Expanding space and time at Igbo-Ukwu: insights from recent fieldwork

Kingsley Chinedu Daraojimba[1,2], Abidemi Babatunde Babalola[2,3,4], Marcus Brittain[2,5], Elizabeth Adeyemo[6], Louis Champion[7], Pamela Jane Smith Shaw[2], Federica Sulas[2]

[1] Department of Archaeology and Tourism, University of Nigeria, Nsukka, Nigeria
[2] McDonald Institute for Archaeological Research, University of Cambridge, UK
[3] Centre of African Studies, University of Cambridge, UK
[4] The British Museum, UK
[5] Cambridge Archaeological Unit, University of Cambridge, UK
[6] Department of Anthropology, University of Notre Dame, USA
[7] Department of Genetics and Evolution, University of Geneva

Corresponding author: kingsleyjohnbosco@yahoo.com

Abstract
We present results of fieldwork conducted in Igbo-Ukwu in 2019 and 2021 aimed at expanding the temporal and spatial record of the ancient settlement. Local participation and public engagement are central to the project, which has yielded a new dataset that enhances our understanding of the archaeological and landscape context of Thurstan Shaw's pioneer investigations. Extending southward by 2 km from the sites of Igbo Richard, Igbo Isaiah and Igbo Jonah, a large ceramic assemblage of Igbo-Ukwu ware was recovered in four of our five areas of investigation. In the two areas discussed in this article, substantial quantities of cultural materials came from stratified contexts. From these, three radiocarbon dates fall between the end of the 9th and the second half of the 13th centuries CE. This paper introduces various pilot studies conducted on samples recovered and collected from the recent excavations. Soil analyses (pH and particle size distribution) indicate the presence of mostly acidic soils and differential preservation potential. Multi-method analysis of pottery from excavated trenches, including multivariate analysis and elemental (pXRF) measurements, recorded similar fabrics but with varying colour and chemical composition. Archaeobotanical analysis on samples from the new excavations reveals the presence of wood charcoal and, for the first time, remains of *Vitex* sp. and the palm oil tree associated with Igbo-Ukwu cultural deposits. This project has garnered new data on material culture, spatial distribution, subsistence and environment. Thus, the research has demonstrated that a multi-scaler approach that combines various recovery and analytic methods may provide valuable insights on aspects of Igbo-Ukwu's past.

Résumé
Nous présentons les résultats de nouveaux travaux de terrain menés à Igbo-Ukwu en 2019 et 2021 dans le but d'élargir les données temporelles et spatiales pour le site. La participation locale et l'engagement public sont au cœur du projet, qui a donné lieu à un nouvel ensemble de données qui améliore notre compréhension du paysage et du contexte archéologique des enquêtes pionnières de Thurstan Shaw. S'étendant vers le sud sur 2 km à partir des sites d'Igbo Richard, d'Igbo Isaiah et d'Igbo Jonah, un important ensemble de céramiques d'Igbo-Ukwu a été retrouvé dans quatre de nos cinq zones d'investigation. Dans les deux zones discutées dans cet article, une quantité significative de matériaux culturels provenaient de contextes stratifiés. Parmi ceux-ci, trois dates radiocarbone se situent entre la fin du 9ème et la seconde moitié du 13ème siècle de notre ère. Cet article présente diverses études préliminaires menées sur des échantillons découverts et collectés lors des fouilles récentes. Les analyses de pH et de distribution granulométrique indiquent la présence de sols majoritairement acides et un potentiel de préservation différentiel. L'analyse multi-méthodes de la poterie, y compris

l'analyse multivariée et les mesures élémentaires (pXRF), a enregistré des matériaux similaires mais de couleur et de composition chimique différentes. L'analyse archéobotanique d'échantillons provenant des nouvelles fouilles révèle la présence de charbon de bois et, pour la première fois, des restes de *Vitex* sp. et le palmier à huile associé aux gisements culturels d'Igbo-Ukwu. Ce projet a recueilli de nouvelles données sur la culture matérielle, la distribution spatiale, la subsistance et l'environnement. Ainsi, la recherche a démontré qu'une approche multi-échelle qui combine diverses méthodes de récupération et d'analyse peut fournir des informations précieuses sur les aspects du passé d'Igbo-Ukwu.

Keywords: Ceramic; Igbo-Ukwu; Stratigraphic excavation; Southeast Nigeria

Introduction

The fieldwork described here is the first to be conducted at Igbo-Ukwu since Thurstan Shaw's pioneering excavations in the 1960s (Shaw, 1970; 1977). Though additional fieldwork was anticipated to build on his foundational analysis, this was curtailed by the Nigerian Civil War. As testified by the papers within this special issue, investment into the scientific study of material culture excavated from Igbo-Ukwu continues to enlighten understanding of West African histories in a global context. The fieldwork described in this paper represents an initial phase of research designed to expand our understanding of the spatial extent and subsurface deposits at Igbo-Ukwu beyond the Anozie family compound where Shaw excavated (see McIntosh, this issue, for an overview of previous research and discoveries at Igbo-Ukwu). Analyses undertaken thus far provide preliminary data on archaeobotany, soil chemistry and material culture, especially pottery and ironwork. We also provide new insights into chronology, site occupation and use.

Our research program in 2019 and 2021 had an explicitly exploratory component. The excavation of three 1x1m test pits in 2019 and 48 shovel tests in 2021 provided information on the location and nature of subsurface deposits in previously unexplored areas of Igbo-Ukwu. Using this information, we identified five promising areas for placement of additional test excavation units in 2021.

Project origin

First steps towards a new project in Igbo-Ukwu were conceived in 2014 during a memorial in honour of Thurstan Shaw at the McDonald Institute for Archaeological Research in Cambridge, organised by Smith Shaw and attended by the Traditional Ruler, HRH, Igwe, Dr. Martin N. Ezeh, IDU II of Igbo-Ukwu. The IDU bestowed Pamela Jane Smith Shaw with the title of Eze Nwanyi (Queen) granting her the right to begin new work in Igbo-Ukwu. The following year Smith Shaw and Marcus Brittain visited Igbo-Ukwu to negotiate with community leaders and potential partner institutions. Smith Shaw ran archaeological workshops designed for clan-based delegations in Cambridge in 2015, 2016 and 2019. Fieldwork and classroom training, all with members of the local community, began in Igbo-Ukwu in 2019, coordinated by Smith Shaw and Kingsley Daraojimba (Daraojimba, 2019; 2021) and followed, in 2021, by in-field and museum workshops and a photo exhibit with

Abidemi Babalola. The project now enables a growing team of Nigerian specialists to develop their expertise; this work is designed to enrich community involvement and to feed back into the development of sustainable local infrastructures.

