HISTORICAL AND ENVIRONMENTAL DETERMINATIONS OF THE ANCIENT EGYPTIAN FORTRESSES IN TELL EL-RETABA

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The paper is focused on historical connotations of the Tell el-Retaba site to its geographic position with regards to hydrologic and pedologic situation. It suggests the position of Wadi Tumilat on the Peutinger map and persistence of desert (military) routes in the area around the Wadi. The river aggradation mound ascertained in Tell el-Retaba allows us to suggest an existence of natural riverbeds or a canal in Wadi Tumilat even before the Second Intermediate Period. The paper also brings some pedological explanations to origins of settlement. It presumes that besides the canal on the western and southern side of the Tell a marshland/swamp could also originate on its northern side, after the settlement occurred on the Tell. The occupation probably developed directly on the Bw horizon of original soil, as agricultural or grazing settlement. The humiferous A horizon was removed prior to construction.

Key words: Tell el-Retaba, Wadi Tumilat, canals, desert routes, maps, geography, pedology

Tell el-Retaba (تل الرطابى)[1] is situated in a (originally narrow desert) valley (*Wadi Tumilat*[2] *or Tumaylat*;[3] وادي الطميلات)[4] leading from the eastern rim of the middle Nile delta eastward, towards Crocodile Lake (*Buhayrat el-Timsah*) in the Isthmus of Suez. It is about mid-way between Zagazig (ancient Bubastis) and Ismailia (Suez Canal), approximately 35 km westward of Ismailia. It appears as a slightly elevated dry plateau standing out from the cultivated alluvial plain of Wadi Tumilat. Since 2007 Tell el-Retaba became an excavation site of a joint Polish-Slovak archaeological project.[5]

During excavations several questions emerged on the historical, environmental and constructional determinations of the excavated structures. Looking for answers on these questions requires a combination of archaeology, written sources and an inter-disciplinary approach, based on relevant natural sciences

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1 Actually *el-Retābī*: adjective is allegedly given according to a kind of dates (*rutab*), which are preserved with about 35 – 40% moisture (see www.fao.org/docrep/t0681e/t0681e03.htm). Nowadays, there are not so many palm trees in the vicinity of the site.

2 According to J.K. HOFFMAIER (Ancient Israel in Sinai, p. 62) the name of the Ancient Egyptian god Atum is preserved in the name of the Wadi. However, DIODORUS (Library of History I, 33:12, p. 113) mentions that the river, which flows through Wadi's canal, "*is named Ptolemy*". The name seems to still be known after at least 300 years (PLINY the Elder. Natural History VI, XXXIII, 165, p. 463) and it might be worth for linguists to contemplate whether the name Ptolemy could not be rather the source for Tumaylāt; i.e. *Ptwlmjs* could pass through Demotic and Coptic dialects as *P(3)-twlmj-s,* with sooner or later kinetic reversal/metaplasm (LIPIŃSKI, E. Semitic Languages, p. 598) into *Twmil(-s)*, reinforced by Arabic طمي (تربة الطمي– "*alluvial soil*"), see http://arabic.britannicaenglish.com; which also has a reasonable and apt meaning in connection with the character of the (western part of the) Wadi.

3 COOPER, J. The Medieval Nile, p. 97.

4 Eastern part of the Wadi was also previously known as "*Wady Saba Byar*" (Abar), i.e. *Valley of seven water wells*. CALMET, A. et al. Dictionary of the Holy Bible, p. 465; ROBINSON, E., SMITH, E. Biblical Researches, p. 73.

5 The project is implemented by the Institute of Archaeology of the University of Warsaw and the Aigyptos Foundation, Žitavany, supported by the Polish Centre of Mediterranean Archaeology in Cairo; the Slovak part of the team has been led by Jozef Hudec since 2007. The Institute of Oriental Studies, Slovak Academy of Sciences have been involved in the project since 2013 and received the research grant APVV-0579-12: *Slovak Research of Ancient Egyptian Civilization*. More on the history of the site and the research results see: RZEPKA, S. et al. Tell el-Retaba 2014 (in print), RZEPKA, S. et al. *Tell el-Retaba from the SIP till the LP*, pp. 39 – 120; RZEPKA, S. et al. *NK and TIP in Tell el-Retaba*, pp. 129 – 184; RZEPKA, S. et al. *Tell el-Retaba 2007 – 2008*, pp. 241 – 280; RZEPKA, S. et al. *Tell el-Retaba, season 2011*, pp. 87 – 108; RZEPKA, S. et al. *Tell el-Retaba, season 2010*, pp. 79 – 95; RZEPKA, S. et al. *Tell el-Retaba: season 2009*, pp. 107 – 123; RZEPKA, S. et al. Tell el-Retaba 2008, pp. 138 – 145. RZEPKA, S. et al. Tell el-Retaba 2007, pp. 143 – 151; WODZIŃSKA, A. Tell el-Retaba 2011, pp. 109 – 115; WODZIŃSKA, A. Tell el-Retaba, season 2010, pp. 96 – 103; WODZIŃSKA, A. Tell el-Retaba 2009, pp. 124 – 133; WODZIŃSKA, A. Tell el-Retaba 2008, pp. 146 – 152. WODZIŃSKA, A. Tell el-Retaba Ceremic Survey, pp. 152 – 159.

and technical disciplines. This contribution focuses on some such questions related to the excavations.

Tell el-Retaba was already regarded strategic in Ancient Egypt, given by its geographic position and hydrology. The persistence of the geographic importance could be supported even later on by Napoleon's expedition to Egypt in the years 1798 – 1801, which also documented to a large extent the geography of Egypt, including Wadi Tumilat (Pl. 1 and 2).

1. Canals and sea

The situation captured on *DESCRIPTION de l'Égypte*'s maps indicates that parts of an ancient canal, connecting the Eastern Delta and the Red Sea areas, were still visible to the Frenchmen, although silted up in several places. From the village of El-Abaseya in the west, up to Ras el-Wadi in the middle of the Wadi Tumilat, three disconnected segments of the canal seem to be plotted on the *DESCRIPTION* map[6] (Pl. 2). The canal runs into the Wadi Tumilat north of El-Abaseya, about the place where today's freshwater Ismailia canal (*Teraat al-Ismailia*), built in the 19th century, runs into it.

However, there were probably several canals differentiated by time (from the Middle Kingdom to Roman Period) and routes (north or south) in western Wadi Tumilat[7] and one route further in its eastern part – Wadi Saba' Abar. In the western part of the Wadi the canal of the *DESCRIPTION* map could be a descendant of the Northern canal, which might have left the old Pelusiac Nile branch[8] at Bubastis[9]/Zagazig or Phacussa[10].

The supposed Southern canal was recorded in the *DESCRIPTION* map in the vicinity of Tell el-Retaba only. Some 50 years later a section of the 1847 Brigade Française map[11] shows entire descendant of the Southern canal. Traces of the ancient canal between Ras el-Wadi and Tell el-Maskhouta are also well described in other sources from the 19th century.[12]

Modern canals of 19th century AD, including *Teraat al-Ismailia,* used some parts of the ancient canals.[13] The descendants of ancient canal(s) maintained

[6] DESCRIPTION, p. 76ff, Planche 30f (see http://descegy.bibalex.org/).

[7] REDMOUNT, C.A. The Wadi Tumilat, pp. 127 – 135; STIROS, S.C. Misconceptions, pp. 37 – 42, Fig. 2; COOPER, J.P. Egypt's Nile–Red Sea Canals, pp. 195 – 209.

[8] DIODORUS SICULUS. The Library of History I, 33:8, p. 111; COOPER, J.P. Egypt's Nile–Red Sea Canals, p. 198f.

[9] GODLEY, A.D. Herdotus, History II:158, p. 471.

[10] STRABO. Geography XVII, I:26, p. 79.

[11] COOPER, J.P. Egypt's Nile – Red Sea Canals, p. 201.

[12] DE BELLEFONDS. Mémoires, 127f.

[13] LANE E.W., THOMPSON, J. Description of Egypt, p. 65; REDMOUNT, C.A. The Wadi Tumilat, p. 130, note 15.

separately from the Ismailia one in Ras el-Wadi/Tell el-Retaba area. However, from two ancient canals which joined (south) westwards of Tell el-Retaba only one descendant survived nowadays in a special combination: it runs toward Tell el-Retaba from the north-western direction, as the Northern canal; it is supplied by a new influx of the *Masraf el-Wadi* canal, which might be descendant of the Southern canal.

Masraf el-Wadi runs roughly in the direction of old "*Bahar Abou Sir*" – i.e. the Abusir canal, which emerged from the now non-existent "*Berket el-Serigeh*" lake at the turn of the 18th and 19th centuries.[14] It is not excluded that the "*Bahar Abou Sir*" canal was the descendant of the anticipated ancient Southern canal in the western part of the Wadi Tumilat.[15] This canal might join the Northern canal in Ras el-Wadi area.

The conjunct canal runs further to the east;[16] the character of the wadi slightly changed eastward of Ras el-Wadi – from a wider alluvial plane it became a more narrowed valley, with several side tributaries (Pl. 2).

