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Contents

Spis treści

Fascicle A
MEDITERRANEAN AND NON-EUROPEAN ARCHAEOLOGY

Fascykuł A
ARCHEOLOGIA ŚRÓDZIEMNOMORSKA I POZAEUROPEJSKA

Miron Bogacki, Wiesław Małkowski

Topographical survey in the area of two Christian buildings outside the city walls of Ptolemais (Cyrenaica, Libya) (Pls. 58–59)

Topographic measurement works in Ptolemais have been conducted by the Polish Archaeological Mission of the Institute of Archaeology of the University of Warsaw since 2002.[1] A multi-layer digital map which integrates various forms of spatial data such as satellite images, aerial photos, terrain models, geophysical maps and vector objects (architectural elements visible on the surface and contours) was prepared as a result of this survey. It was necessary to develop a methodology for fieldwork using GIS techniques, which allowed for proper data processing and later analysis and clear presentation. Measurements and aerial images give the possibility of description, and even partial interpretation or reconstruction of documented objects. This article refers to the extensive documentary work in Ptolemais, focusing on the two Christian buildings discovered outside the eastern walls of the city.

The first section will discuss the working methods used during fieldwork, while the second part describes aspects of interpretation and reconstruction.

Topographical measurements of the area east of Wadi Ziwana/Omran[2] outside the city of Ptolemais were carried out in the framework of the research grant directed by Professor Ewa Wipszycka. The method used in this task combined the total station measurements, the aerial photography, and the AutoCAD platform for processing data.

Characteristics of total station measurements

For inventory works in the remains of ancient buildings selected for the non-invasive research (**Fig. 1**), the tachymetric method was applied with the use of Leica TCR 407 Power instrument. Making use of reference survey points established for Ptolemais, it was possible to locate survey stations in the immediate vicinity of the building near Wadi Ziwana. In order to establish the position of particular points forming the shape of the object the polar coordinate system was employed[3]. For each survey station the axis of sighting was measured, and subsequently the following measurements were taken: horizontal and vertical angles, the slope distance between the survey station and the target point using a defined height of the measurement rod with a circular prism. The collected data were transmitted and processed in the Winkalk software. The result was a set of Cartesian coordinates (x, y, h) allowing for the preparing of maps and sketches, as well as the establishing of particular measurements (distance between characteristic points, areas of particular sectors).[4]

Drawing a vector numerical map

As a result of processing the total station measurements, a sketch and a numerical map were created. The

[1] On the topographical works conducted by the Mission: T. Mikocki, M. Gładki, W. Małkowski, *Badania urbanistyczne antycznego Ptolemais z zastosowaniem tachimetru elektronicznego*, (in:) *Fundacja Nauki Polskiej dla archeologii. Podsumowanie programów TRAKT i ARCHEO*, Lublin 2003, 64; T. Mikocki et al., *Ptolemais in Libya, Excavations conducted by the Mission of Institute of Archaeology, University of Warsaw in 2002 and 2003. Report of two seasons of excavations*, "Światowit" V (XLVI)/A (2003), 2005, 107–118: T. Mikocki et al., *Ptolemais in Libya, Excavations conducted by the Mission of Institute of Archaeology, University of Warsaw in 2004 and 2005. Report of two seasons of excavations*, "Światowit" VI (XLVII)/A (2004), 2006, 93–107; T. Mikocki et al., *Ptolemais: Archaeological Tourist Guide*, Warsaw-Tripoli 2006; W. Małkowski, *The City Plan of Ptolemais*, (in:) E. Jastrzębowska, M. Niewójt (eds.), *Archeologia a Tolemaide. Giornate di Studio in occasione del primo anniversario della morte di Tomasz Mikocki*, 27–28 maggio 2008, Roma 2009, 125–132; K. Misiewicz, W. Małkowski, M. Muszyńska, *The topography of Ptolemais. Results of non-destructive survey campaigns (2002-2005)*, (in:) M. Luni (ed.), *Cirene e la Cirenaica nell'antichità*, Monografie di Archeologia Libica XXX, Roma 2010, 197–204; General publications about topography and architecture of Ptolemais: C.H. Kraeling, *Ptolemais. City of the Libyan Pentapolis*, Chicago 1962, S. Stucchi, *Architettura Cirenaica*, Monografie di Archeologia Libica IX, Roma 1975.