Geographical context

Igbo-Ukwu lies on a cuesta of Nanka sands belonging to the Ameki Formation where ridges and gullies of sandstones and ironstones give texture to an uneven, gentle topography (Nfor et el. 2007) (Fig. 1a). The geology is rich in iron minerals but too porous to retain rainwater, over 50 per cent of which is lost to infiltration. Aquifers are very deep (today *c*. 300 m), and groundwater is generally scarce, but some springs feed perennial streams along the eastern slopes of the upland and discharge into the floodplain of the Aghomili River in the east (Ogbukagu 1984). The three sites investigated by Shaw – Igbo Isaiah, Igbo Jonah and Igbo Richard – are situated on a high elevation of the escarpment at about 366 m above sea level and tower over the surrounding landscape overlooking the floodplain of the Obizi River to the west. Considerable and unplanned urban expansion has transformed Igbo-Ukwu and adjoining towns into a sprawling urban landscape. Farmland and residential compounds nevertheless continue to present opportunities for methodological investigation.

Insert Fig. 1:

The 2019 and 2021 Fieldwork

Overview

The 2019 fieldwork was a small-scale training excavation of three 1 x 1 m test units designated TP1-3 (Fig. 2). TP1 was located on the present-day boundary of Igbo-Ukwu and the town of Ora-Eri, 60 m northwest of Shaw's excavations; TP2 was 12 m south of Shaw's Igbo Isaiah investigation, and approximately 540 m south from this was the location of TP3. The location of TP3 was randomly selected to test areas outside the Anozie compound. A sizeable pottery assemblage came from each unit along with occasional items of iron and chalk across deposit sequences that reached sterile levels at depths within 0.8-1.2 m (Table 1).

During January 2021, five study areas (Areas 1-5) that covered a range of 3.3 linear km from north to south were chosen for more expansive investigation. Each of these areas was located within an elevation of 360-320 m above sea level (Fig. 1b). Area 1, which encompasses Shaw's original excavation areas, expanded the investigation around TP1 within farmland belonging to the Anozie family, and includes TP2. Area 2 incorporates TP3, though investigation was centred on the palace compound of the late HRH, Igwe, Dr. Martin N. Ezeh, IDU II of Igbo-Ukwu. In accordance with the practice established by Shaw, the area of the compound is identified as Igbo IDU II. Availability of access to properties governed the locations of Areas 3-5.

Insert Fig. 2:

Survey work in 2021 was initiated in Study Areas 1-4 by establishing shovel-test units (0.25 x 0.25 m or 0.25 x 0.5 m), to depths of up to 1 m. The shovel test aimed at detecting and mapping the spatial distribution of cultural deposits as well as recording stratigraphic relations between different areas. These results are summarised in Table 2.

Shovel-test and excavation units were established and recorded in spit levels, normally of 10 cm thickness. In some instances, excavation proceeded according to natural layer based on changes in soil colour and material concentration. All excavated deposits were sieve-screened through a 3 mm aperture. Cultural materials were recorded by their level of recovery. Shaw (1970, 53 and 56) noted the challenges posed by the Igbo-Ukwu soils in the task of observing and interpreting stratification, and a similar experience was met during the recent fieldwork. A deposit sequence has subsequently been determined within each of the excavated units by their section profiles and it is anticipated that the results from geoarchaeological sampling will help towards a clearer understanding of the processes by which some of these may have formed.

The 2021 shovel test units

Forty-eight exploratory shovel test units were opened comprising 14, 11, 16 and 7 test units in Areas 1, 2, 3 and 4, respectively (Table 2). Based on the extent of the site to be investigated and time constraints, a decision to carry out shovel testing supported by augering across the study areas was reached. This procedure was intended to provide insight regarding the artefact distribution across the areas. Augering from the base of the units determined the overall thickness of the deposits being investigated. Results from the shovel tests indicate that not all the units produced cultural materials; some units were sterile. This guided our choice of where to situate the excavation units.

The following discussion presents the results from excavation units in Areas 1 and 2. The material assemblages from the units that are described below are summarised in Fig. 3 and Table 1.

Insert Fig. 3:

Insert Table 1:

The 2021 excavation units

Our 2021 excavations were, in part, guided by results from our test units in 2019. Shovel testing in 2021 also allowed us to select viable location for excavation. The new excavations were targeted at exploring new areas outside Shaw's original excavations with the aim of contributing to defining the chronostratigraphic sequence of material culture and unravelling new ecological data for the area. Five excavation units ranging in size from 1 to 2 m^2 were established in Areas 1 and 2. The units were labelled BOCCU, ANE, CEC, EKO, NCCE, and ECR being the initials of the volunteers who are descendants of the original landowners. The excavation units have been re-assigned to individual designators by a combination of 'IU', area number, and unit number, i.e., IU-1.1; IU-1.2; IU 1.3; IU 1.4; IU- 2.1; and IU- 5.1 respectively. No excavation units were opened in Areas 3 and 4. In Area 5, unit IU-5.1 (2 x 1 m) was a shallow featureless excavation; from this came three ceramic vessels, probably of late historical origin and which are not included in the following discussion.

Area 1. *Excavation units IU-1.1 – IU-1.4*

Towards the centre of the shovel-test distribution in Area 1, two 2 x 2 m excavation units (IU-1.3 and IU-1.4) were opened to a depth of 0.7 m and 0.8 m respectively, revealing only a

ploughsoil over a featureless horizon of lateritic sandy loam, disturbed by rooting and animal burrows. These produced only a small quantity of cultural material, mostly pottery (Table 1), consistent with the findings from the shovel testing in central Area 1.

Excavation units IU-1.1 and IU-1.2 were opened towards the north and south ranges of the shovel-test distribution. IU-1.1 was expanded from 1.0 x 1.0 m to 2.0 x 1.4 m and subsequently overlay one half of TP1 from the 2019 season (Fig. 4). From a depth of 0.7 m, the unit size was reduced to 1.4 x 1 m. A sizeable pottery assemblage was collected across all levels, including the modern ploughsoil (contexts [12] and [13]), substantially decreasing in frequency at a depth of *c*. 1.15 m (a homogenous layer of lateritic sandy loam: context [23]). All layers within IU-1.1 are described as compact 'dusky red' sandy clay riddled throughout by small roots. Layers were defined by artefact densities and their tip lines, with occasional lenses of charcoal and fine reddish sand. In the east and south sections, the unit was cut by a pit approximately 1.05 m deep with a rounded base, with its uppermost and southern portion partially truncated by a later, more irregular feature containing pottery displaced from the main pit. This feature was associated with the growth and attempted removal of a tree stump by intruders who visited the site in our absence at the close of work for the day. The pit was filled by four distinct deposits: [16]-[19]. Many small pot sherds (<2 cm in diameter) came from context [16] contributing about 42 per cent to the pottery assemblage. At the interface of context [16] and [17] were two distinct clusters of small to medium sized potsherds. Cluster 1 was encountered at a depth of 0.3 m with Cluster 2 slightly to the west of the first but *c*. 10 cm deeper (Fig. 5). A sample of wood charcoal from this deposit returned a radiocarbon date of 978-1151 cal. CE (2 sigma, Beta 587210). A complete outline of the edges of the pit was difficult to define either in plan or in section. Mostly large sherds were encountered within context [18] broadly arranged in an arc that may define the pit edge (Fig. 4), and a diameter within 1.5-2.0 m may be estimated. Also found within context [18] was a lump of white chalk. Not occurring locally to Igbo-Ukwu, the use of chalk (*nzu*) in various invocation ceremonies and in shrines is widely documented (e.g. Shaw 1970, 67; https://re-entanglements.net/chalk/). Though contexts [18] and [19] appear to be similar, there was a gradual lessening of artefacts in [18] before a further assemblage was revealed in [19], including a complete miniature vessel at a depth of 0.9 m (see *Pottery Assemblages* below) and 10 cm below this, two refitting sections of a socketed iron blade (Fig. 5):