There is a contradictory discussion on the shape of the Red Sea shoreline in antiquity – whether it came from the Isthmus of Suez and into the eastern part of Wadi Tumilat. The roots of the submerged Isthmus (Inland See) are already connected with ancient authors.[17] Also, several modern researchers support this idea, mainly based on the presence of sea shells, and suggest that the Red Sea shore was close to Tell el-Maskhuta.[18] Other researchers strongly oppose this hypothesis, using oceanographic, archaeological and geological reasoning.[19] If "*Tell el-Maskhuta was the final terminus for the canal*" of Neko II[20] before the seashore at the beginning of the 6th century B.C.,[21] then the Red Sea should already be in its present scope at the end of the 6th century, when Darius started his canal[22] and erected stelae along its course.[23] It would mean that a serious tectonic or climatic change could have influenced the natural environment of Wadi Tumilat in the 6th century BC, which is neither confirmed by available sources of archaeoseismology,[24] nor paleoclimatology.[25] However, extended

[14] DESCRIPTION, p. 76, Planche 30.
[15] REDMOUNT, C.A. The Wadi Tumilat, p. 130.
[16] REDMOUNT, C.A. The Wadi Tumilat, p. 131.
[17] Overview of ancient authors see: FRITZ, G. A. The Lost Sea of the Exodus, p. 55f.
[18] VAN SETERS, J. Changing Perspectives 1, Fig. 1.
[19] FRITZ, G.A. The Lost Sea of the Exodus, pp. 111 – 123.
[20] VAN SETERS, J. Changing Perspectives 1.
[21] LLOYD, A.B. Herodotus, p. 157.
[22] LLOYD, A.B. Herodotus, p. 152.
[23] POSENER, G. La premiere domination perse, pp. 48 – 87.
[24] GUIDOBONI, E., COMASTRI, A., TRAINA, G. Catalogue of Ancient Earthquakes, p. 87ff; SINTUBIN, M. et al. Ancient Earthquakes.
[25] ISSAR, Arie S. Climate Changes during the Holocene, p. 22f, 82 – 86; BROOKE, John L. Climate Change and the Course of Global History, pp. 300 – 316.

water level in the Isthmus cannot be completely excluded, at least as a result of recorded high floods between the 9th and 6th century B.C.[26]

2. Natural river aggradation mound

It is improbable that several canals recorded by ancient authors were instructed by ancient Egyptian rulers to be dug from scratch. Also, due to economic and labour constraints[27] it is rather possible that canals utilised older riverbeds, and were in due times repaired and prolonged. Canals, thus, very probably utilised landscape formations from the Nile geologic periods[28] and also meanders from historic times. According to recent geologic and cartographic research it seems that between the late Middle Kingdom/SIP and Late/Ptolemaic Period there were broad Nile meanders/riverbeds flowing below/north of Memphis towards north-east.[29] SHEEHAN suggests "*the existence of a first millennium BC precursor to the part of the Canal of Trajan that follows the line of the Holocene channel*" and he connects it with the ancient *Jtj* canal, indicated in written sources westward of *Iwnw*/On/Heliopolis in the New Kingdom.[30]

It is also possible to expect kind of older natural (silted) riverbeds or semi-artificial canals in Wadi Tumilat. This assumption is also based inter alia on indication by Tell el-Retaba's excavation of an elevated natural gravel river aggradation mound (see STOPKOVÁ and FULAJTÁR below), which was utilised for a SIP cemetery and defence walls of the New Kingdom (primarily Petrie's Wall 1)[31] later on and which is respected by the flow of the descendant of the ancient canal even nowadays.

Elevations of western points that represent the top of the gravel layer were compared with the terrain in the northwest area of the site. As this area seems to be almost flat, an average elevation of 4.240 m was used for comparison. As Pl.

[26] SAID, R. The River Nile, p. 152.
[27] GODLEY, A.D. Herdotus, History (II, 158:4) mentioned 120,000 Egyptians who reportedly perished in the digging of Necho II's canal. This number is exaggerated (it would represent about 5% of the hypothetic total of the Egyptian population in Late Period; see BUTZER, K. Early Hydraulic Civilisation in Egypt, p. 85), similar to 100,000 construction workers at pyramids building (II, 124); the canal enterprises were complex and needed a lot of labourers. Comparison to the Suez Canal construction is only faint; for the Suez Canal (built between 1859 and 1869) about 20,000 Egyptian peasants were conscripted every 10 months (see www.suezcanal.gov.eg/sc.aspx?show=8) into forced labour (corvée) until it was banned by Ismail Pasha in 1863. Slowness of works has been highly criticised. Information on mortality is not reliable (several thousands), modern sources even use the numbers of Herodotus. The complexity of such enterprise could be illustrated by LLOYD, A.B. Herodotus, p. 157.
[28] SAID, R. The River Nile, pp. 32 – 56, 68 –77, Fig. 1.32.
[29] LUTLEY, K., BUNBURY, J. The Nile on the Move, p. 5, Final map.
[30] SHEEHAN, P. Babylon of Egypt, note 20.
[31] PETRIE, W.M.F., DUNCAN, J.G. Hyksos and Israelite cities. Tab. XXXV.

3 shows, the gravel layer in its lowest part is situated approximately 12 – 13 cm above the terrain of the plain. Location of the gravel layer points and terrain observation points in the field are shown in Pl. 4.

Preliminary model of the gravel layer was interpolated in open-source software *GRASS GIS*[32] using the module *v.surf*.rst.[33] Several settings of the tool were tested before the final version was chosen. According to cross validation results, the default settings of the module with higher tension (100 instead of the default 40) was used. This made the spline function more plastic.

Statistical characteristics of the input points show that the data is not too variable and the interpolated output is similar. However, as input points are quite sparse and they are distributed irregularly in the study area, lower precision of interpolated values can be expected.

In Tab. 1, there may be seen that the differences between real and interpolated values are quite high. Spatially heterogeneous dataset and the differences at input points reaching high values indicate that this interpolated model must be considered to be a preliminary study. As an initial preview it can be useful to predict the behaviour of the gravel layer, nevertheless, especially in large empty areas between the points the shapes might be virtual. As the gravel layer seems to be quite flat, this risk is relatively low, yet it is necessary to specify more input points to improve the precision of the model.

	Input points	**Interpolated raster**	**Cross validation**
Number of values	14	315	10
Minimum [m]	4.352	4.241	-0.687
Maximum [m]	5.594	5.562	0.349
Mean [m]	5.110	5.113	0.034
Variance [m^2]	0.193270	0.038077	0.092714
Std. deviation [m]	0.440	0.195	0.304

Tab. 1 Statistical characteristics of the dataset

Pl. 5 shows the preliminary model of the gravel layer (the colourful raster) compared with approximate DEM (the contours), including the differences between the real and interpolated values (cross validation points). It can be seen

32 *GRASS Development Team, 2015*.
33 MITÁŠ et al., 2015.

that the gravel layer is decreasing from the southeast to the northwest in correlation with the terrain. However, it is necessary to use additional input points and also more precise DEM in further research and modelling.

In hydrological and geological[34] context, it is worth taking into consideration the possible existence of a canal before the Second Intermediate Period (SIP).[35] Pharaoh Sesostris (II or III)[36] of the Middle Kingdom was mentioned by ancient authors[37] as the first ruler who allegedly dealt with a canal construction (or rather silt removal?) in Wadi Tumilat. Despite the local archaeological sources for the Middle Kingdom activities and settlements are rather sparse so far,[38] pottery from Tell el-Retaba's tomb 927 indicates very late 13th Dynasty through to early 15th Dynasty occupation.[39] Expected increased sedentarisation of populations, which the SIP Hyksos rulers governed later on, would not probably be possible without more irrigation water, which might be made available by Sesostris canal from the north-eastern riverbeds[40] into the Wadi Tumilat area.[41] Nota bene, the area was not developed or occupied for the first

[34] TRZCIŃSKI, J. in RZEPKA, S. et al. From Hyksos settlers to Ottoman pipe smokers. Tell el-Retaba 2014 (in print).

[35] It is not possible to estimate the SIP canal extension beyond/eastward of Tell el-Retaba in the present state of research; see REDMOUNT, C.A. The Wadi Tumilat, p. 134.

[36] G. POSENER (Le canal du Nil a la Mer Rouge, p. 268) suggested Sesostris I or III as the possible constructors; J.P. COOPER (Egypt's Nile–Red Sea Canals, p. 195) suggested Sesostris II. All of them were significant rulers, and Sesostris II and III are also known for their involvement into water regulation and canal construction; Sesostris II in Fayoum (VIOLLET, P.-L. Water Engineering, p. 66) and Sesostris III in the First Cataract (BREASTED, J.H. Ancient Records of Egypt, pp. 642 – 649.). We would rather favour Sesostris III because his reforms increased state organisational and labour capacities for complex projects and because of his frequent expeditions to Sinai (BREASTED, J.H. Ancient Records of Egypt, pp. 713 – 738). Moreover, there were exceptionally high Nile floods, mentioned in inscriptions of Amenemhat III (SAID, R. The River Nile, p. 145ff), who had quite long co-regency with Sesostris III (WEGNER, J. *The Nature and Chronology of the Senwosret III–Amenemhat III*, p. 251). The Tumilat canal could partly divert the high waters of the Delta. In this overall context we do not share the hypothesis that Sesostris was a substitution for a traditional or ideal pharaoh (LLOYD, A.B. Herodotus, p. 16ff).

[37] ARISTOTLE. Meteorologica I, XIV:25, p. 116f; STRABO. Geography XVII, I:25, p. 77; PLINY THE ELDER: Natural History VI, XXXIII:165, p. 461.

[38] REDMOUNT, C.A. The Wadi Tumilat, p. 134.

[39] RZEPKA, S. et al. *Tell el-Retaba from the SIP till the LP*, p. 95f.

[40] LUTLEY, K., BUNBURY, J. The Nile on the Move, p. 5, Final map.