[2] The local name Wadi Ziwana/Omran refers to a single wadi on the eastern side of Ptolemais, where Ziwana is the upper and middle part, Omran – the lower part, close to the sea.

[3] W. Kosiński, *Geodezja*, Warszawa 2010, 260–261.

[4] W. Małkowki, *Listing archaeological sites with a total station tachymeter. Data processing opportunities for surveyed sites*, "Polish Archaeology in the Mediterranean" XVIII (2006), 2008, 498–504.

numerical map is a set of linear elements, precisely visualizing the measured objects in scale. The shapes of the structures are drawn based on the x, y, and h coordinates. A map prepared in this way makes it possible to carry out precise measurements and to prepare two-dimensional reconstructions, as well as to work on specially prepared raster backgrounds (aerial and satellite photographs, geophysical maps).

The calibration of raster backgrounds – aerial photographs

Aerial photographs served as photographic backgrounds for the numerical map. They were taken with the use of kites and balloons by Miron Bogacki while documenting archaeological sites in Ptolemais.[5] The photographs were taken with the Canon 5D camera. They were georeferenced in the Raster Design (Autodesk) software and then adjusted to the measured objects clearly visible on the surface (corners of buildings, drums of columns, solid stone blocks). Thanks to indicating the same points on the numerical map and the processed image, it was possible to match the photographs with the vector plan. Such a background, partly free of optical aberrations and having cartometric properties, allows both analysing the surveyed area and taking the linear measurements.

Characteristics of kite aerial photography

Weather conditions in Ptolemais were perfect for taking aerial photographs of the site with the use of a camera suspended from a kite. The Mediterranean coast provides ideal wind conditions, with especially favourable constant east winds (called *shargi* in Arabic) and, less frequently, north winds from the sea. Neither the land relief nor the local flora obstructed our work; it was possible to move around the area without problems. The photographed buildings are located outside the Polish archaeological concession, which required obtaining a special approval from the Department of Archaeology of Libya. In result, photographs of two basilicas were taken: the one located near Wadi Ziwana in May 2009 and the other near Wadi Omran in May 2010. The whole task had to be carried out by two persons, because of considerable strength required to winch the kite and technical skills required to operate the remote camera. In photographing Ptolemais three kites of the FlowForm type were employed, each of them of different dimensions and destined for different wind conditions. The basilica near Wadi Omran was photographed with the use of the smallest kite, and the basilica near Wadi Ziwana with the medium-sized one. The FlowForm kites are ribless, a solution that eliminates the risk of breaking a frame in stronger winds and, consequently, crashing the camera. The appropriate shape and profile make these kites stable during the flight, which is essential in obtaining unblurred high-resolution photographs. Kites of this type do not rise vertically but at an angle of 45° to 70°, depending on the strength of the wind and the adjustment of strings. This feature made the photographing of one of the basilicas somewhat problematic, because with the north wind blowing the operator of the kite was forced to move along the very edge of the sea. The photographs were taken at different altitudes (100 to 300 m above ground level) in the afternoon, so that the sunlight could highlight the land relief. The kite's operator did not control the kite string directly with his own hands. Instead, the string was threaded in a pulley block and attached to a climbing harness. Such a solution allowed the operator to move unimpeded, without much effort. The surveyed areas were photographed both vertically and at an angle.

The photographic equipment

The photographs were taken with the Canon 5D camera equipped with the 35 mm f2.0 and 28 mm f1.8 Canon lenses. This camera has a full-frame sensor of nearly 13 megapixels, which provides high-quality images even at high-sensitivity settings. In our work, prime lenses were used, since they are lightweight and more compatible with the photogrammetric software. The camera was mounted on a special, remotely controlled frame, which had been already successfully used in other archaeological projects.[6]

[5] M. Bogacki, W. Małkowski, K. Misiewicz, *Kite Aerial Photography (KAP) as a tool for completing GIS models. Ptolemais (Libya) case study*, (in:) R. Lasaponara, N. Massini (eds.), *Advances on Remote Sensing for Archaeology and Cultural Heritage Management. Proceedings of the 1st International EARSeL Workshop CNR, Rome, September 30–October 4, 2008*, Rome 2008, 329–333.