Insert Fig. 4:

Insert Fig. 5:

Currently undergoing conservation and analysis, the iron blade is missing its tip, but its lower portion survives to a length of 72 mm and a width of 56 mm tapering to 47 mm. A covering of rust with a mix of sand and charcoal concretions demonstrates that the break occurred prior to its deposition. The socket, which is circular in cross-section, is 87 mm long with a 26 mm wide aperture and reduces to a diameter of 20 mm at the shoulder. Weighing 140 g, the original blade length may be estimated as close to 18 cm. The complete miniature vessel and socketed blade stand out within the pit's material repertoire. All other blades from Igbo-Ukwu are fashioned with a tang fastening and the vessel, by its scale, is also unique.

It is notable that although a great deal of the pottery from IU-1.1 was recovered from cut features, contexts [20], [21] and [22] each produced sizeable assemblages. The 267 sherds recovered from TP1 alone illustrates the proximity of the pit to deposits containing an

accumulation of cultural materials, and that the scale of the halo of deposition did not extend into the shovel-tested units.

IU-1.2 was opened as a 2 x 2 m unit and reduced to *c*. 1 x 2 m from a depth of *c*. 0.5 m (Fig. 6). Following removal of modern layers (contexts [1-3]), cultural materials were encountered from a depth of *c*. 0.6 m within moderately loose dark red and charcoal-flecked clay [4] and, beneath this, a layer of dark red loam (context [5]) that thickened in the south section, dipping to a depth of *c*. 1.55 m. Context [7] was a distinct cluster of almost 300 mostly decorated potsherds encountered at the point of the dip below context [5] and was mixed with small charcoal flecks and lumps over a black charcoal lens at *c.* 1.65 m depth from which a radiocarbon date of 1188-1210 cal. CE was obtained (2 sigma, Beta 587121). A band of dark orange sand tipped beneath the east side of context [7] from a horizontal charcoal-flecked layer (context [10]) that produced a small number of potsherds and was separated from context [5] above by a thin seam of sand mottled with yellow clay (context [6]). It is possible that context [10] may represent a sealed land surface over the undisturbed geology (context [11], lateritic sandy loam devoid of cultural material; this showed no change in two auger profiles up to a depth of 2.4 m). The exact nature of the pottery cluster in [7] is ambiguous. In plan, it was one of nine irregular shallow hollows recorded across the south half of the unit penetrating the surface of context [10] but was the only one of these to produce pottery of any quantity. Continuing into the south section, we may not discount the possibility that this represents the edge of a pit that deepens beyond the excavated area. At the base of the unit, augering was conducted at two spots to explore the extent of the material culture bearing deposit. The auger reached a depth of 2.4 m and 2.0 m and no cultural materials were recovered. The soil from the augering was similar to the soil encountered at the basal layer, which was semi-compact moist red laterite.

Insert Fig. 6:

*Area 2. Excavation unit IU-2.*1

This unit was placed to explore archaeological potential within the palace compound, where surface potsherds and possible crucible fragments have been noted (Akinade, 2010, 43-44). Prior to investigation, the resident, Ms Ife, explained how, within the ground surface of an unpaved area of the compound, a hollow of unspecified character would occasionally appear and necessitate refilling. Her mother, HRH Ocheze, corroborated the situation of the compound's sinking portion. Oral history collected from local residents in 2019 indicated that a similar narrative of occasional sinking that necessitated refilling was given for the area where the bronze roped pot was later recovered at Igbo-Isaiah. Based on this insight, we dug eleven positive shovel tests in the strip of unpaved space in the northern sector of the palace compound (Fig. 2), including an augering that at a depth of 1.35 m reached cultural deposits. These results informed the placement of excavation unit IU-2.1 at IDU II, that was opened to 2 x 2 m but was reduced to 2 x 1 m at a depth of 10 cm owing to a lead service pipe (Fig. 7).

Insert Fig. 7:

The upper 0.6 m of the unit consisted of a homogenous sandy loam that changed in colour from light reddish brown [24] to dark reddish grey [25], becoming increasingly compact with depth. Some *c*. 940 potsherds came from these deposits and are undergoing analysis. It is likely that these potsherds represent a mix of types and ages owing to the recent levelling activities across

the area. At a depth range of 0.6-0.8 m was a notable frequency of small-sized sherds (0.6-1.5 cm in diameter), which constitutes about 45 per cent of the pottery collected from the unit. Although small sized sherds were also noted at depths 0.2-0.3 m, 0.4-0.5 m and 1.1-1.2 m, these constitute only about 29 per cent of the pottery assemblage. The frequency of potsherds and charcoal increased considerably from a depth of 0.6 m, and by 0.8 m it was evident from the arc of their distribution in plan, decreasing in scale by depth, that these were contained within the upper profile of a large pit that cut the undisturbed reddish sandy clay geology [28]. Just a fraction of the pit was exposed in the unit, which continued beyond the 1.35 m excavated depth. Capped with light orange charcoal-flecked sand [26], dark reddish brown compact sandy loam [27a-d] again filled much of the pit with a depositional sequence marked by distinct bands of concentrated charcoal, fire-hardened clay, and pottery tipping from its outer edge. Charcoal from one of these bands [27b] at *c.* 1.15 m depth produced a radiocarbon date of 892-1023 cal. CE (2 sigma, Beta 587119). Deposits [27a] and [27b] overlay an indurated layer of fire-hardened clay [28]. The exact nature of this layer is uncertain, and it may belong to the material displaced with [27c], in which two lumps of iron slag (202 g) were found.