[41] The canal could be constructed in context of higher Nile floods, registered during the late 12th Dynasty, after the droughts resulting from 4.2 ka BP Event (PARCAK, S. The Physical Context of Ancient Egypt, p. 10), similar to Fayoum water and reclamation management (VIOLLET, P.-L. Water Engineering, 65ff).

time in the Middle Kingdom; there are several evidences of the Easter harpoon nome's existence, already at the end of the Old Kingdom.[42]

3. Lake and dykes

There are also assumptions of a lake existence in the western part of the Wadi Tumilat, probably already filled with water up to Ras el-Wadi[43] in ancient times. Also, the name of the nome[44] – Eastern harpoon (*Wᶜ i3b*)[45] – does not indicate an arid area, rather a place where a hunt by harpoons was possible.

In pharaonic times is not attested, whether the lake, probably a result of annual floods, subsequently slowly dried up, or whether it was fed by a Nile canal also outside the flood season. Due to altitude[46] it is rather improbable that the Northern canal would be a source of non-flood water from the Zagazig area.

If deep enough and diverted from the Nile in the southern part of the 13th Lower Egyptian nome,[47] the Southern canal exploitation for perennial water might have brought higher chances. However, it seems, that bringing water was not the only purpose for such a canal. A relative high quantity of quartzite, which is found in Tell el-Retaba,[48] might indicate, that the canal could also serve quartzite mines in Gebel el-Ahmar (nowadays an Arab Contractors compound on el-Nasr Road, Cairo).[49]

In the 13th century AD geographer Yaqut mentioned caravanserai al-Sadir[50] in a marsh and bush area between El-Abaseya and el-Khashabi[51] into which pours the overflow of the Nile when it rises.[52] This indication, despite being medieval, would support, together with the cutting of the canal ceremony in the

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[42] FISCHER, H.G. Some Notes on the Easternmost Nomes, pp. 129 – 142.
[43] BIETAK, M. On the historicity of the Exodus, p. 22, Fig. 2.2.
[44] On *sp3t* and its original system see WILLEMS, H. Historical and Archaeological Aspects, p. 4 – 8, note 10.
[45] WILKINSON, T.A.H. Royal Annals, p. 165.
[46] The Delta slopes to the north, with a gradient 12 m its entire 170 km stretch – approx. 1:14 (ISSAWI, B. An introduction to the Physiography of the Nile Valley, p. 20).
[47] BAINES, J., MALEK, J. Atlas, p. 15; LUTLEY, K., BUNBURY, J. The Nile on the Move, p. 5, Final map.
[48] RZEPKA, S. et al. Tell el-Retaba 2007, p. 148.
[49] The mines were used since the Old Kingdom (ASTON, B.G., HARRELL, J.A., SHAW, I. Stone, p. 53f). Only optical comparison of similarities among quartzite pieces from Tell el-Retaba and Gebel el-Ahmar have been possible so far.
[50] COOPER, J. The Medieval Nile, p. 97.
[51] Tell el-Maskhouta is called Abou Kachab in DESCRIPTION (Pl. 2).
[52] COOPER, J. The Medieval Nile, p. 97. Al-Sadir was 3 days from Fustat. Google maps bee-line distance between Fustat and Tell el-Retaba is about 100 km. If a camel caravan travels ca 25 miles per day (CALDWELL, J. et al. World History, p. 14), it is 75 miles in 3 days, i.e. ca 121 km, what might be the limits of the realistic distance between Fustat and Tell el-Retaba via desert.

mouth of *Amnis Trajanus* (see below), an assumption that the lake in the western part of the Wadi Tumilat was rather seasonal than permanent, at least in its later part of existence.

It seems that waters might have been halted in Ras el-Wadi by either natural or an artificial barrier since closely undetermined period. So far it is supposed, that the higher altitude of Ras el-Wadi was a natural barrier. However, memoirs recall that in "*1800, while the French were there, the Nile not only flowed into the valley, but broke through a great dyke near the middle of it and penetrated almost to the Bitter lakes. The water on this occasion, in some parts of the valley, was from twenty to thirty feet deep*".[53]

In the 12th century a dyke is mentioned at the end of the Wadi Tumilat canal in "al-Sadir in al-Sharkiya."[54] Beside these sources from the 2nd millennium AD, DIODORUS SICULUS[55] and STRABO[56] mentioned that a barrier or a lock was on the Ptolemaic canal in Wadi Tumilat (thus more than a thousand years earlier).

It is likely, that the "*great dyke near the middle of*" Wadi Tumilat could be Tell el-Retaba; its defence walls and position across the middle of the Wadi's width were probably interpreted as a dyke. On satellite photographs[57] Tell el-Retaba looks indeed like a huge dam across the valley, even though it is not the largest ancient ruin in the Wadi.[58]

Although it was not the main purpose of the Tell el-Retaba fortresses, it seems their walls might be able to resist floods to some extent. The Petrie's Wall 2 (P2) and Migdol gate[59] were built into a mound of fine yellow sand,[60] as attested so far on the western and southern side of the fortification. The mound was heaped on artificially removed and levelled cultural layers. The surface of the level below the P2 Wall mound was hardened, probably as a result of walking and/or building activities. The thickness of the sand layer below the P2

[53] CALMET, A. et al. Dictionary of the Holy Bible, p. 465. Mentioned 20 – 30 feet means depth of ca 6 – 9 metres.
[54] COOPER, J. The Medieval Nile, p. 97.
[55] Library of History I, 33:11; "*At a later time the second Ptolemy completed it, and in the most suitable spot constructed an ingenious kind of lock* (diaphragma)"; MURRAY, W.M. The Age of Titans, p. 77f.
[56] Natural History, XVII, I: 54 – 55.
[57] Satellite Dataset Declass 2 (2002), acquisition date 25 April 1966 (*earthexplorer.usgs.gov*); author is in debt to Mr François LECLÈRE for reference to the website.
[58] The largest ancient ruin was "*Abookescheyd*", i.e. Tell el-Maskhouta; see WILKINSON, J.G. Topography, p. 320.
[59] PETRIE, W.M.F., DUNCAN, J.G. Hyksos and Israelite cities. Tab. XXXV.
[60] HUDEC, J. in RZEPKA, S. et al. *Tell el-Retaba from the SIP till the LP*, p. 71f; HUDEC, J. in RZEPKA, S. et al. From Hyksos settlers to Ottoman pipe smokers. Tell el-Retaba 2014 (in print).

Wall's bricks varied. It was recorded that the northern face of the southern P2 Wall was covered by fine yellow sand to a height of about 1.7 m, the fine sand layer finished about 4.5 m northwards of the P2 Wall. The "ramp" of fine yellow sand was covered by a layer of grey coarse grained sand which was about 80 – 90 cm thick. The layer was extended almost to the ruin of the P1 Wall (Pl. 6). The fundaments of the P2 Wall, which were about 6 m thick, slightly rises southwards;[61] the yellow and grey sand layer probably served both (1) to stabilise the pressure of masonry on the northern face of the Wall (also in case of floods); (2) to enable approach to at least 3.5 m height of the P2 Wall. Similar sand ramp could also be found on the internal side of the almost 10 m wide western P2 Wall. The fine sand was also observed in the wall sections by NAVILLE.[62] Petrie's Wall 3 was built over the sand ramp some time later, still during the rule of Rameses III.[63]

It can be assumed that the recent shape of the Tell, which gradually increases from west towards east by at least 3 – 5 metres (see Digital elevation models of E. Stopková, Figs. 7 – 11), was also formed by abrasion of more or less frequent floods,[64] after its occupation was abandoned.[65]

Digital Elevation Model (DEM) of the northern part of the Migdol's Northern tower (cut by the trench of Naville in the 19th century)[66] was interpolated in *Surfer® 11* (*Golden Software, Inc.*) using interpolation method *Kriging*. The resolution of output raster is 5 cm. The DEM is the result of data collection during the 2014 season only and will be continued in future seasons.

The probably washed away westernmost extension of the Tell has already been used for agricultural purposes since the 1980s (it was not so before).[67]

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[61] To resist outside pressure from the South?

[62] NAVILLE, E.H. The Shrine of Soft el Henneh, p. 24f.

[63] RZEPKA, S. et al. *Tell el-Retaba from the SIP till the LP*, p. 73ff; HUDEC, J. in RZEPKA, S. et al. From Hyksos settlers to Ottoman pipe smokers. Tell el-Retaba 2014 (in print).

[64] See information of Mr Emil FULAJTÁR on the pedologic PII profile below. If 15 – 16 cubits was an optimal height of flooding (GODLEY, A.D. Herdotus, History II: 13, p. 289) in the Memphis area and 6 – 7 cubit (3 – 3.5 m) in the middle of the Delta (SELIN, H. Encyclopaedia of the History of Science, p. 1752), it means that 3 – 4 meters might also be sufficient in the middle of Wadi Tumilat. In such a case top levels of Tell el-Retaba would be high enough above optimal flooding. The above mentioned flooding in 1800 AD seems to be extraordinary high.

[65] The Tell could be the natural barrier in the Wadi also if it had a shape of an "island", as the results of geological and pedological research (TRZCIŃSKI, J. in RZEPKA, S. et al. From Hyksos settlers to Ottoman pipe smokers. Tell el-Retaba 2014 (in print); FULAJTAR, E. below) might be interpreted.

[66] HUDEC, J. in RZEPKA, S. et al. *Tell el-Retaba from the SIP till the LP*, p. 68f, Fig. 54.

[67] The Tell was not accessible until an Israeli-Egyptian peace agreement was signed, thus the western part was still intact before the 1980s.

Therefore, it will be difficult to ascertain archaeologically the sort of settlements in this part of historic area and rather pedologic research could be helpful here (see FULAJTÁR below).

The question of a possible dyke(s) might deserve more attention and research in the future. Any dyke has not been proven by excavations in Ras el-Wadi/Tell el-Retaba so far.[68] If any dyke existed (beside misinterpretation of defence walls as dyke), then questions would arise about its date[69] and detailed purpose.