[6] M. Bogacki, W. Małkowski, K. Misiewicz, *Kite Aerial Photography...*; M. Bogacki et al., *Multimethodological Approach to the Study of Ancient City Planning: The Case of Ptolemais in Cyrenaica, Libya*, "Študijné Zvesti Archeologického Ústavu Slovenskej Akadémie Vied" 41, 2007, 116; M. Bogacki et al., *GPS RTK Mapping, Kite Aerial Photogrammetry, Geophysical Survey and GIS Based Analysis of Surface Artifact Distribution at the Pre-Hispanic Site of the Castillo de Huarmey, North Coast of Peru*, (in:) R Reuter (ed.), 30th EARSeL *Symposium Remote Sensing for Science, Education, and Natural and Cultural Heritage UNESCO, Paris (France), 31 May–3 June 2010*, Paris 2010, 121–130. Available at <http://www.earsel.org/symposia/ 2010-symposiumParis/ Proceedings/ EARSeL-Symposium-2010_2-10.pdf>.

The frame can be turned both horizontally and vertically, a feature that allows taking photographs in each direction. The levelling of the camera is possible thanks to a string threaded in a pulley block, invented by Pierre L. Picavet.[7] Photographs are taken remotely with the use of a radio controlling console, which enables a photographer to manoeuvre the camera, set the autofocus, and release the shutter. The wireless image transmission from the camera (on frequency 2.4 GHz) allows previewing captured image and choosing the best frame. During each session about 500 photographs were taken. They were saved in the RAW format, which provides the best quality. The best photographs were subsequently selected for further processing in Adobe Photoshop CS4.

Additionally, a mosaic of the Wadi Ziwana area was prepared, consisting of about twenty-five photographs (**Fig. 2**). The vertical photographs of the two basilicas were used to produce an orthophotomap and to prepare the full geolocation of the surveyed region in the general GIS system for Ptolemais. The high-resolution photographs made it possible to supplement missing data in the vector plan of the basilicas as well.

The basilica near Wadi Ziwana, at the foot of Gebel al-Akhdar

This building is located outside the eastern part of the city walls of Ptolemais, some 250 m north of the foot of Gebel al-Akhdar and some 100 m south of a Roman bridge (**Fig. 3**). The basilica is clearly visible from the east thanks to a large stone rubble heap. In this place Wadi Ziwana meanders towards the east, leaving a c. 100 m long gentle slope between the walls and the wadi. The basilica was erected on the very bank of the wadi, about 60 m from the city walls. The area between the building and the walls is occupied by a cemetery consisting of numerous limestone sarcophagi (quite often completely preserved) and rectangular rock-cut cist graves.

The dimensions of the building (**Fig. 4**) are c. 39 m (NW-SE axis) by 25.5 m (NE-SW axis). It was located c. 45 m above sea level. The basilica, erected on the edge of the wadi, was in a constant danger of sliding down the bank caused by the erosion of the ground. Such a location called for a strengthened construction. Therefore, a retaining wall (c. 0.6 m thick) was built, which is now clearly visible on the surface. West of this wall (in the distance of c. 4.3 m) a portico can be noticed consisting of four columns found *in situ* (each c. 0.8 m in diameter). The intercolumniation is c. 2.9 m (+/- 5 cm), but between the second and third columns it measures 8.5 m. Such a discrepancy is connected with the adding of an apse on the east side of the building. The apse has been only partly preserved, as part of its walls slid down the bank of the wadi. Nevertheless, this construction, measuring 6.9 m in diameter, appears to have been added to the main wall of the basilica in a later phase. In its central part, in the axis of the wall, one can notice grooves for steps, most probably remains of a synthronon. An additional element pointing to a liturgical function of the building is a stone block with a cross in relief (**Fig. 5**), doubtlessly a keystone.