In summary, the 2021 excavations have provided insights into understanding the character and spatial distribution of sites in Igbo-Ukwu. With excavation yielding few to no cultural materials in broad areas, particularly units IU-1.2, IU-1.3 and IU-1.4 in Area 1 (Fig. 2), it could be suggested that cultural materials, mainly pottery, were mostly concentrated in secondary deposits including pit features. Shaw's observations at Igbo Jonah, with its multiple pits, and Igbo Richard, with regions of essentially sterile deposit interspersed with features (burials, shrines, cisterns) where cultural artifacts were concentrated, are also consistent with this pattern (Shaw 1970, appendix VII). Small sherds measuring less than 2 cm were present in appreciable quantities in the pottery assemblages of the excavated units, but frequent in the shovel test units. This variation in the pottery frequency may reflect a combination of site activities and deposit formation processes, which may be further revealed through detailed studies of the excavated pottery. In the interim, pilot studies of the excavated pottery provide relevant insights.

Pottery Assemblages

The ceramic assemblage from our 2021 excavations is undergoing analysis. An initial assessment focused on the assemblages from IU-1.1 and IU-2.1, the two most productive excavated units (Table 3), which forms the discussion here. The assessment has drawn from the multivariant analyses developed for the Inland Niger Delta ceramics (McIntosh 1995), but also significantly benefited from Shaw's (1970: 207-224) description of Igbo-Ukwu pottery for comparison. The multivariant approach was adopted because certain decorative motif on Igbo-Ukwu ware (e.g., grooving and concentric circles) are still used in some Igbo ritual vessels today. Recognising the limitation of typological approach, the multivariate approach creates more room to develop a schema for analyzing pottery with elaborate attributes aimed at identifying spatiotemporal variations across and within different sites with well-contextualized radiocarbon chronologies (see McIntosh, this issue).The assessment was focused on the rim sherds from two units, against which sixteen variables were recorded on each sherd, including rim diameter, thickness, angle, and form; lip shape; lip indentation type; hardness; surface colour; paste color; core; non-plastic inclusions, surface finish/condition; surface treatment (slip/paint); and plastic decorative motif. These variables were number coded and entered in an excel spreadsheet for analysis. The results are summarized in Table 4.

.

Insert Table 3:

Insert Table 4:

With a focus on IU-1.1 and IU-2.1 (Table 3), from a total of 6952 sherds (including body and rim sherds), a sample of 194 rims were selected for initial examination based on diagnostic features such as complete rim profile and size greater than 3 cm across. The sample constituted 67 per cent of the recovered rim sherds from the two units. Everted rims account for over 70 per cent of the sampled rims (Table 5). Just under half of the sampled rims are decorated, mainly with varieties of incisions, grooves, fingertip impression, raised or cordons, concentric circles and wavy comb or dragged (Fig. 8). Sand is the dominant non-plastic inclusion, with crushed quartz occasionally encountered. It is not certain if the sand was part of the clay or intentionally added as temper. An indented lip, or what Shaw (1970) referred to as a 'bifid' feature, was common across the assemblage. The indentation sometimes bifurcates the lip into two equal halves, though variations occur in which one of the bifurcated halves is longer, sharper, or more rounded than the other part (Fig. 9). Pottery with thickened and ledged rims characterized with roulette and netting pattern also occurred but in low frequency (Table 5; Fig. 10).

Insert Table 5:

Insert Fig. 8:

Insert Fig. 9:

Insert Fig. 10:

The relative frequencies of oxidized reddish-orange surface color versus grey-black (33 per cent in IU-2.1, 10 per cent in unit IU-1.1) may provide potential insights into firing conditions (Table 5). Overall, pottery forms and decorations appear to be similar across the two excavated units.

A lid fragment and a near complete conical stopper (Shaw's Type D1) both came from IU-2.1, and a complete miniature vessel was encountered in IU-1.1 (Fig. 5). Found in context [19], the miniature vessel measures 73 mm high with a maximum body diameter of 57 mm and rim diameter of 46 mm. The vessel was manufactured in a sandy fabric fired to a reddish orange color, its surfaces then smoothed over. With rounded base and near straight body, it was relatively thick-walled (*c*. 7 mm) with five deeply incised horizontal grooves (each *c*. 5 mm wide) producing a 'tall' ribbed neck effect with enhanced rim, though with only a faint trace of an indent. By scale, the vessel is a unique finding among the 2021 pottery assemblage from Igbo-Ukwu as Shaw did not report anything of this type. Possibly associated with drinking palm wine, miniature vessels have been noted in ritual contexts in contemporary Igbo society as well as for storing medicines (Okpoko, 1987: 452).

The pilot assessment of the assemblages from IU-1.1 and IU-2.1 reveals some morphological consistency with Shaw's description of Igbo-Ukwu pottery. Dominance of rims with an indented lip along with the rim form/type, and the variety of decorative motifs across the sample set indicate the assemblages share some of the traits recorded by Shaw as 'Igbo-Ukwu ware' (Shaw, 1970). Particularly, Shaw's pottery types A4 & 5 and C (Fig. 11) characterized

by everted bifid rims with incised, fingertip impression, cordons, parallel grooving, concentric circles, comb-wavy dragged and bosses are unambiguously represented. Shaw (1970: 221) ascribes variants of type A (8-11) and type B characterized by horizontal grooving and variety of rouletting to a modern context as they did not appear in the ancient contexts. Certain pottery elements that Shaw identified as characteristic of recent pottery were present in our assemblage. These include thickened and ledged rim forms and net patterns and variants of twisted cord and roulette decoration. The traits were present in the assessment sample recovered from within the top 0.4 m of IU-1.1 and at a depth of 0.5-1.05 m in IU-2.1, mixed with sherds displaying more reliably earlier pottery traits. Mixing of early and late pottery within the upper deposit horizon of IU-1.1 may not be surprising, as the excavated unit is situated within agricultural land. In the case of IU-2.1, the introduction of residual cultural material during the refilling of the reported sunken area may similarly account for such mixing.

Insert Fig. 11:

The assemblage is undoubtedly reminiscent of Shaw's collection and description of Igbo-Ukwu ware. The bifid rims in their varieties appear to be an attribute typical of the Igbo-Ukwu potting tradition. Although Shaw (1970) did not capture the different forms of bifid in his classification, it is therefore unclear how and if the variation in the placement of the bifurcation relate to vessel form and function. This relationship between the two variables may be considered during full analysis and perhaps may be another element for chronological differentiation among Igbo-Ukwu pottery. However, more is needed to be done with a larger assemblage recovered from securely stratified and dated contexts to help refine the ceramic chronology at Igbo-Ukwu. There is also limited understanding of the sourcing and combination of raw materials used in the manufacture of Igbo-Ukwu pottery. This was an area of concern at the forefront of a pilot study in elemental analysis of the 2021 assemblage, which is presented below.