Dyke utilisation as a **bridge over the canal** would be one among the first logical purposes. However, in such a case the dyke would make an obstacle to navigation and discontinue the canal's purpose to connect the Delta/Mediterranean and the Red Sea, as mentioned in ancient sources.[70] Beside interruptions by bridge(s) or dyke(s), navigation was also nevertheless complicated by flood periods,[71] water flow and depth and wind directions.[72] It seems that cruise was rather one way constrained – from west to east. Sailing westward was probably not as naturally a simple enterprise as aerodynamic drag on the Nile. The prevailing north wind did not exclude leeway, which might be, however, complicated by the supposed width of the canal (ca 30 – 46 m).[73]

Since time of Aristotle[74] questions have arisen about **sea waters possibly coming** to inland, if the canal was connected to the Red Sea. However, the Nile water followed a natural gradient, from the Nile altitude of ca 12 m near Cairo[75] to ca 10 m in the western part of the Wadi and to 2 m in its eastern part.[76] Although there are significant difference in the tidal ranges between the Mediterranean (ca 10 cm) and the Red Sea (up to 2.7 m),[77] neither tidal wave was able to penetrate into Delta. However, at least an extraordinary Red Sea tide or tsunami might have some impact on the area from the Gulf of Suez up to

[68] A dune–like projection on the northern side of the Tell has not been excavated yet.
[69] In written sources, indications are absent about a dike which would predate Ptolemaic period and DIODORUS. Library of History I, 33:11.
[70] GODLEY, A.D. Herodotus, History II:158, p. 471f; STRABO. Geography XVII, I:25, p. 77ff; DIODORUS SICULUS. The Library of History I: 33, pp. 109 – 113; PLINY the Elder. Natural History VI, XXXIII:166f, p. 461ff.
[71] KAHN, D., TAMMUZ, O. Egypt is difficult to enter, pp. 37 – 66.
[72] HUME, W.F., LYONS, SIR H.G., GREAVES, R.H. Egypt, p. 39.
[73] STRABO. Geography XVII, I: 25, p. 77ff; PLINY THE ELDER: Natural History VI, XXXIII:166f, p. 461ff.; LLOYD, A.B. Herodotus, p. 153.
[74] ARISTOTLE. Meteorologica I, XIV:25; p. 116f.
[75] ISSAWI, B. An introduction to the Physiography of the Nile Valley, p. 8.
[76] ISMAEL, A.M.A.A. Applications of Remote Sensing, p. 8.
[77] STIROS, S.C. Misconceptions, pp. 37 – 42.

the eastern mouth of the Wadi Tumilat,[78] if a canal mouthed into the Red Sea. Thus, a construction of dykes could be possible, even, if also influenced by worries of improper calculations of natural constants (e.g. see level altitudes) by ancient engineers, as it was the case even at the turn of the 18th and 19th centuries.[79]

Possible dyke(s), lock(s) or barrier(s) on the ancient canal would therefore be more understandable in the eastern part of the valley. Anyway, usage of a lock dyke is also attested at the other end of the canal, in connection to the ceremony of the cutting of the canal[80] in Cairo. This custom is being connected by some Egyptologists to a much older tradition of cutting a dike, rooted at the beginning of Ancient Egypt.[81]

Exploitation of a dyke for **keeping strategic flooding water reserves** in the western part of the Wadi only, in order to inhibit nomads from exploitation of the eastern half of the boundary Wadi and control them,[82] might seem less probable. The name "*Wady Saba Byar*" (the Valley of seven water wells) used for the eastern part of the Wadi and reports in the 19th century indicate, that water could be available in the eastern part of Wadi Tumilat also by wells.[83] If no cardinal changes or amplitudes of these hydrologic conditions occurred in the Wadi, a dyke construction could prevent agricultural usage of water, rather than a pastoral one, especially in the years with less than optimal floods. This meaning could also be given to the above mentioned ceremony of the cutting of the canal, which did not allow to slop scarce water to non-essential, potentially nomadic areas in poor years. If water was already there the dykes might also serve to its better distribution for irrigations.

4. Communication node

Even at the turn of the 18th and 19th centuries the importance of Tell el-Retaba is continuously attested by its position of a central junction in the middle of Wadi Tumilat. Tell el-Retaba or Ras el-Wadi had a strategic role of

[78] Report, The Foreign Quarterly Review, p. 200f; Even if tectonic shifts might be supposed to have occured in the past, influencing the altitudes and tidal ranges, it does not seem to be the case FRITZ, G.A. The Lost Sea of the Exodus, pp. 111 – 123.

[79] Report. In *The Foreign Quarterly Review*, p. 193.

[80] SANDERS, P. Ritual, Politics, pp. 100 – 104; SHEEHAN, P. Babylon of Egypt, Fig. 49.

[81] King Scorpion; BADAWY, A. The civic sence of Pharaoh, pp. 103 – 109. Opening of dykes (sémasia) see also SEIDLMAYER, S.J. Historische und moderne Nilstände, pp. 93 – 103.

[82] Papyrus Anastasi VI, 4.11 – 6.5; GOEDICKE, H. Papyrus Anastasi VI, pp. 83 – 98; BIETAK, M. On the historicity of the Exodus, p. 20f.

[83] CALMET, A. et al. Dictionary of the Holy Bible, p. 465.

communication node. Desert caravan routes to and from Cairo, El-Khanqah[84] and Bilbeis crossed here with routes to and from Karaim,[85] Salhieh (El-Salhiyyah) and Bir Makdal (or Madkur?)[86] on Sinai Peninsula (see Pl. 1) and even further.[87]

It is noteworthy to compare the 18th and 19th centuries' desert road network with a more ancient one. At first glance the late Roman Tabula Peutingeriana[88] might not look like the best material for such purpose. Its cartographical deformations prevent proper reading of the map and rather postulate its "interpretation". However, putting side by side the Peutinger map (Pl. 12) and a map with a reconstruction of the historic Nile delta (Pl. 13) could be visual for a comparison, despite some twists of the Peutinger map.

First, it is possible to suggest that the Nile branch, denoted as river #107h by TALBERT,[89] which is "*leading to the easternmost of the mouths in the Nile delta*",[90] could be *Amnis Trajanus* (Canal of Trajan),[91] the canal flowing into Wadi Tumilat.[92] According to recent excavations, the original *Amnis Trajanus* flowed out of the Nile between bastions of the Babylon fortress,[93] as displayed on the Peutinger map. The *Amnis Trajanus* was the predecessor to *Khaleeg el-Masr*,[94] which was filled in and Cairo's Sharia Port Said has copied its direction since 1898.[95] At the beginning of the 19th century the canal only flowed into Birket el-Hagg, southward from El-Khankah.[96]

[84] El-Khanqah (meaning "sufi's gathering place") was once an important settlement, see *MEMOIRS*, p. 50. Description in MEMOIRS attracts to a suspicion, whether the name **Khanqah** could not be derived of ancient **Henikiu** from the Madaba mosaic map, despite the absence of proper archaeological evidences. At least Henikiu is on the eastern side of the Delta, south-east from Athribis; the identification with Kom Razin in the Western Delta (DONNER, H. The Mosaic Map of Madaba, p. 83, section C) is rather implausible.

[85] Probably El-Korin/Koryan in Kafr el-Lahaysah.

[86] GARDINER, A.H. The Ancient Military Road, Pl. XIII.

[87] E.g. to el-Arish: see CALMET, A. et al. Dictionary of the Holy Bible, p. 465.

[88] RUS, T. Römische Reisewege, p. 3ff; R. TALBERT (Rome's World, 2010, p. 162) suggests that the map's purpose was rather to celebrate peace by Diocletian's Tetrarchy.

[89] TALBERT, R.J.A. Rome's World, 2010.

[90] See http://www.cambridge.org/us/talbert/talbertdatabase/TPPlace3462.html

[91] LANE, E.W., THOMPSON, J. Description of Egypt, p. 65.

[92] "… on the border of Arabia and Aphroditopolis: Babylon, Heliopolis, Heroum city [Heroöpolis] thru which, as well as thru the city Babylon, flows the mountain stream Traianus". In PTOLEMY. *Geography* IV:5.

[93] SHEEHAN, P. Babylon of Egypt.

[94] LANE, E.W., THOMPSON, J. Description of Egypt, p. 65, 83.

[95] WILLIAMS, C. Islamic Monuments, p. 129; According to Williams it is also a predecessor of Necho's canal.

[96] LANE, E.W., THOMPSON, J. Description of Egypt, Fig. 2. Both later locations are now north-westward from to the Cairo International Airport.

The suggested identity of river #107h flowing into the Wadi Tumilat as *Amnis Trajanus* is also supported by the position of the cities of Clysma and Arsinoe and also by the (Great) Bitter Lake (*Lacus mori* or *amarus*),[97] even though the lake seems to be connected to the Gulf of Suez.[98] The connection of Wadi's canal back to Pelusiac (?) branch does not confront our suggestion, due to the existence of so far unknown meanders and canals.[99]

Second, the directions of routes on the Tabula Peutingeriana[100] resemble some directions used at least fourteen centuries later on the *Description* maps.[101] There are three destinations (Cairo, El-Khanqah and Bilbeis) southwest of Tell el-Retaba on the DESCRIPTION map (Pl. 1). It seems there are also three roads on the Peutinger map starting in the north of Babylon. Babylon, and predecessors of El-Khanqah and Bilbeis were separated from each other by an airline distance of about 30 km; thus also two later spots might have some Roman military significance.[102]

It is possible to suggest, that the desert roads on Peutinger's map starting north from Babylon[103] (today's Old Cairo) crosses the canal in Wadi Tumilat (Pl. 12) at Tell el-Retaba and continues on the northern site of the Wadi, as the similar road to Bir Makdal/Madkur.[104] The crossing on this spot was the first

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97 Buḥayra al-Murrah/ مرارة (al-Kubrā) in Arabic (http://www.britannica.com/place/ Great-Bitter-Lake). See http://www.cambridge.org/us/talbert/talbertdatabase/TPPlace 447.html; http://www.tabula-peutingeriana.de/ tp/tpx.html

98 However, the road leading through the connection of Gulf and Bitter Lake advise otherwise and indicates an overland connection.