Hypothetical reconstruction of the building near Wadi Ziwana

The analysis of the relation of the apse axis to the second and the third columns seemed to be the best point of departure for reconstructing the shape of this basilica. Thanks to this analysis the following measurements were obtained: 4.5 m from the centre of the second column to the axis of the basilica; 4.0 m from the centre of the third column to the axis of the basilica. The distance of 8.5 m between the second and the third columns is roughly equal to three standard intercolumniations of 2.9 m (+/- 5 cm), which makes it possible that two more columns (both 0.8 m in diameter) may have been placed there (marked as A and B on **Fig. 4**). Apart from the four columns found *in situ*, two other columns were found lying on the ground. Their precise location is unknown, but their probable position can be reconstructed based on calculating the known intercolumniation and comparing the result with a calibrated aerial photograph on which the two fallen drums are visible. The columns marked as C and D must have fallen towards the east. The distance equal to three standard inter-columniations (measured from the eastern line of drums) and the arrangement of the fallen elements appear to confirm their reconstructed position.

The building must have extended towards the west, yet no constructions are visible on the surface. Therefore, the original shape of the basilica cannot be established without excavation work. While the excluding of the columns reconstructed as A and B from the plan of the basilica allows establishing the width of the main nave, we have no means to know its length. It is quite probable, however, that the nave extended beyond the reconstructed western row of columns (C and D).

[7] J.S. Aber, *History of Kite Aerial Photography*. Available at <http://www.geospectra.net/kite/history/history.htm.Aber 2008>.

This edifice seems to have been constructed on an earlier building, which is indicated by both the asymmetrical axis of the apse and a different brick bond used in the construction of the apse. The irregularities in the ground plan point to a terrace building, perhaps a pagan temple, as a predecessor of the basilica. However, this hypothesis cannot be verified without excavation works and at present it seems to be confirmed only by analogous terrace sanctuary, of Demeter and Persephone in Cyrene.[8]

As this area is rather loosely built-up and there are hardly any spatial requirements for erecting buildings, it seems that the basilica was intentionally located on the bank of the wadi. This may have resulted from a general idea of locating temples on escarpments, making them visible from a considerable distance, and is probably connected with erecting primeval sanctuaries on hilltops and slopes.

The basilica near Wadi Ziwana/Omran

This building is located on the west bank of Wadi Ziwana (in its lower course called Wadi Omran; see note 2), and neighbours the eastern necropolis of Ptolemais. The city walls are hardly visible in this area owing to the modern settlement, but the basilica is certain to lie outside the city, c. 300 m from its walls. Both east and west of Ptolemais, pits belonging to ancient quarries are situated. Many of them, especially the ones nearest to the city, were adapted for sepulchral purposes. In the walls of the quarries, rock-cut burial chambers are found, both single and in groups, sometimes connected with rock-cut corridors. Additionally, numerous cist graves were cut in the quarries' bedrock. The landscape is complemented by freestanding limestone sarcophagi in various state of preservation, from tiny pieces to whole objects together with lids.

The basilica (**Fig. 6**) was discovered in 2004 by Professor Tomasz Mikocki while excavating an Attic sarcophagus. This marble sarcophagus, found in fragments a year earlier by Faraj Tahir and Abdusalam Bazama, the employees of the Tolmeita (Ptolemais) Museum, is dated to the 2nd c. AD. It seems, however, that it appeared in the church at a much later date, probably after its sculpted decoration had been reworked in the 5th c. or slightly later. This object was placed at that time in the northwestern room of the narthex, and presumably contained mortal remains of a significant clergyman, a martyr, or a statesman. The sarcophagus was moved to the Museum, where it was restored and reconstructed by the Polish Archaeological Mission. It is now on permanent display at the museum. The sarcophagus was studied in detail by Faraj Tahir in his MA thesis.[9]

During the excavation in 2004, remains of the narthex of the basilica were brought to light as well as other architectonic elements within 100 m². During this work, it was possible to uncover a fragment of the basilica's walls, a few columns, and the axis of the whole structure (marked black on **Fig. 6**). The basilica, originally located in one of the quarries/cemeteries, has been preserved only in its foundations and is now virtually invisible on the surface, apart from the excavated part. In its immediate vicinity, modern pastoral houses with farmyards were built (marked grey on **Fig. 6**). Fortunately, the modern building activity stopped at the southern wall of the basilica; the interior of the church appears to remain untouched. Yet, only the excavation in this area could verify this opinion.