Pottery elemental analysis

Elemental analysis of the ceramic materials was conducted to (1) examine the composition of the ceramic sherds, and (2) investigate the patterns of differentiation in the elemental composition of the ceramics from the excavated units. This analysis is aimed at building data for understanding the variation in the ceramic assemblage for future ceramic technological and provenance studies. This analysis also follows chemical characterization of archaeological ceramics in the investigation of ancient pottery technology and production system in West Africa (Ige et al., 2009; Usman et al., 2005).

A total of 122 ceramic samples consisting of 44 sherds from IU-1.1, 16 sherds from IU-1.2, and 62 sherds from IU-2.1 were randomly selected for the analysis. The portable X-ray Fluorescence (pXRF) machine was applied directly on the samples. Employed as an exploratory technique, pXRF is able to yield a high degree of chemical compositional accuracy and precision, non-destructive to the sample (Forster et al., 2011). The samples represent about 10 per cent of the entire ceramic assemblage recovered from each of the three excavated units. The sample selection was also informed by the intent to analyse sherds representative of the range of ceramic types. Using R statistical software, the data was refined through Principal Component Analysis (PCA) to simplify complex data dimensions into comprehensible models to identify major elements driving similarities or differences observed across the sample data. Multivariate analysis of variance (MANOVA) was conducted to investigate the difference between groups. This essentially tests the hypothesis that there is no variance in the chemical

composition of the ceramic samples by excavation units when tested against the first four principal components.

Reported in parts per million, Fig. 12 shows the average concentration of nine major elements across study sample. The major elements measured are aluminium (Al), silica (Si), phosphorus (P), sulphur (S), potassium (K), calcium (Ca), titanium (Ti), iron (Fe), manganese (Mn), and magnesium (Mg). Other minor and trace elements are chromium (Cr), nickel (Ni), copper (Cu), zinc (Zn), rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), niobium (Nb), thorium (Th), arsenic (As) and uranium (U). As and U were excluded from the PCA analysis due to low measurement precision.

Insert Fig. 12:

Fig. 13 shows that elemental composition groupings of the overall dataset are not patterned by the excavation unit. Moreover, the p-values drawn from the MANOVA testing of the first four data dimensions add statistical security to the proposition of there being no variance in the group mean of elemental composition by excavated unit. Both Wilk's and Pillai tests also produced a p-value of 0.2, which supports the hypothesis that there is no statistical variation in the mean of the sherds from the three excavation units. There is nevertheless significant elemental characterization patterning in the data presented in Fig. 13, which primarily relates to the quantity of magnesium (Mg), zinc (Zn) and nickel (Ni). Sherds that are rich in these elements score high on the PC1 bar. These patterns could relate to different assemblies or qualities of resources utilised in ceramic production, such as in paste variability or temper additives. Mg enrichment in content nevertheless suggests that there could be a variation in clay composition that is expressed by the elemental properties of some of the sherds, and which, by implication, may represent exploitation of different clay reserves. Future studies would expand on the sample size in this study to investigate provenance and technological history of the Igbo-Ukwu ceramics.

Insert Fig. 13:

Soils and environment

Analysis of local soils and sediments from both surface and buried deposits is aimed at building a record of local environmental conditions through time and across space. As first observed by Shaw (1970: 53, 56) and during our recent investigations, the nature of local soils, their relation with past development and site formation and post-depositional processes remains elusive, compromising our ability to build detailed archaeological stratigraphies. In the absence of soil records from Igbo-Ukwu, our project is beginning to establish a baseline of data on the nature and processes of local soils and sediments. Loose samples collected from the ground surface of Areas 1, 3 and 4 were analysed for pH and particle size distribution (PSD) at the Department of Soil Science, University of Nigeria, Nsukka, following standard procedures (Pansu and Gautheyrou, 2006: 5581-5584). Detailed geoarchaeological analyses, including soil micromorphology and geochemistry, are currently focusing on examining the nature and (micro-) stratigraphy of key cultural deposits. Interim results from pH and particle size distribution analyses offer a baseline insight to the character of the soil cover at Igbo-Ukwu, mineral sources and processes of soil formation and transport, soil-water nexus relations, and implications for preservation conditions relative to the recovery of organic and inorganic artefacts.

Soil pH and particle size distribution

Summarised in Table 6, the results reflect the presence of sand to silt-sand soils with little clay (5.8-9 per cent) and moderately acidic to neutral pH (6.6-6.9). Variability across the areas investigated is indicated, for example, by samples from Areas 1 and 3 that yielded the highest clay content (> 6.3 per cent) detected in the sample set and moderately acidic pH, while Area 4 samples were characterised by lower clay content and neutral pH.

Insert Table 6:

Regional soil cover is primarily ascribed to the movement and deposition of eroded reddish, brown lateritic materials (Ocheli et al., 2021; Ogbukagu, 1984). These lateritic materials support the development of loose or poorly consolidated fine-grained sand to silty loam soils, characterised by moderate drainage and strongly acidic pH (4.1-5.1) (Ayaduono et al., 2020; Egbueri & Igwe, 2021; Kayode et al., 2019). In regional soil mapping, the region is characterised by Luvisols and Arenosols (Jones et al., 2014).

The preliminary results suggest that surface deposits recorded in the study areas have a loamy texture consistent with the region's dominant soil types. Slightly higher pH and clay content might however be reflective of localised conditions, which might include poorer drainage and higher availability of minerals (silicate) in the wider Igbo-Ukwu landscape that could be linked to its topographic position (on a cuesta) and long-term occupation history. Albeit a volatile soil property, the slightly enhanced pH in Areas 1, 3 and 4 would afford better preservation conditions for organic and inorganic artefacts than areas across the wider region associated with strongly acidic soils.

Archaeobotanical remains

Fewer than one hundred archaeological sites in West Africa have produced archaeobotanical remains and very few of these are located within Nigeria (for a general review of West African archaeobotany see: Champion, 2019; Champion and Fuller, 2018; Orijemie, 2018). Consequently, questions relating to subsistence strategy in Igbo-Ukwu have been poorly understood. Archaeobotanical agenda adopted in this research was with the aim of understanding what type of plants early Igbo-Ukwu settlers exploited and the antiquity of plant use. Macro remains were collected during the fieldwork in four loose 10-litre samples from IU-1.1 and IU-1.2 by a process of bucket flotation, passing the deposit through a 1mm mesh sieve. Each sample was sorted by fraction (>2.5 mm, 2.5–1 mm) and quantitatively analysed for charred plant structures under a low-power (5–40x) stereomicroscope (see method in Champion and Fuller, 2019).