99 OREN, E.D. Migdol, pp. 7 – 44; REDMOUNT, C.A. The Wadi Tumilat, p. 131f, note 24; MOSHIER, S.O., HOFFMEIER, J.K. Which way out of Egypt?, p. 103, Fig. 8:2.

100 http://www.cambridge.org/us/talbert/talbertdatabase/TPPlace425.html; http://www. tabula-peutingeriana.de/ tp/tpx.html.

101 DESCRIPTION, Vol. 6, p. 76, planche 30, carte topographique, Canal de Suez; Vol. 6, p. 14, planche.

102 Roman legionnaires could march ca 15 Roman miles per day on paved roads or 27 Roman miles in 24 hours by ship (LUTTWAK, E.N. The Grand Strategy, p. 81), i.e. over 22 km by road or 40 km by ship. Thus the distances among Fustat, Khanqah and Bilbeis could be roughly equal to two daily military marches (in hot Egyptian weather) or about 9 hours of navigation (by 1.7 knot or 3.15 km per hour speed at low Nile; by 3.5 knots or 6.5 km/h during a high Nile flood see COOPER, J. The Medieval Nile, p. 126). Heliopolis was about half way between Babylon and El-Khanqah. According to S. VINSON (Egyptian Boats and Ships, p. 7), the low water speed of the Nile was 1.85 km/h and high flood speed was 7.4 km/h. Flood could come by Amnis Trajanus to Ras el-Wadi (ca 120 km) in about 16 – 18 hours, thus less than a day.

103 See http://www.cambridge.org/us/talbert/talbertdatabase/TPPlace425.html; http:// www.tabula-peutingeriana.de/tp/ tpx.html

104 Which might have in some parts its track similar to the contemporary *Tareek el-Harby No. 36*.

possible opportunity from the side of the Delta[105] because the western part of the Wadi was covered by a lake or swamps for most of the year (see above).

However, there is no evidence that probable military etymology of Stratonicidi[106] on Peutinger map[107] could have any relation to Tell el-Retaba. Naville's views that Tell el-Retaba was also a Roman military camp (for slingers)[108] were not confirmed by recent excavations.

There is also another road on the southern side of Wadi Tumilat, which joins the northern one, after some stops, in the area of Simiati.[109] Due to the caption's location on the map it is not definitively clear which part of these roads along Wadi Tumilat has the length of 36 Roman miles (ca 53 km). In both cases it could be a reasonable distance between Tell el-Retaba and the area of Bir Makdal, as marked on the map in the *DESCRIPTION* de l'Égypte (Pl. 1).

It can be assumed that the desert (military and trade) highways persisted in similar directions, if travel and strategic conditions did not changed dramatically. In Egypt desert highways reflect independency of the distinctive/strategic geographic points they connected together away from the meandering and silting Nile branches, as is the case of a canal or canals and lake in Wadi Tumilat, especially in periods when waterways were not reliable and navigable in particular.

A historic extrapolation of the 18th century's desert (military and trade) roads' directions into the past could also be taken into consideration, if methods and ways of travelling and shipping had not changed radically.

Ancient Egyptian transportation (both civil and military) was strongly dependent on the usage of boats, ships and pack and/or draught animals. Among the earliest ways of transport documented so far in ancient Egypt were boats and ships[110] and asses (*Equius asinus*).[111]

In Wadi Tumilat transport by boats and ships could be assumed only from west to east and vice versa (see above). The usage of animals, especially donkeys, horses and camels provided, in comparison to waterways, a wider variability of directions and shortcuts, especially in the desert. Asses were used from prehistoric times; changes of their routes could have been slightly affected

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105 The Roman roads on the Peutinger map also avoid crossing the Delta (except the Mediterranean coast) and passed through in the area of the Babylon-Memphis narrow (Pl. 12).

106 *Στρατός νικητής*, Army of Victor?

107 www.cambridge.org/us/talbert/talbertdatabase/TPPlace425.html; www.tabula-peutingeriana.de/tp/tpx.html

108 NAVILLE, E.H. The Shrine of Soft el Henneh, p. 25.

109 See http://www.cambridge.org/us/talbert/talbertdatabase/TPPlace427.html; (Σήμα, σήματες - Signal?)

110 CASE, H., PAYNE, J.C. Tomb 100, pp. 5 – 18; JONES, D.A. Boats, 1995.

111 BOESSNECK, J. Die Tierwelt, p. 78f; JANSSEN, R, JANSSEN, J. Egyptian Household Animals. pp. 36ff.

by the introduction of horses (*Equus caballus*) approx. in the SIP[112] and by single-humped camels (*Camelus dromedarius*) approx. in the TIP.[113]

According to the above mentioned suggestion changes in ways of travelling and shipping and thus in routes directions might not be pushed by circumstances since at least the TIP by the late 19th and early 20th century, when railways and cars appeared.

5. Pedological survey[114] (E. Fulajtár)

There are many cases of valuable contributions of pedological research to interpretation of archaeological observations and data. Very useful is especially the capability of traditional general pedology and soil genesis to reconstruct the soil forming processes and development of the soil during different stages of changing geographical conditions and resulting soil forming processes. As the soil-scape is "*mirror of the land-scale*",[115] the reconstruction of soil genesis can contribute significantly to making the paleo-environmental reconstruction and help understanding the living conditions of ancient populations.[116] Apart of traditional approaches to the soils science can contribute to archaeological research by many narrow research specialisations.[117]

The exchange of information is valuable in both directions. The archaeological site represents from the pedological point of view a special long-lasting laboratory in which the soil genesis can be studied as the initial conditions of parent material and the time of soil development is known. This helps to understand the soil forming processes and to estimate the time needed for particular processes to manifest their effects.

In Tell el-Retaba some questions emerged which answering required interdisciplinary cooperation between archaeology and soil science.[118] These questions were related to:

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[112] JANSSEN, R., JANSSEN, J. Egyptian Household Animals, pp. 38 – 43.
[113] HEIDE, M. The Domestication of the Camel, pp. 331 – 384.
[114] Cooperation was established between the *Institute of Oriental Studies, Slovak Academy of Sciences* (*IOS SAV*), *Aigyptos Foundation* (*AF*), *Slovak Soil Science Society and the Soil Science and Conservation Research Institute of National Agricultural and Food Centre* (*SSCRI NAFC*) with an objective to perform a general soil survey of Tell el-Retaba.
[115] KUBIËNA, W.L. Micromorphological features of soil geography, 1970.
[116] GEBHARDT, A., LANGOHR, R. Micromorphological Study of Construction Materials, pp. 595 – 620.
[117] OONK, S. et al. Geochemical and mineralogical investigation, pp. 155 – 165; PATE, F.D., HUTTON, J.T. The Use of Soil Chemistry Data, pp. 729 – 739.
[118] RZEPKA, S. et al. Tell el-Retaba from the SIP till the LP, 2014, pp. 39 – 120.

1) the paleo-environmental conditions under which the settlement has developed;
2) the distinction between the anthropogenic and natural layers, represented by original soils and quaternary sediment formations;
3) the stratigraphic embedding of the ancient architectures into underlying layers.

This part of the contribution summarises the preliminary results of the pedologic field survey of Tell el-Retaba. The survey was incorporated into the program of excavations in the autumn of 2014. The archaeological excavations run in the western and south-western part of Tell el-Retaba.[119] The overview of the study site is provided in Pl. 14.

The results are mainly based on the field soil and sediment stratigraphic and morphological observations and supporting field methods (such as petrographic and mineralogical characterisation of coarse fraction, estimation of soil texture, remote sensing and geodetic measurements). The survey was supported by analytical parameters, which results are not available yet. However, for the purpose of the study the most important information is provided by the field methods and the major findings and conclusions can now already be done on the base of detailed and comprehensive field observations.

5.1. Objectives of soil survey

The soil survey at Tell el-Retaba had three major objectives:

1) The pedological characterisation of recent soil scape at Tell el-Retaba and its closest neighbourhood, paleo-pedological reconstruction of ancient soil-scape (status before the establishment of settlement), and the use of soil information for interpretation of paleo-environmental conditions, with the focus on living conditions of settlements at the investigated site.
2) The identification and characterisation of original natural soil formation directly underlying the anthropogenic stratigraphic complex.
3) The survey of stratigraphic formations (both anthropogenic and natural) in the surroundings of major excavated architectonical structures and the interpretation of stratigraphic situations with respect to embedding clarification of the ancient architecture basements especially the Migdol at the western end of the fortress, the fortification wall (Petrie's Wall 2),[120] and residential architectures of the New Kingdom and the Second Intermediate Period.

[119] RZEPKA, S. et al. Tell el-Retaba from the SIP till the LP, 2014, pp. 39 – 120.
[120] PETRIE, W.M.F., DUNCAN, J.G. Hyksos and Israelite cities. Tab. XXXV.