Although the area of this basilica is easily accessible for non-invasive research, the electrical resistivity tomography is hard to apply owing to the aridity of the soil and the presence of many metal wastes both on the surface and just beneath it. This latter fact, in turn, makes the electromagnetic survey impossible. In practice, removing the garbage would mean excavating the area. Therefore, the only non-invasive methods applicable here were the aerial photography and the total station measurements.

Thus, a plan of the basilica was created (**Fig. 6**), in which the precise total station measurements (+/- 5 cm) were the point of reference for the spatial distribution of artefacts. The following elements were measured:

1. the width of the outer wall (1.3 m; detected in several places);
2. the width of the inner wall in the narthex (0.65 m);
3. the distance between two inner corners in the western part of the basilica (19.62 m; adding the width of the outer wall, the total length of the shorter side of the church can be established at 22.22 m);
4. single stone blocks preserved *in situ*, on the border of the modern buildings.

The measuring of the shorter side of the church made it possible to also establish the length of the longer one, calculated according to the ratio of 1.7:1, known from a few Libyan examples: one from Cyrenaica (the West

[8] D. White, *The Extramural Sanctuary of Demeter and Persephone at Cyrene, Libya: The site's architecture, its first six hundred years of development*, Philadelphia 1993, 37.

[9] F.A.O. Tahir, *Sarkofag antyczny z nekropoli Wadi Omran w Ptolemais, Libia*, Warszawa 2006, MA in the Institute of Archaeology, University of Warsaw.

Church at Apollonia) and two from Tripolitania (Basilica 4 at Sabratha and el-Khadra at Breviglieri).[10] This ratio allowed estimating the length of the longer side at 37.77 m and placing the reconstructed plan in the context of the visible architectonic elements, paying special attention to the measured south-eastern corner.

It is worth noticing in this place that the ratio of the West Basilica at Ptolemais is 1.6:1. Additionally, the constructional axes of both buildings are virtually parallel. This is all the more interesting since they are the two remotest churches in Ptolemais known to date; the distance between them is 1650 m.

The walls of the basilica near Wadi Omran were constructed of local limestone and the columns were made of marble. On the basis of the preserved elements, the intercolumniations can be estimated at 2.21 m, which is close to seven modules of the Roman foot (0.296 m).

Similarly, the shorter and the longer sides of the basilica can be calculated at 75 and 130 feet, respectively. In result, the main nave must have been separated from the aisles by two rows of eleven columns. Two more columns supported the passage to the narthex. All of them were 0.5 m in diameter in their lower parts. The reconstruction of the apse and the eastern pastophories is hypothetical, based on the following calculation: the width of the main nave (measured between the centres of two opposite columns) is 10.8 m (37 feet), which constitutes the half of the total width of the church; such a nave could accommodate an apse measuring 8.8 m in diameter (30 feet).

The hypothetical entrance to the basilica, placed in the eastern wall, was marked with an arrow on the plan (**Fig. *6***).

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[10] R.M. Carra Bonacasa, *La basilica occidentale di Tolemaide dallo scavo al progetto*, (in:) E. Jastrzębowska, M. Niewójt (eds.), *Archeologia a Tolemaide...*, 223.

Miron Bogacki, Wiesław Małkowski

Badania topograficzne w obrębie dwóch budowli chrześcijańskich położonych poza murami Ptolemais (Cyrenajka, Libia)

W ramach badań nad architekturą chrześcijańską Ptolemais (Cyrenajka, Libia) wykonano pomiary topograficzne dwóch budowli, które sklasyfikowano jako chrześcijańskie bazyliki. Oprócz pomiarów geodezyjnych wykonano też fotografie lotnicze z użyciem latawca. Obrazy lotnicze zostały połączone z planem sytuacyjnym jako kartometryczne fotomapy. Umożliwiło to analizę poglądową dokumentowanego obszaru, jak i wykonywanie pomiarów bezpośrednio na zdjęciu. Opracowanie wyników w formie fotomap pozwoliło na rysunkową rekonstrukcję planów budowli.