A total of 85 archaeobotanical remains were recovered in Samples 1-3 in addition to wood charcoal, with the greatest frequency registered in IU-1.1 (Table 7). Though containing charcoal, Sample 4 was devoid of any plant remains. Fruits of *Vitex* sp. and the palm oil tree cf. *Elaeis guineensis* were represented by 83 endocarp fragments, though high fragmentation of the endocarp hindered more precise identification. A single caryopsis of pearl millet (*Cenchrus americanus*/*Pennisetum glaucum*) was also present in IU-1.1 (Sample 1) but came from the upper profile of the excavated unit and is likely to post-date the pit; however, a fragment of carbonised food residue came from contexts more securely attributed to the pit in IU-1.1 (Sample 2) and is identified as a potential residue of porridge.

Insert Table 7:

Although use of 1 mm mesh rarely captures small seeds and plant remains such as pearl millet (*Pennisetum glaucum*) or fonio (*Digitaria exilis*) caryopsis, this small study shows the very high potential for further archaeobotanical studies within Igbo-Ukwu that would be enhanced by greater sample numbers and volume, and a variety of mesh apertures.

Oil palm exploitation

From around 3050 BCE, abundant archaeological evidence of the endocarp of the oil palm, *Elaeis guineensis*, in the rain forest and woodland savanna zones of west and west central Africa has proved the tree to be a significant factor in the region's subsistence economy (Sowunmi 1999). In Nigeria, many archaeological sites have recorded remains of oil palm. At Itaakpa in the southern Guinea savanna zone, Oyelaran (1998) attributed burnt kernels of oil palm and their close association with stone axes, human remains and ceramics, to the exploitation of the oil palm as a food resource by humans as far back as mid-3rd century BCE (2210 $\pm$ 80 BP). Also, in the Badagry coastal mangrove forest region, the presence of charred palm kernels, charcoal and groundstone axe in the cultural phase of the AP1 site was interpreted to possibly indicate the exploitation of the oil palm from the early 8th century BCE (2,670 $\pm$ 90 BP, Alabi, 2002), an earlier date than Itaakpa's. Similarly, more recent dates of c. 17th century CE (350±30 BP) and the last century CE (126.5 – 0.3 pMC) were noted for oil palm exploitation in the rainforest zone based on evidence of charred oil palm endocarps occurring in association with potsherds and charcoal (Daraojimba, 2016; Daraojimba et al. 2018, respectively). Such oil palm recoveries from archaeological sites in savanna and forest regions of Nigeria, dating from the Late Stone Age period to the last century CE, clearly reflects long and continuous exploitation of this important tree crop.

The recovery of oil palm endocarps in association with charcoal and pottery from archaeological contexts in Igbo-Ukwu reflects the role this important economic tree must have played in people's daily lives. Currently in southeastern Nigeria, there is still paucity of archaeobotanical data on the antiquity of exploitation of the oil palm or generally plant exploitation/food production. As reported by Williamson (1993) based on linguistic evidence, oil palm (*Elaeis guineensis* Jacq.) is heavily embedded in culture and ritual among the people of southern Nigeria just like other old indigenous plants including wine palm (*Raphia hookeri* Mann Wendl.), yams (Aerial yam-*Dioscorea bulbifera* Linn., and Guinea yams- *D. cayenensis* Lam. and *D. rotundata* Poir) and kola nuts (*Cola acuminata* (P. Beauv) Schott and Endl. and *C. nitida* A. Chev.). Thus, it is pertinent that more archaeobotanical investigations be conducted at Igbo-Ukwu and the southeastern region to identify archaeological features/areas (e.g., hearths, middens and granaries) where first-hand evidence of plant use can be recovered from their primary context. Recent archaeobotanical research by Ngonadi (2022) in and around Lejja will help to situate Igbo-Ukwu within broader ancient subsistence economy in Eastern Nigeria.

Discussion – expanding space and time at Igbo-Ukwu

Our revisit to Igbo-Ukwu after Shaw's pioneering work over six decades ago has expanded the view of archaeology beyond the three compounds he originally investigated. Though the physical record recovered during the fieldwork presented here is at an early stage of analysis,

there are several significant outcomes that can be reflected upon here. The shovel test pits and excavation units recorded a presence of cultural deposits well beyond the three sites excavated in the 1960s. Significantly, the radiocarbon date obtained from IU-2.1 extends the temporal depth of some of these deposits to between the late 9th to early 11th century. Initial study of the pottery from 2021 excavations, based on similarities in morphology, decoration patterns and chemical composition, provides additional datasets for understanding the chronology of the sites and material culture in connection with typical Igbo-Ukwu traditions.

This research has demonstrated that a multi-scale approach, combining various recovery and analytic methods is highly profitable in providing valuable insights on the material culture, food ways, and environment. Data from soil analysis suggest that the Igbo-Ukwu landscape has great potential for preserving organic and inorganic remains, which is demonstrable by the archaeobotanical data, especially the presence of palm oil fruits.

It is notable that in Areas 1 and 2 the results from 2019 and 2021 provide further evidence for concentrated pit cutting and deposition, as was documented by Shaw at Igbo Jonah and in the upper excavated levels of Igbo Richard in addition to a number of deeply cut water-catchment cisterns. Pit digging seems to have occurred with a variety of depositional complexity. Some of the pits that Shaw encountered contained complete or near complete vessels and associated artefacts that led him to consider the pits as having been opened specifically to receive these items. In fact, these were considered to have functioned as a form of sacred offering akin to a shrine. Other pits, such as that identified in IU-1.1, may have been filled over a longer period of time with a succession of deposits bearing varying degrees of material content. Whilst these could be read as receptacles for domestic waste, the sequence of accumulation in some pits may display characteristics of deposition that mark various rhythms of activity, or even specific events.

The distribution of activities associated with ‘Igbo-Ukwu ware’ has been extended southward from Shaw’s original investigations, occurring in Areas 1 and 2 and covering a linear distance of 0.5 km. Additional sherds of Igbo-Ukwu ware including the grooving and concentric circles were recovered from shovel tests in Areas 3 and 4, some 3 km south of Areas 1 and 2. Further investigations may be necessary to demonstrate chronological linkages between these areas, against which the results of the ongoing pottery analysis will also prove instructive. At a broader regional scale, our understanding of the spread of Igbo-Ukwu cultural influence, including cultural material, is meagre. Although archaeological excavations across Igboland have yielded other sizeable pottery assemblages and similar (though generally slightly later) radiocarbon dates, these have either gone unreported (e.g., Hartle, 1967, 1980) or have received only limited description (e.g. Anozie 1985; Okpoko et al., 2009), which evidently hampers cross-site comparison.