5.2. Methods

The methodological approach of pedological investigation at Tell el-Retaba was based on conventional pedological field survey methods – soil morphological description and its interpretation, aimed on the reconstruction of soil genesis and classification. The field estimation of textural classification was supported by the dry and wet sieving of coarse fraction (separated to two fractions 2 – 5 mm and more than 2 mm) and coarser sand fractions (except for fine and very fine sand) which was directly done at the study site in an improvised lab. Similarly the petrographic and mineralogical assessment of coarse fraction was done at the studied site. Classification of the investigated soils was done according to WRB.[121] The investigated soil profiles and morphological features were recorded by photo documentation. Characterisation of soils and sediments will be supported by basic soil analyses (soil texture, pH, CaCO3, organic carbon), soil micromorphology and soil mineralogy (mineralogy of coarse and sand fraction and x-ray analyses of clay fraction). The soil analyses should still be done.

The geographical and pedo-geographical characterisation of the site was supported by remote sensing. To get the information on relief elevation (especially the differentiation between Tell and the surrounding plain, but also within the area of Tell) needed for paleo-pedological and paleo-environmental interpretation of the soil survey geodetic measurements were made.

The archaeological site provided very suitable space for studying the ancient soil-scape and the contact zone between the original soils and the anthropogenic accumulations. These excavations represent in total approximately 1000 m long set of various outcrops of different orientation, depth and thickness where the exposed vertical profiles cut through the soils and deposits of various age and origin can be observed. Based on the careful survey of the whole length of these outcrops, a few major sites were selected to clean representative profiles.

5.3. Results

5.3.1. *Characterisation of the site*

Tell el-Retaba is a slightly elevated geomorphological unit of anthropogenic origin. It is a typical example of landscape structures abundant in Egypt, created by long-lasting ancient settlement. Such anthropogeneous deposits are considered by quaternary geologists as anthropogeneous sedimentary geological formation of holoceneous age and as cultural layers by archaeologists. From the pedological view point these deposits represent an anthropogenic parent

[121] IUSS Working Group WRB.

material for the development of anthropogeneous or urban soils. According to recent soil classification such soils can be classified as Technosols. This taxonomical unit cover soils developed on completely artificial parent materials created by man from material transported from other areas and deposited by man. The final stage in the development of typical Tell is covering the whole structure after it is abandoned by Eolian deposits.

Tell el-Retaba is a smooth topographical elevation of oval shape elongated along an east-west axis (Pl. 14). Its total acreage reaches approx. 20 ha. From the south it is directly neighboured by a fresh-water canal. The whole area of Tell is built by several meters of thick anthropogenic deposits of light texture. The colour of this material indicates significant content of organic matter. The anthropogenic deposits are from place to place covered by Eolian sands of light colour which does not contain organic matter. The Tell is very dry and practically bare. The only vegetation occurs in its western and north-eastern periphery. The surrounding area is flat alluvial plain intensively exploited by agriculture and intensively urbanised. Several villages and small townships are in close neighbourhood. The agricultural exploitation of the area is based on the use of canal irrigation. The following crops were recorded at fields surrounding the Tell: rice, millet, pea nuts, sesame and mango.

5.3.2. *Overview of investigated profiles*

The investigations covered all three major earth material formations occurring at the study site and in its closest surroundings – the natural quaternary deposits, natural and anthropogenic soils and anthropogenic deposits – archaeological cultural layers. Stratigraphy, soil horizonation and morphology were studied in the vertical soil profiles. Most profiles were carefully cleaned in already available outcrops of former archaeological excavations and on construction sites. These outcrops provided a lot of space for the investigation and were exploited as much as the terrain conditions allowed. The profiles were selected at well representative sites. The following major outcrops were investigated:

- Ditch of Egyptian rescue excavations.
- Excavation site of residential architectures from the New Kingdom period.
- Excavation site of residential architectures from the Second Intermediate Period.
- Construction pit in north-west periphery of the Tell.

Soils of adjacent agricultural areas were investigated with the aid of dug soil pits and auger boreholes. These investigation sites were situated in following fields:

- Peanut field with flooding irrigation west of the Tell.

- Mango orchard with flooding irrigation southward of the Tell (south of the canal).

Apart of the detailed morphological investigation of soil and sediment profiles there carried deep stratigraphic investigations using auger boreholes. In these stratigraphic profiles the detailed soil and sediment morphology was not investigated and attention was only focused on a basic stratigraphic description. The major purpose was to drill through all anthropogeneous layers and reach the natural substratum. This was the assessment of the whole complex of anthropogeneous sedimentary complex could be done. These drills were done at two sites and aimed at two purposes:

- Drills at Migdol: to assess the static embedding of the Migdol.
- Drill above the local market place: to investigate the contact between the anthropogenic depositions northward of the Tell and the adjacent plain.

5.3.3. *The pedological characterization of recent soil scape at alluvial plain surrounding Tell el Retabi*

Two dug profiles and 2 auger boreholes were described at agriculturally exploited alluvial plain: one profile (Profile I at agricultural land, PIa) (Pl. 15) and two auger boreholes (auger observations I and II) were at peanut field west of Tell el-Retaba and 1 profile (Profile II at agricultural land PIIa) (Pl. 16). The investigation of all four profiles showed that the soil-scape of plains adjacent to Tell are formed by the alluvial environment. The ground water table occurs at a depth of approximately 100 cm. All profiles are light in texture and they are developed under the alteration of oxido-reduction conditions typical for water-lodged alluvial areas with strongly reducing conditions dominating in lower parts of the profiles. However, the soils at the alluvial plain are not uniform. There is a significant difference between all profiles at peanut field on the one hand and the profile in mango orchard on the other hand. The soil at the mango orchard is typical Gleyic Fluvisol with strongly developed greenish Gleyic horizon in the lower part of the profile over-lied by well pronounced rusty oxidation horizon and Ochric A horizon. The profile is texturally strongly differentiated with prevailing sandy sub-horizons and one layer of gravel below the A horizon. This soil is only slightly transformed by man (by agricultural exploitation). Although recently used for orchard, in the past it was probably cultivated. In contrary, all three profiles at peanut field have been completely transformed by man. Although they show basic influences of alluvial environment, the presence of a ground water table and the reduced Gleyic horizon in the lower part of the profile, they are most probably developed from Eolian sand deposited at the alluvial plain. The Eolian origin can be deduced from the much lighter texture and significant textural uniformity. Although all profiles are sandy, the sand is much finer at peanut field and it does not contain any layers of gravel. The texture is relatively uniform over the profile, except for the finer texture of Ochric A horizon. The significant difference is in the organic matter content and colour. While in PIIa profile at mango orchard only the surface horizon is humiferous, in PIa profile there are several greyish sub-horizons with considerable organic matter content. The sharp and irregular waved boundaries and discontinuity of particular layers forming isolated pockets and lenses indicate that the whole soil profile was disturbed and turbated by man. This presumption also supports artefacts (ceramics fragments, charcoal and angular stones of non-alluvial origin) found in the lower part of the profile (at a depth of 80 – 100 cm). This intensive disturbance of the soil profile may be related with long lasting practicing of flooding irrigation, which requires frequent digging of channels and ditches, periodical opening and closing of the channels during the irrigation process. Another process which could support the anthropogenic disturbance of soil could be the slow and long lasting Eolian deposition of sand which was successively burying the surface A horizon transformed by frequent digging related to flood irrigation. This anthropogenic transformation did not develop at PII profile most probably because this profile is located very closely to the canal and irrigation here was probably not needed as this area was reached by natural flooding. Another possible explanation could be the very light texture conditioning very low water retention capacity and very high permeability so flooding irrigation could be inefficient. This area could be used as pasture or orchards as threes have a deeper root system and can reach the water table. However, solving this question definitely would require data on land use history for at least 100 years to see older land use under the natural hydrological regime of the Nile before the Aswan dams were constructed and prevented natural flooding.

5.3.4. *Original soilscape at Tell el-Retaba*

Two profiles representing the original soils at Tell el-Retaba were investigated:

- Profile of original buried soil I (Pob I) in the ditch of Egyptian rescue excavations.
- Profile of original buried soil II (Pob II) on the construction site.

The results of PoI and PoII (Pl. 17 and 18) investigation showed that the geological formation on which Tell el-Retaba had developed is very different from the surrounding plain. As mentioned above, the plain is built by young (in fact recent) coarse alluvial sand deposits, which contains from place to place thin layers of gravel (as it is in profile PagII) and probably by Eolian sandy deposits of considerably finer texture, which are turbated by human activity probably resulting from agricultural exploitation (flood irrigation). The basement of Tell is built by a thick layer of alluvial gravel. The thickness of this formation approximately reaches 4 meters as shown by auger drills of the lower parts of both PogI, PogII. Below that there is very coarse sand with lamellar very fine gravel layers. This huge gravel formation is significantly elevated above the surface of the surrounding alluvial plain. This is already seen due to the lack of ground water table in this formation. As the distances from the profiles situated at the alluvial plain and the distance from channel are just a few hundred meters it is presumed that the water table should be continuous below both the plain and Tell and should be at the same altitude. The elevated position of the gravel formation was also confirmed by geodetic measurements.

Important information for further paleo-environmental reconstruction was gained from granulometric and mineralogical characterisation of coarse fraction of gravel. The gravel was composed of three significantly different types of material (Pl. 19):

1st type: Well-rounded alluvial gravel grains of up to 30 mm size, dominated by quartz with a very small portion of feldspars and igneous rocks. This material was transported very long distances by the main course of the Nile and finally by the Nile canal. This material was strongly abraded during transport and mostly only quartz as the most resistant mineral among the abundant rock forming minerals was preserved.