Obydwie budowle o cechach chrześcijańskich bazylik zlokalizowane są na obszarze nekropoli poza wschodnimi murami antycznego miasta.

Pierwszą omawianą w tekście jest budowla u stóp wzgórz Gebel al-Akhdar. Jest to obiekt, w przypadku którego zaadaptowano w dużej mierze wcześniejszą architekturę do funkcji kościoła lub kaplicy chrześcijańskiej. Przypisanie funkcji bazyliki wynika głównie z obecności absydy po wschodniej stronie oraz przedstawienia krzyża na dekorowanym reliefem bloku kamiennym.

W odległości około jednego kilometra na północ, stosunkowo blisko wybrzeża morskiego, znajduje się druga budowla – bazylika przy Wadi Ziwana/Omran. Obiekt zlokalizowany jest w przestrzeni kamieniołomu, który pełnił później funkcje sepulkralne. Bazylika została odkryta w 2004 roku przez Prof. Tomasza Mikockiego podczas eksploracji sarkofagu attyckiego, datowanego na II w n.e.; około V wieku został poddany przeróbce rzeźbiarskiej i następnie, ze zmienioną dekoracją, umieszczony był w przedsionku kościoła. Do pomiaru odczyszczono elementy planu kościoła: narożniki murów, bazy kolumn, ściany narteksu (w którym znajdował się sarkofag).

W oparciu o analizę fotografii lotniczych, a także danych pochodzących z pomiarów, wykonano hipotetyczny plan bazyliki. W sąsiedztwie budowli znajdują się współczesne domy pasterskie z zagrodami dla zwierząt, częściowo wykorzystujące zachowane ściany bazyliki. Szczęśliwie dla pozostałości budynku kościoła, współczesna architektura oparła się jedynie na murze południowym, dzięki czemu wnętrze planu jest zapewne w całości nienaruszone. Nie ma jednak co do tego pewności, ponieważ, jak dotąd, nie przeprowadzono tu szerokopłaszczyznowych badań wykopaliskowych. Rekonstrukcja planu tego założenia pozwala jednak dość precyzyjnie określić wymiary oraz proporcje budowli, dzięki czemu możliwe są porównania z innymi znanymi obiektami tego typu.