Radiocarbon dates came from wood charcoal in three excavated units (Table 8), from contexts considered to be stratigraphically secure. The earliest radiocarbon date came from a large pit within IU-2.1 in Area 2, with a calibrated range between the terminal 9th and early 11th century CE. For the two radiocarbon samples in Area 1 there is a disproportion between their dates and the depth from which they were obtained: a date between the end of the 10th century to the middle of the 12th century CE is attributed to a sample from a depth of 0.44 m within a cut feature in IU-1.1 but a younger date between the end of the 12th century and the second half of the 13th century CE was registered from a sample at a depth of 1.45 m in IU-1.2. Additional radiocarbon dates may be required from within these units to fulfil statistical reliability. Moreover, noting that the units in Area 1 are separated by just 20 m within an area of

agricultural land, it is evident that geoarchaeological insight is necessary to improve understanding of the speed and character of the processes by which deposits have formed in different portions of Area 1 and across Igbo-Ukwu more generally.

Shaw obtained a suite of radiocarbon dates from Igbo Richard and Igbo Jonah, but within standard deviations that are considerably broader than is achievable by today's standards: the late 7th to mid-12th century (Fig. 14). Reported in this issue by McIntosh and Cartright, the textile associated to Igbo Isaiah dates between the second quarter of the 11th century and the last quarter of the 12th century, and usefully lies within the centre of the dates from IU-1.1 and IU-1.2.

Insert Table 8:

Insert Fig. 14:

The new radiocarbon dates reported in this issue suggest that activities connected to Igbo-Ukwu ware encompass a period of three or more centuries, between the 10th and 13th centuries CE. There is currently no indication that the source of potting clays varied greatly throughout this period, though any subtle changes to the form and decoration of the ceramics still await identification. There is a need to properly contextualise ceramic assemblages, thereby refining the ceramic sequence against subtleties of change and to identify which traits are visible with greater durability over time. The set of new dates further refines and solidifies the chronological framework applicable to early features encountered by Shaw at Igbo Richard, Igbo Jonah and Igbo Isaiah. The importance of chronological resolution to the project is necessary to further situate Igbo-Ukwu's social and technological complexity within a larger picture of early and emergent urban forms in West Africa.

Long overdue at Igbo-Ukwu, fieldwork is now once again providing opportunities to develop the historical narrative of this landscape. Understanding the environmental circumstances within which this complex culture developed and the potential impact of human activities to these calls for further research. Such exercises are required to resolve even the most basic of questions that remain unanswered, and through which a foundation may be laid to address the nature and complexity of society responsible for Igbo-Ukwu's remarkable craftworks.

Acknowledgements
The new project at Igbo-Ukwu received funds from the Cambridge-Africa Alborada Research Fund, the Society of Antiquaries of London Research Grants, the Thriplow Charitable Trust and the Robert Kiln Trust. Dr Pamela Jane Smith Shaw and the McDonald Institute for Archaeological Research (MIAR), University of Cambridge (via Professor Paul Lane's strategic research funds) generously provided the funding for the 2019 pilot project. The MIAR also funded the 2021 project through Dr Babalola.

We thank the Department of Archaeology and Tourism, University of Nigeria, Nsukka; Dr. Mark Golitko of the Notre Dame Archaeological X-ray Fluorescence Laboratory (NDAXL); and Vincent Ojukwu and Curator Enyi Samuel from the National Commission for Museums and Monuments, Igbo-Ukwu, Nigeria, for their support. We are deeply grateful to the Igbo-Ukwu community compounds owners and officials: Late HRH Igwe Dr Barr Martin N Ezeh, IDU II, President General Sir Christian Ike, HRH Ocheze B Ezeh, HRH Eze Dr Alexander

Anozie, Chief J C Major-Azike, Major Lieutenant Johnson Anozie, Raphael Anozie, the Late Chibuike Anozie, Patrick Anozie, Charles Okonkwo, Frank Umeh-Ozulumba, Walter Ugboaja, Okey Ezeh, Obum Anozie, Barr Clifford Ubabukoh and Chief Okeke. We also thank our dedicated trainees, Abuchi, Nneamaka, Nonso, Victor, Nickson, Chidalu, Chibuko, Chidubem, Obiajulu, Ugoma, Ogechukwu, Blessing, Delight, Chiemerie, Chikwado, Ife, Udochukwu, Miracle, Chukwudi, Okechukwu, Chidera, Ebubechukwu, Chukwuebuka, Chukwuemeka, Kenechukwu, Ijenu, Ezeudegbunam, Caleb, Kelvin, and Chikamso. We are grateful to our amiable research team Dr. M. Mangut, Boluwaji, Omokolade, Mustakim, Stanley, and Diya. Ayobami Diya also helped with some of the graphics. Special thanks to Professor Susan McIntosh for the invitation to contribute to the symposium on Igbo-Ukwu at 50 at the 25th conference of the Society of Africanist Archaeologists (SAfA) and the special issue, and for all of her input and patience in helping to see this article come to fruition.

Declarations

Conflict of Interest The authors declare no competing interests.

References

Akinade, O. A. (2010). *A New Focus on the Archaeology of Igbo-Ukwu*. Abuja: Prints Xray Ltd.

Alabi, R. A. (2002). Environment and Subsistence of the early inhabitants of coastal southwestern Nigeria. *African Archaeological Review,* 19(4), 183-201.

Anozie, F. N. (1985). *Archaeology of Igbo land*. Nimo: Asele Institute.

Ayadiuno, R. U., Ndulue, D. C., Mozie, A. T., & Phil-Eze, P. O. (2020). Geomorphological analysis and terrain characterization of the Du and Anambra rivers system of Southeastern Nigeria. *Palarch's Journal of Archaeology of Egypt/Egyptology*, 17(9), 7704-7719.

Champion, L. (2019). The evolution of agriculture, food and drink in the ancient Niger River Basin: Archaeobotanical studies from Mali and Benin. PhD Thesis, University College of London.

Champion, L., & Fuller, D. Q. (2018). New evidence on the development of millet and rice economies in the Niger River Basin: Archaeobotanical results from Benin. In A. Mercuri, D. A, R. Fornaciari, & A. Höhn (Eds.), *Plants and people in the African past* (pp. 529–547). Switzerland: Springer.

Champion, L., & Fuller, D. Q. (2019). Archaeobotany: Methods. In *Oxford research encyclopedia of African history*, https://doi.org/10.1093/acrefore/9780190277734.013.204

Daraojimba, K. C. (2016). Humans and oil palm (*Elaeis guineensis* Jacq.) exploitation in Orile-Owu, southwest Nigeria, 1450-1640 A.D: archaeobotanical evidence. *Dig It,* 2, 14-23.

Daraojimba, K.C., Oyelaran, P.A., Barros, M.A., Cordeiro, J., & Luz, C.F.P. (2018). Archaeological Deposit in Motako, Southwest Nigeria, Investigated by Pollen Analysis. In A.