2nd type: Partially rounded alluvial gravel of up to 50 mm size dominated by quartz and flint, but containing a significant portion of other minerals (feldspars) and rocks, and also secondary mineral nodules formed in soils and unconsolidated quaternary sediments, mainly composed manganese secondary minerals and carbonates. This material shows evidences of much shorter transport. Some stones, especially those grains of partially rounded quartz could come from a major course of the Nile, but they overcame a much shorter transport than the material of the first type. Other stones, especially flints, other rocks and minerals and nodules probably came from surface runoff coming from the tributary Wadis entering the upper part of the Nile canal.

3rd type: Very poorly rounded stones of up to 50 mm size dominated by flint, but containing a significant portion of other minerals (feldspars) and rocks, and a significant portion of secondary mineral nodules formed in soils and unconsolidated quaternary sediments and mainly composed of manganese secondary minerals and carbonates. The quartz is almost missing in this gravel fraction. This material shows evidences of very short transport. It came from the closest neighbourhood and was transported by Wadis from desert hills occupying the south-eastern neighbourhood of the Nile Delta.

The gravel was strongly calcareous and rich in large (up to a few cm) *manganese-carbonate nodules* and loose impregnations which were formed in situ after gravel deposition.

At this gravel formation the soil with strongly developed rusty B horizon and Mollic A horizon was developed. The B horizon was over 100 cm thick and could be according to the intensity of weathering separated into more intensively weathered and more rusty B (or B1) horizon (60 cm thick) and less intensively weathered and lighter in colour B/C (or B2) horizon (40 cm thick). As no clay coatings are observable on a macroscopic scale and also the dry climate makes clay leaching improbable the B horizon was considered to be weathering B horizon and it was classified as Cambic Bw horizon. It was rich in manganese nodules and strongly calcareous, which indicated two stages of development 1) the earlier stage of weathering of non-calcareous material (either decalcified or primary non-calcareous) under a relatively moister climate and 2) the later stage of secondary carbonatisation under a dryer climate and under conditions of evaporation soil moisture regime.

Dating of these two stages of soil development would require reliable paleo-climatic reconstruction of the site. It is sure that both stages must have happened before settlement was established at Tell el-Retaba and anthropogenic deposits started to accumulate on this site. A probable period, when the weathering stage could have taken place is the Atlantic period of Holocene and the carbonatisation could follow during Subboreal.

The A horizon of identified Paleosol is missing in some parts of the contact zone between the original buried soil and the anthropogenic deposits. This could be caused either by erosion (as the Tell was slightly elevated above the plain) or it could have been removed by man when establishing settlement. Maybe both processes were combined. The erosion need not have been caused by water, but wind erosion could have taken place during the dry period of development or when the settlement removed the vegetation and exposed the soil to wind. The A horizon is missing in some parts of the Egyptian rescue excavations' ditch and is completely missing at both excavation sites of the SIP architectures. However, it is especially well preserved on construction site. Its presence at this site can be related to its peripheral position at the margin of Tell and out of the fortress and urbanised area.

At places where the A horizon is preserved it was characterised as 40 cm thick dark grey A horizon which can be classified as Mollic as the colour meets the requirements for Mollic horizon and due to the presence of carbonates the quantity and quality of organic matter would certainly be sufficient for Mollic horizon. The A horizon is sandy loam with very little content of gravel (up to 5%). The upper boundary of the original buried horizons can be distinguished in some parts of the outcrops, but in other parts coincide with overlying dark grey anthropogenic depositions. Usually anthropogenic layers can be distinguished by artefacts, but especially in peripheral areas out of the fortress the artefacts are few and on the other hand, few artefacts can also occur in the original A horizon.

The final stage in the reconstruction of the original buried soil is its classification. The original soil developed on alluvial gravel has two diagnostic horizons – Mollic A horizon and Cambic B horizon and should be classified as Calcic Chernozem.

5.3.5. *Recent soil development at Tell el-Retaba*

Although major attention was paid to the investigation of original buried soils making the floor for ancient settlement and underlying the anthropogenic deposits and to some extend to soil-scape of adjacent lowland a brief investigation of recent soil-scape at Tell el-Retaba was done as well. The survey identified two groups of recent soils:

- Soils developing from anthropogenic sediments
- Soils developing from Eolian sands covering some parts of anthropogenic deposits

Both soil groups only show very weak traces of recent pedo-genesis. Although this is a long time and in other areas it would result in significant soil development, at the studied Tell the very dry environment determined not only by the arid subtropical climate, but also by the elevated position and light texture, hindered most major soil forming processes such as organic matter formation, weathering, formation of structure, leaching, etc.

The soils developing from anthropogenic deposits (Pl. 20) show very high morphological variability resulting from anthropogenic processes of deposition. They are stratified and contain a lot of artefacts. Almost no recent soil stratification can be seen as it is masked by the original sedimentary stratification. Recent formation of surface humiferous A horizon can be presumed, but it is not visible as the whole anthropogenous deposits contain organic matter and its contents vary with stratification. Some layers in any part of the profile may be darker than the surface layers, so it is not possible to distinguish how much organic matter was formatted in situ after the sedimentation process was finished. In a few places there were observed weak recent structure formation, but it is very seldomly occurring only in places where sediment contains slightly more clay and silt. Another recent morphological feature is redistribution of soluble minerals, mainly carbonates (nodules, pseudomycelia), eventually others. These soils can be classified as Technosols.

The soils developed at Eolian sands (Pl. 21) have very homogenous and monotonous morphology. The Eolian sand is light in colour, does not contain organic matter and it is finer than alluvial sand building surrounding the plain. At this sand even weak enrichment in organic matter resulting from recent pedo-genesis is visible so the formation of Ochric A horizon was recorded. Other morphological features are traces of bioturbation, especially 1 – 2 cm thick Krotovinas created by burrowing animals and containing sand infillings from above which can be recognised due to slight organic matter content. Very rarely traces of red-oxidomorphic features (rusty nodules of 2 – 5 mm diameter) occur. This is surprising as the environment is dry and sandy soils have good permeability, but as these features are very local, they can be explained by the accumulation of moisture in some depressions which can be presumed in rough relief resulting from the ruins of architecture. The soils on Eolian sands are non-calcareous. They can be classified as Regosols.

5.3.6. *Characterisation of stratigraphic profiles*

Three deep (4.5 – 5 m) stratigraphic profiles were done by auger (Pl. 22 – 24). Two of them were at Migdol (at the inner side of the gate threshold and in towers background – Pl. 23 – 24) and one at the market place at the northwest margin of the Tell (Pl. 22). Drilling in very thick and very dry loose sand was not possible because of unstable borehole walls. Loose sand was pouring from the borehole. The upper part of the profiles (approximately 150 cm) which was most dry and loose and most unstable was excavated as a hand dug soil pit and the deeper part was investigated by auger. Drilling was possible only if water was repeatedly poured into the borehole to moisten the sand and the drilling was successively advancing through the moistened section of the sand layer. This approach, however, did not allow a more detailed characterisation (colour, texture, etc.) of the material because it was contaminated by material fallen from the upper part of the borehole. Moreover, it caused difficulties to distinguish the transitions between particular layers of investigated sand profiles and to set the boundary depths. Another problem with the depth determination was that all three profiles were situated on the slope built by very loose and easily moving sand so the surface was under permanent changes due to movement of the staff across the site. For these reasons the depth limits could not be precisely distinguished and only approximate depths could be recorded. Although the depths were measured with respect to fixed marked points, they were nothing more than the artificial points fixed by technical means representing the arbitrarily selected elevation levels. However, the detail pedological characterisation of particular sub-horizons and their exact depths, thicknesses and boundaries were not needed for these profiles. The major purpose of the first two stratigraphic profiles was to observe the substratum into which the architecture of Migdol was embedded and the third stratigraphic profile should show how the contact zone between the Tell and the surrounding plain was built. These tasks were fulfilled despite difficulties with augering and reduced accuracy of the description of these profiles.

The stratigraphic characterisation of two profiles at the Migdol were similar. The upper part of both profiles was about 100 – 150 cm thick loose and very dry sandy deposits with very small organic matter content (indicated by slightly greyish colour). Whole parts of the profiles were very homogeneous and with almost no visible stratification. Deeper parts of the profiles were slightly more compacted and a slightly moister complex of stratified sandy layers with varying organic matter content, but homogeneous in texture. At a depth of approximately 4 meters original soil was buried, developed from gravel classified as Cambic Chernozem and characterised in chapter aimed on original soil-scape of Tell el-Retaba.

The stratigraphic profile at the market place (Pl. 22) was very different from both profiles at Migdol. The upper part (approximately 150 cm) was built by natural Eolian sand without organic matter. Below that there was an approximately 180 cm thick layer of stratified slightly humiferous anthropogenic sand similar to a major part of the Migdol profiles. In a deeper part of this profile the sand with small organic matter content was successively transformed to dark grey heavy clay with high organic matter content. The texture was getting successively heavier with the depth increase, the organic matter content was increasing, the colour was getting darker and the moisture was increasing at a depth of approximately 300 cm, there occurs about 40 cm thick layer of very dark grey clay. The most surprising feature was the occurrence of about 50 cm thick water saturated layer on the top of the clay layer (local ground water), but below the clay layer only sand continued slightly moist and with slight organic matter content. This sand layer contained artefacts (small fragments of ceramics) and was unambiguously of anthropogenous origin. This was the limit to which the auger observation was possible with available technical means and at this site the natural buried Calcic Chernozem developed from gravel parent material was not reached.