PLATE 58

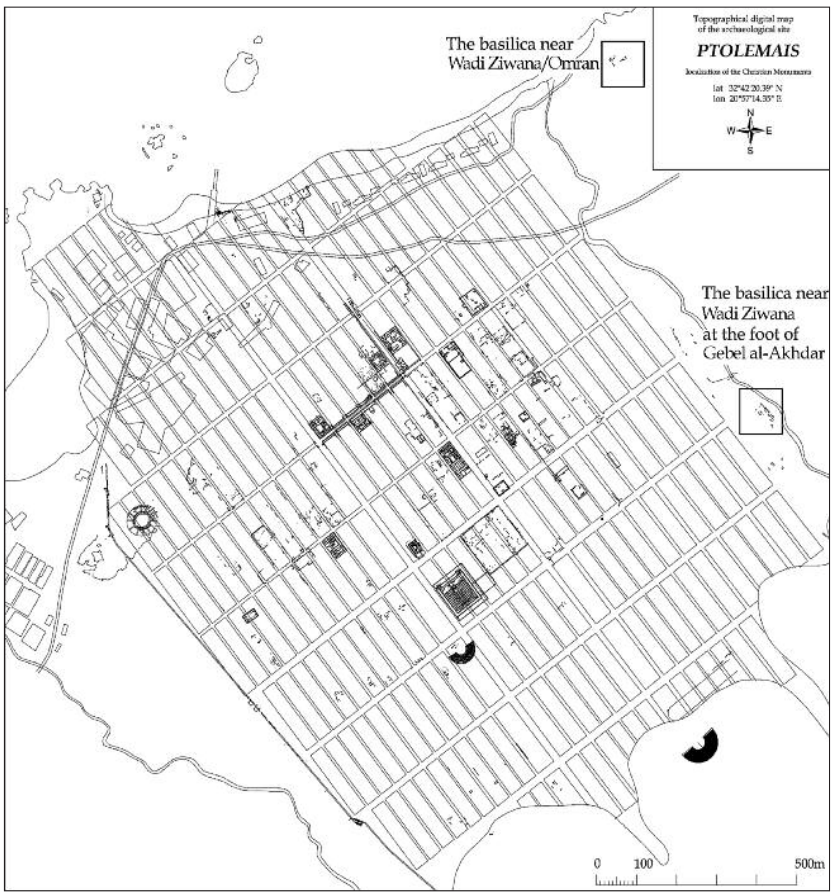

Fig. 1. Plan of Ptolemais with localization of the extramural basilicas (Drawing W. Małkowski).

Ryc. 1. Plan Ptolemais ze wskazaniem bazylik położonych poza murami miasta.

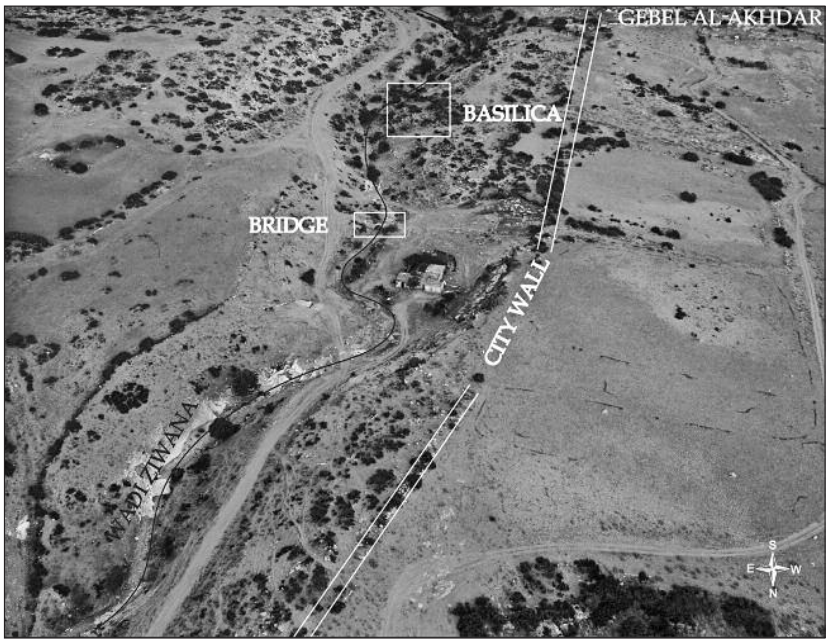

Fig. 3. Wadi Ziwana area. Oblique scene with interpretation (Photo M.Bogacki, Drawing W. Małkowski).

Ryc. 3. Obszar Wadi Ziwana. Ukośny obraz z fotointerpretacją.

Fig. 2. Photographic mosaic of the Wadi Ziwana area (Photo M. Bogacki).

Ryc. 2. Obszar Wadi Ziwana. Mozaika obrazów fotograficznych.

