Mountain” and the Nat Yekan Sacred Water Tank*

**Project Summary:** The IRAW@Bagan project is aimed at developing an integrated socio-ecological history for residential patterning, agricultural practices, and water management at the Medieval Burmese (Bama) capital of Bagan, Myanmar (11th to 14th century CE). As part of this long-term research program investigations have been initiated on Mount Tuyin, located 11.25 km southeast of Bagan’s walled and moated epicenter. This upland area figures prominently in the chronicles of early Bagan, given that it was one of five places around the city that a royal white elephant carrying a Buddhist tooth-relic kneeled down, prompting King Anawrahta (1044-1077 CE) to build a pagoda (i.e., temple) there. Numerous 13th century religious monuments were subsequently built on the summit of the mountain. Recent explorations on Mount Tuyin have drawn attention to an additional feature of historical significance, a rock-cut tank located along the eastern edge of the Thetso-Taung ridge. Referred to by local villagers as Nat Yekan (Spirit Lake), this reservoir appears to have been integral not only to the initial collection and subsequent redistribution of water across the Bagan plain via a series of interconnected canals and reservoirs, but also, through its associated iconographic imagery, it may have been intended to symbolically purify this water, enhancing its fertility prior to its flowing into the city’s peri-urban zone. The proposed investigations will employ hydrological modelling, excavations, and both iconographic and epigraphic analysis to build a multilayered understanding of Nat Yekan’s economic, political, religious, and ideological significance during Bagan’s classical era.

**Project Description:** Bagan, like most of the historic Buddhist capitals of Myanmar, was located in the central “dry zone” (Aung-Thwin 1987:88, 1990:1; Aung-Thwin and Aung-Thwin 2012:38; Hudson 2004, 2008:553; Stadner 2013:12; Strachan 1989:8; Stargardt 1968), Myanmar’s “most arid” region (Cooler 1997:19-20). As the only significant upland area on the Bagan plain, Mount Tuyin is believed to have played a significant role in water management strategies at the ancient city (Moore et al, 2016; Win Kyaing 2016), especially with respect to the flow of runoff downslope, from the western side of the Mount Tuyin summit, towards the expansive Mya Kan Reservoir (aka Emerald Lake or Kyanzittha Reservior; Aung-Thwin 1990:28; Luce 1969:56). Located atop Mount Tuyin, Nat Yekan (Spirit Lake) was likely a key collection node within this broader water management system. This rectangular tank is 26.5 m x 14 m in size, 7.3 m deep, and could have held as much as 2660 m³ of water (Ni Tut 2013:161). Nat Yekan was largely hewn from the sandstone substrate, although on its east side an 11-m long, 5 m high sandstone slab retaining wall was used to close off the reservoir (Ni Tut 2013; see also Moore et al. 2016:295). A smaller (2.7-m long) section of retaining wall was also used to close off the eastern corner of the north wall. A round hole, ca 20 cm in diameter, is carved into the very center of the tank, possibly having served to hold a pillar to measure water depth.

Four flights of carved stairs lead down into the Nat Yekan tank. These are reminiscent of the intricate stairway systems associated with the stepwells (*baoli*) of Medieval India (Bhattacharya 2015:36; Shubhangi and Shireesh 2015). As with the Indian stepwells, which “were often carved profusely with elaborate detail” (Bhattacharya 2015:36), a number of iconographic images are
incised into Nat Yekan’s walls, including a water maze, the tail of a crocodile, a Naga-serpent, three hamsa birds (geese), a crocodile or Makara (water monster), an egret, tortoise, two small fish, and a Naga-Buddha image (referencing the time when the Naga King used his hood to protect the meditating Buddha from a rain storm; Fisher 1993:23, 175; Leidy 2008:170; Luce 1969:171; Moore 2007:244; Stadner 2013:34). Water imagery is clearly evident in all of these depictions, and many are also tied to notions of purity, fertility, and power within the Buddhist belief system (e.g., Beer 2003:5, 69, 72, 77, 97; Fisher 1993:23).