Mercuri, D. A, R. Fornaciari, & A. Höhn (Eds.), *Plants and people in the African past* (pp. 246–270). Switzerland: Springer.

Daraojimba, K. C. (2019). Short notes on the 2019 Igbo-Ukwu research project. *West African Journal of Archaeology*, 49, 177-184.

Daraojimba, K. C. (2021). Archaeology education in Igbo-Ukwu, southeast Nigeria. *Archaeologies: Journal of the World Archaeological Congress,* 17 (2), 193-216, doi.org/10.1007/s11759-021-09426-x.

Egbueri, J. C. & Igwe, O. (2021). The impact of hydrogeomorphological characteristics on gullying processes in erosion-prone geological units in parts of Southeast Nigeria. *Geology, Ecology, and Landscapes* 5(3), 227–240, doi: 10.1080/24749508.2020.1711637.

Forster, N., Grave, P., Vickery, N., & Kealhofer, L. (2011). Non-destructive analysis using pXRF: methodology and application to archaeological ceramics. *X-Ray Spectrometry*, 40(5), 389-398.

Hartle, D. D. (1967). Archaeology in Eastern Nigeria. *Nigeria Magazine*, 93, 134-143.

Hartle, D. D. (1980). Archaeology East of the Niger: A review of cultural-historical developments. In B. K. Swartz & R. E. Durnett (Eds), *West African culture dynamics: Archaeological and historical perspectives* (pp. 195-203). New York: Mouton.

Ige, O. A., Ogunfolakan, B. A., & Ajayi, E. O. (2009). Chemical characterization of some potsherd pavements from parts of Yorubaland in southwestern Nigeria. *Journal of Archaeological Science, 36*(1), 90-99.

Jones, A., Breuning-Madsen, H., Brossard, M., Dampha, A., Dewitte, O., Hallett, S., Jones, R., Kilasara, M., Le Roux, P., Micheli, E., Montanarella, L., Spaargaren, O., Tahar, G., Thiombiano, L., Van Ranst, E., Yemefack, M. & Zougmore, R. (2014). *The major soil types of Africa* (EUR 26857): Luxembourg, Publications Office of the European Union, doi:10.2788/17215

Kayode, O. T., Aizebeokhai, A. P., & Odukoya, A. M. (2019). Soil characterisation for precision agriculture using remotely sensed imagery in Southeastern Nigeria. *Journal of Physics*, Conf. Series 1299, doi:10.1088/1742-6596/1299/1/012070

McIntosh, S. K. (1995). Pottery. In S.K. McIntosh (Ed), *Excavations at Jenné-Jeno, Hambarketolo, and Kaniana (Inland Niger Delta, Mali), the 1981 Season* (pp 130-213). Berkeley: University of California Press.

Nfor, B. N., Olobaniyi S. B., and Ogala J. E. 2007. Extent and Distribution of Groundwater Resources in Parts of Anambra State, Southeastern, Nigeria. *Journal of Applied Science and Environmental Management* 11(2), 215-221.

Ngonadi, C. V. (2022). Early Agricultural Communities in Lejja Southeastern Nigeria: An Archaeobotanical investigation. Unpublished PhD Thesis, Department of Archaeology, University of Cambridge.

Ocheli, A., Ogbe, O. B., & Aigbadon, G. O. (2021). Geology and geotechnical investigations of part of the Anambra Basin, Southeastern Nigeria: implication for gully erosion hazards. *Environmental Systems Research*, 10, 23, https://doi.org/10.1186/s40068-021-00228-2

Ogbukagu, I. N. (1984). Hydrology and chemistry of surface and groundwater resources of the Aguata area, SE Nigeria. *Journal of African Earth Sciences,* 2(2), 109–117.

Okpoko, A. I. (1987). Pottery-making in Igboland, Eastern Nigeria: An ethnoarchaeological study. *Proceedings of the Prehistoric Society*, 53, 445-455.

Okpoko, A. I., Ibeanu, A. M., & Umeokafor, C. E. (2009). Archaeological survey of Nri. *West African Journal of Archaeology*, 38(1 & 2), 79-92.

Orijemie, E. A. (2018). The Archaeobotany of the Later Stone Age in Nigeria: A Review. In: Mercuri, A.M., D'Andrea, C., Fornaciari, R. & Höhn, A. (Eds.), *Plants and People in the African Past* (pp 362-379). Switzerland: Springer.

Oyelaran, P. A. (1998). Early settlement and archaeological sequence of Northeast Yorubaland. *African Archaeological Review,* 15(1), 65-79.

Pansu, M., & Gautheyrou, J. (2006). *Handbook of soil analysis*. Heidelberg, NH: Springer.

Reimer, P., Austin, W., Bard, E., Bayliss, A., Blackwell, P., Bronk Ramsey, C., Butzin, M., Cheng, H., Edwards, R., Friedrich, M., Grootes, P., Guilderson, T., Hajdas, I., Heaton, T., Hogg, A., Hughen, K., Kromer, B., Manning, S., Muscheler, R., Palmer, J., Pearson, C., van der Plicht, J., Reimer, R., Richards, D., Scott, E., Southon, J., Turney, C., Wacker, L., Adolphi, F., Büntgen, U., Capano, M., Fahrni, S., Fogtmann-Schulz, A., Friedrich, R., Köhler, P., Kudsk, S., Miyake, F., Olsen, J., Reinig, F., Sakamoto, M., Sookdeo, A., & Talamo, S. (2020). The IntCal20 Northern Hemisphere radiocarbon age calibration curve (0–55 cal kBP). Radiocarbon, 62, 725-757, doi: https://doi.org/10.1017/RDC.2020.41

Shaw, C.T. (1970). *Igbo-Ukwu: An account of archaeological discoveries in Eastern Nigeria*. (Volumes I and II). London: Faber and Faber Limited.

Shaw, C.T. (1977). *Unearthing Igbo-Ukwu.* Ibadan: Oxford University Press.

Sowunmi, M. A. (1999). The significance of the oil palm (*Elaeis guineensis* Jacq.) in the late Holocene environments of west and west central Africa: A further consideration. *Vegetation History and Archaeobotany,* 8, 199-210.

Usman, A. A., Speakman, R. J., & Glascock, M. D. (2005). An initial assessment of prehistoric ceramic production and exchange in northern Yoruba, north central Nigeria: results of ceramic compositional analysis. *African Archaeological Review*, 22(3), 141-168.

Williamson, K. (1993). Linguistic evidence for the use of some tree and tuber food plants in southern Nigeria. In T. Shaw, P. Sinclair, B.W. Andah & A. Okpoko (Eds), *The Archaeology of Africa: Food, Metals and Towns* (pp 139–153). London and New York: Routledge.