PLATE 59

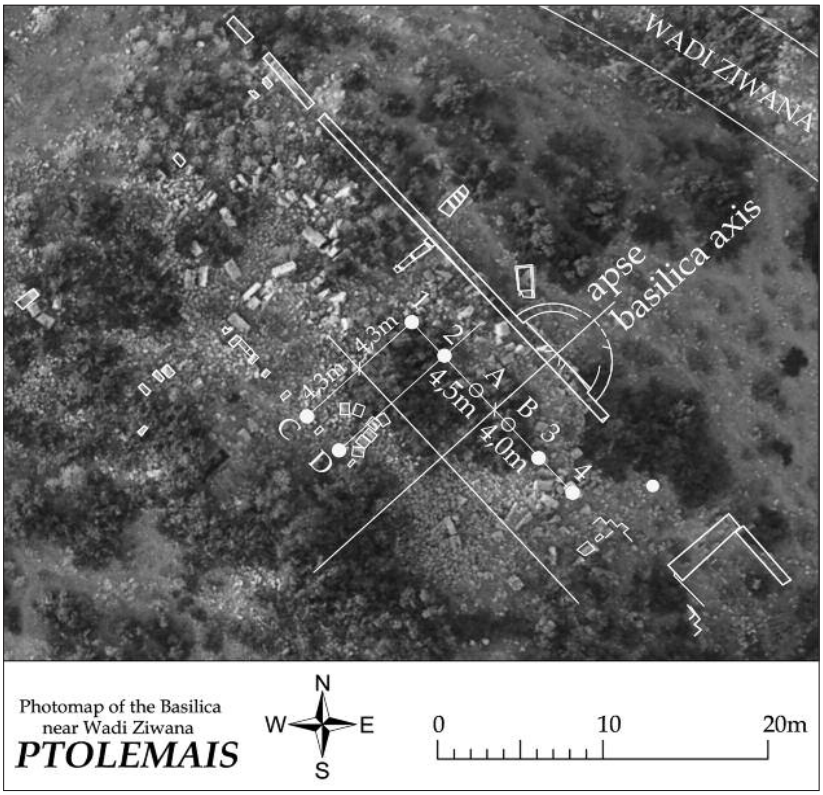

Fig. 4. Photoplan of the Basilica near Wadi Ziwana (Photo M. Bogacki, Drawing W. Małkowski).

Ryc. 4. Fotoplan Bazyliki w pobliżu Wadi Ziwana.

Fig. 5. Stone block with a cross relief from Basilica near Wadi Ziwana (Photo W. Małkowski).

Ryc. 5. Blok kamienny z reliefem w kształcie krzyża, Bazylika w pobliżu Wadi Ziwana.

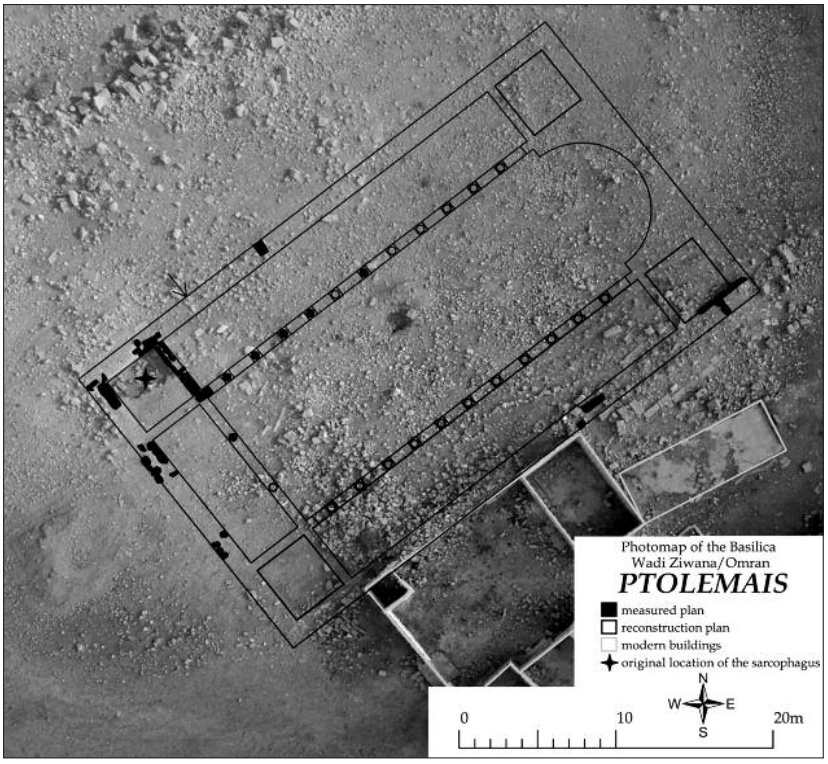

Fig. 6. Photoplan of the Basilica near Wadi Ziwana/Omran (Photo M. Bogacki, Drawing W. Małkowski).

Ryc. 6. Fotoplan Bazyliki w pobliżu Wadi Ziwana/Omran.