Also noteworthy is that the natural sandstone rim in the northwest corner of the tank has been purposely cut down by roughly 1-2 m, in a clearly symmetrically manner. The very center of this lower portion of the tank rim – which is roughly 8 m in length – articulates precisely with the top of the carved Naga-Buddha image. The northwest stair also begins its descent into the tank at exactly the same elevation, confirming that this lower wall level was once an exposed “living” surface. Above this lower section of the tank rim is an inward sloping, 3-4 m high wall containing myriad sandstone boulders (>25.6 cm in length) configured in a series of terraces. This artificial retaining wall appears to have been used to close off the northwest corner of the reservoir at the same level as the higher rock-cut and stacked sandstone slab walls enclosing the rest of the tank. To the north of this artificial retaining wall the hillside gradually descends to the western foot of Mount Tuyin, and the area of the Mya Kan reservoir.

Nat Yekan clearly offers some tantalizing evidence for ancient water management practices, but there are many questions that remain to be answered concerning its broader significance to the Bagan community:

1) How did water enter the Nat Yekan tank?
2) How much water could the tank hold?
3) Could the tank hold water year-round?
4) Would climate changes have impacted the tank’s water storage capabilities?
5) Was Nat Yekan physically connected to a broader water management system?
6) When was the tank constructed, and what was its original form?
7) How was water withdrawn from the tank?
8) Did the lower section of sandstone rim in the northwest corner of the tank initially serve as a spill-way, and did it direct water into the Mya Kan catchment?
9) If a spillway did exist in the northwest corner, how regularly did the tank discharge water?
10) When, and why, was the artificial retaining wall/dam in the northwest corner of the tank constructed?
11) If a spillway originally existed in the northwest corner of the tank, does its surface contain additional iconography?
12) Where the multiple stairs found within Nat Yekan modelled on those of Indian stepwells, and if so, what is the significance of this emulation?
13) Does the assemblage of iconographic elements and available inscriptions support the idea that Nat Yekan was a “sacred water tank” that served to sanctify water, thereby increasing its powers of fertility?
14) Do further iconographic features exist within the tank, and are there any other inscriptions of relevance to our understanding of this water management feature?
**Goals and Objectives:** The Net Yekan investigations will enhance our understanding of water management at Bagan, in addition to providing information on the efficacy of traditional rainwater harvesting systems, a topic which has recently drawn considerable attention in India (Bhattacharya 2015:31). Our research will also allow us to explore the broader significance of Nat Yekan, both within the classical Bagan cityscape, and with respect to the wider Southeast Asian cultural sphere. We hypothesize that Nat Yekan’s was a “sacred water tank” from which water flowed downslope, into an extensive water management system that serviced Bagan’s agricultural field system and peri-urban settlement zone. We also posit that Nat Yekan’s iconographic elements served a similar purpose as the Shaivite imagery found in association with the intricately carved river beds along the Stung Kbal Spean River in the Kulen Hills, northeast of the Khmer city of Angkor (Boulbet 1979; Chevance, 2005; Feneley et al. 2016:282-284; Hendrickson 2011:451; Jacques and Dumont 1999; Tan 2014:3; Tawa 2001:134). Across Southeast Asia, such iconographic imagery has long been employed to reaffirm the ideological connection between water and ritual (Boomgaard 2007:6). As has been underscored by Barbara Andaya (2016:243): “For Southeast Asian societies generally, ritual water was highly valued because of its life-giving, healing, and transformative properties. Together with the appropriate ceremonial, the very act of pouring water over a tangible emblem of fertility (like an upright linga) could ensure the community’s well-being.” If the sacred nature of Nat Yekan can be verified, it would also imply that Mount Tuyin was a “water mountain” (Scarborough’s 1998), a specialized ritual and economic node that enhanced agricultural production through the collection, sanctification, and redistribution of water, under the auspices and patronage of societal elites (Scarborough 2003:84).

**Methodology:** The following methods will be employed to address the 14 research questions outlined earlier in this proposal:

**Hydrological Analysis – Questions 1-5** (Macrae and two graduate students): This sub-project will involve a GIS-based hydrological study of Nat Yekan and surrounding area, including the Mya Kan Reservoir. The analysis will be based on hydrological modeling programs (Arc Hydro [see Maidment 2002]) within a geographical information system (ArcGIS [ESRI 2016]). The foundation of this innovative analysis will be a high resolution digital elevation model (DEM) derived from existing remote sensing datasets (i.e., recent aerial photographs and prior mapping initiatives) and traditional total station and GPS survey data collection. The hydrological analysis will include the direction of flow, flow accumulation, and watershed delineation (see Macrae 2017:214-225; Macrae and Iannone 2016:374-388). The identification of these hydrological characteristics across the landscape will allow for an advanced, geo-spatially informed understanding of both naturally occurring features – such as slope, streams, and seasonal ponds – as well as cultural features, such as reservoirs, canals, trenches, and moats.

**Excavation and Artifact Analysis – Questions 6-10** (Iannone and four graduate students): This sub-project will involve high precision photogrammetric mapping of the Net Yekan tank, excavation of the artificial retaining wall in the northwest corner of the tank, and exposure of the possible “spillway” posited to lay beneath it. High resolution 3D mapping of the Nat Yekan tank will be carried out using georeferenced ground control points, a handheld digital SLR camera, and state-of-the-art “Structure from Motion” (SfM) photogrammetric software that will stitch
together a series of photo images into a 3D point cloud (Agisoft LLC 2017a, 2017b; Green et al. 2014:173; Koenig et al. (2017)). A 2 x 4 m excavation unit will then be used to remove a portion of the artificial retaining wall in the northwest corner of tank, down to the level of the proposed spillway. This excavation unit will be axially aligned with the exact center of the proposed spillway, and the Naga-Buddha image located just below it. Structure from Motion (SfM) techniques will again be used to precisely record all excavation contexts, on-floor artifact distributions, features, and both plans and sections, allowing for the production of high resolution orthophotos, digital elevation models, accurate 3D and 2D maps, precise post-excavation measurements, and geospatial analysis in ArcGIS (Benavides López et al. 2016; Green et al. 2014; Koenig et al. 2017; Quatermaine et al. 2014). All context information will be entered into a Microsoft Access database. Samples for radiometric and/or luminescence dating will be collected to augment chronological assessments based on ceramic seriation. All artifacts will be processed, recorded, and preliminarily analyzed in the field laboratory over the course of the field season.

**Art Historical and Epigraphic Analysis – Questions 11-14** (Pyiet Phyo Kyaw and one graduate student): This sub-project will collect and analyze relevant inscriptions and chronicle references to Nat Yekan, in addition to examining all the iconography associated with the tank itself. This will include any iconography associated with the proposed spillway and any newly documented images located inside the tank. The iconographic study will employ applicable inscriptions, chronicles (e.g., Pe Muang Tin and Luce 1923), and handbooks focusing on Buddhist symbols (Beer et al. 2003; Fisher 1993; Leidy 2008) to determine the possible significance of individual images and/or clusters of images. These investigations will also consider the history of all religious edifices and institutions located on Mount Tuyin, and those associated with the Mya Kan reservoir, in order to better contextualize Nat Yekan’s use-life.

**Results:** This project will result in a detailed understanding of the construction history, hydrological characteristics, socio-political significance, and ritual-ideological meaning of the Nat Yekan tank. The resulting data-sets – especially the high precision hydrological and SfM photogrammetric data – will allow for ongoing GIS analysis of a highly sophisticated quality. It is expected that the dissemination of the results will focus on both culture history and methods, and involve:

1) Four major conference presentations;
2) Four journal publications;
3) Four theses and/or PhD dissertations.

**Capacity Building:** Having recently returned to democratic governance (2015), Myanmar has begun to actively seek out research collaborations with international scholars. From an archaeological perspective, the stated goal of such collaborations is to expose Myanmar scholars and students to current theories and methods. Sensitive to these needs, the proposed research program will involve students from both North America and Myanmar in field-based research based on cutting edge theory and methods, including training in the use of GIS-based hydrological analysis and SfM photogrammetry.

**Future Plans:** A single field season of excavations and hydrological analysis is planned for Nat Yekan. If a spillway with iconography and/or epigraphic evidence is indeed found in the
northwest corner of the tank, a second season of funding may be sought in order to fully expose this feature.

**Works Cited**

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Maidment, David R.  

Moore, Elizabeth  

Moore, Elizabeth, U San Win, and Pyiet Phyo Kyaw  

Ni Tut (translated by Nyien Chan Soe)  

Pe Muang Tin and Gordon H. Luce  

Quatermaine, Jamie, Brandon R. Olson, and Anne E. Killebrew  

Scarborough, Vernon L.  


Shubhangi, K., and D. Shireesh  

Stadtner, Donald M.  
Stargardt, Janice  

Strachan, Paul  

Tan, Noel Hidalgo  

Tawa, Michael  

Win Kyaing (U)  

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Equipment to be brought into Myanmar includes: GIS equipment provided by Trent University (i.e., total station, GPS receivers, and laptops).