5.3.7. *Cross-section of fortification wall*

The ditch of Egyptian rescue excavations was dug along the whole western part of Tell, eastwards from the asphalt road (which should be broadened into this area), including the southern fortification walls (Pl. 6). This cross-section of the dominant architecture object provided a unique opportunity to investigate its embedding into the substratum. Approximately a 8 m long and 150 cm high profile section was cleaned in the wall of the rescue excavations' ditch, starting in the internal side of Wall 2 and finishing behind its external side. The whole wall layed on a ca 30 cm thick layer of clean sand with neither organic matter nor artefact content. This sand structure did not form a larger continuous layer, it was more likely a lens structure. From the internal part of Wall 2 the sand layer was covered by a cone-like structure of alluvial gravel similar to the gravel forming the substratum of the Tell (see above the subchapter on reconstruction of original soil-scape at Tell). However, this gravel was completely fresh, without any traces of weathering.

5.3.8. *Paleo-pedological and paleo-environmental reconstruction*

The investigation of sediments and soils described above brought sufficient information to make the paleo-pedological reconstruction of the studied site and also to formulate some paleo-environmental characteristics helping to understand the living environment of the ancient population. In addition, another interesting information on the paleo-environment brought the stratigraphic profile at market place. These findings can be summarised in the following points.

- The whole area is a typical alluvial environment formed by a large river (Nile branch split from the main course of the river, which forms before reaching the sea, a large delta).
- This alluvial environment can be divided into two units which differ in geological formation, relief, moisture circulation and consequently also by soils and vegetation.

  The first unit is the flat alluvial plain built by coarse alluvial sand (with very few inclusions of thin layers of gravel). In a large part of direct neighbourhoods of Tell it is covered by Eolian sand. The plain is until present under the influence of ground water (in September 2014 it was at a depth of 90 – 110 cm). It can be presumed that below the alluvial sand there is alluvial gravel, but it was not reached by augering because of the ground water. The plain is occupied by Gleyic Fluvisols and the soil-scape is strongly modified in large parts of the plain adjacent to Tell by human activity (agriculture and flooding irrigation) so the soils are transformed to Antrosols. It is not possible to distinguish whether the formation of anthropogenous soils was contemporary as the ancient settlement or younger.

  The second unit was a slightly elevated hill where the alluvial gravel was outcropping the surface. The position of alluvial gravel layer in the elevated position (aggradation mound) above the recent river water table indicates that this landscape form was slightly tectonically uplifted. The tectonic lifting is active in this area as it is influenced by tectonic movements of Reef Valley.[122] This hill created a much dryer environment free of ground water influence. However, it was moist enough for weathering and formation of Bw horizon. Later the climate became dryer and Bw horizon was re-carbonatised. This development took place before the settlement established on the hill.

An important feature is the composition of the gravel. The prevalence of well-rounded gravel indicates that this geological formation was created by the Nile branch transporting material from a large distance. But the content of fresh rectangular skeleton of different mineralogical composition indicates that the large quantity of water and sediment load came from close desert hilly land south of the canal. This means that this alluvial environment is different from the central part of the Nile Delta and this has consequences for environmental quality which will be explained further.

- The difference of soil water regime between the plain and hill was quite considerable and this most probably resulted into completely different vegetation. At the plain there was most probably vegetation fixed to wetlands under flood or ground water influence. Most probably it was a flooded savanna, which is the typical ecosystem of the Nile Delta, the so called *Nile delta flooded savanna, the* PA0904 ecoregion of WWF classification.[123]
- The paleo-pedological reconstruction and presumed environmental differentiation of the site helps to understand the probable motivation of the settlement. The dry hill surrounded by wet plains was a most probably very suitable site to establish a safe settlement. In the surrounding areas probably not many such places were available. The dry hill was certainly a much healthier and comfortable environment for settlement than the surrounding wet plain, most probably exposed to flooding. Its position at the intimate neighbourhood of the easternmost Nile branch could indicate first of all the military function and probably the trade function of the settlement. Also, the slightly elevated position of the hill could be an advantage for a military base. It can be also presumed that a ford across the canal could have originated. However, the high suitability of this site for settlement can indicate that the military and trade functions need not be the original motivation for establishing the settlement. Most probably the settlement developed

[122] EL-BOHOTY et al., 2012.
[123] WWF website: http://www.worldwildlife.org/ecoregions/pa0904

here as usual agricultural or grazing settlement and for military and/or trade base it was selected later on.

- Important paleo-pedological and paleo-environmental information is related to soil texture and the mineralogical composition of the coarse fraction of gravel. Both these characteristics indicate that this area situated at the eastern periphery of the Nile delta had different water regimes than the main central part of the Nile delta. In the large majority of the Nile Delta there was a flooding regime characterised by a great input of fine suspended sediment which served as natural manure for agriculture. Since the time of ancient Egyptian civilization until the early 20th century when the first Aswan dam was constructed the deposition of Nile mud each year secured inexhaustible fertility of agricultural land in the Nile valley and the Delta. However, the coarse sand texture of the alluvial plain surrounding Tell el-Retaba indicates unambiguously that there was no fertile fine earth brought by the flooding. The reason why there is such a great difference between Tell el-Retaba and sites in central part of the Nile delta is indicated by the gravel composition. As it was described above it is composed of contrasting material – well-rounded fine gravel mostly composed of quartz representing the long distance transport from the middle and upper part of the Nile basin and rectangular stone fraction dominated by flint, but also containing a lot of soft material such as manganese-carbonate nodules representing the short distance transport of material eroded by local seasonal tributaries of the Nile canal, coming from arid hilly lands bordering the Wadi Tumilat. This difference in sediment carried by flooding is substantial for the development of ancient agriculture. Although recent agriculture at surrounding plains could have high productivity, it can be presumed that ancient agriculture before the introduction of modern mineral fertilizers was much less productive on these light soils, without the periodical supply of nutrients by flooding, as it was in the major part of the Nile valley. It supports the hypothesis that the later development of Tell el-Retaba was due to military and long distance trade rather than serving as innate regional centrum for intensively inhabited and exploited agricultural region with intensive agricultural productions.

6. Conclusions

The stratigraphic profile at market place brought very interesting findings of local clay layer just neighbouring the northern external periphery of the Tell. This clay layer was bearing a thin saturated water layer – a local ground water body. A most surprising fact was that although the clay layer looked (as far as the auger observation allowed) like natural deposit, it was under-layed by anthropogenic sand accumulation with organic matter and containing artefacts. This clay layer and the recent presence of ground water indicates the occurrence of wetland or water body, most probably local geographical structure.[124] The anthropogenic sand containing artefacts shows that the clay layer and wetland or open water body was created later than the settlement developed at Tell el-Retaba.

The soil and Quaternary survey showed that the majority of the investigated parts of Tell el-Retaba are situated at a slightly elevated hill built by alluvial gravel on which the Cambic Chernozem (soil with blach mollic surface A horizon rich in high quality organic matter and rusty Bw horizon coloured by free iron released by weathering) developed. So far the oldest architectures excavated at the site – constructions from the Second Intermediate Period are embedded directly on Bw horizon of the original soil. Two groups of such constructions, excavated in the western part of Tell and in the ditch of Egyptian rescue excavation, were observed and all these structures lie directly on Bw horizon of original soil. This means that the humiferous A horizon was removed (for some unknown reason) prior to the construction of buildings.

So far the earliest occupation identified on Tell could date to the very late Middle Kingdom (13th Dynasty). It might be related to a land reclamation which could be a consequence of Sesostris III canal's construction.

It is difficult to set a precise route sequence and chronology of the canals' construction, based on both, sparse archaeological and written sources. According to ancient and medieval authors, the rulers Sesostris, Necho II, Darius, Ptolemy II, Trajan and 'Amr ibn al-'As were all involved in building and/or cleaning of canals. The rulers could have four separate or interconnected motives for such policy: (1) irrigation and agriculture, (2) trade and expeditions, (3) military[125] and (4) strategic interests[126] (including drinking water delivery).

It is conceivable that an agricultural function of the canals predated the shipping one[127] in earlier periods. Fact, that ancient sources did not mention building/cleaning or existence of canals between the SIP and the TIP, when there is an intensive occupation in Tell el-Retaba, including eastern Mediterranean ware and New Kingdom fortresses, is of interest and should be examined and once interpreted.

[124] See also note 65 above.
[125] SPALINGER, A. Egypt and Babylonia, p. 232.
[126] SIDEBOTHAM, S.E. Berenike and the Ancient Maritime Spice Route, p. 101, 124.
[127] However, DIODORUS intertwines both these functions – Sesostris' canals were used by people to carry out harvesting (I:57).

The military and strategic functions of the canals could rather be associated with new geopolitical environment since the Late Period[128] and with rulers of rather foreign origin.[129] Military role of Tell el-Retaba diminished or has disappeared since the Third Intermediate/ Late Period and Tell el-Maskhuta probably took over its role. Military and strategic functions of the canal did not, however, exclude the earlier functions.[130]

Despite different dynasties and rulers changed, strategic directions and desert short-cuts, connections became preserved among areas of Memphis/ Cairo/Heliopolis – Tanis/Avaris/ Mediterranean Sea (with some offshoots to and from Bilbeis and Zagazig) – Isthmus of Suez/ Sinai/Syropalestine/Arabia – Red Sea/Indian Ocean/ Punt and crossed in area of Ras el-Wadi/ Tell el-Retaba. The route from the area of Tell el-Maskhuta to Salhieh/El-Salhiyyah (i.e. area of Tanis/Avaris),[131] preserved on the *DESCRIPTION* map (Pl. 1), might also support the assumption that (military and trade) desert communications were preserved for millennia.

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[128] Commercial function was, however, also represented: LLOYD, A.B. Herodotus, p. 150, 152; BRIANT, P. From Cyrus to Alexander, p. 384.

[129] A. LLOYD (Herodotus, p. 150) suggest primary commercial purpose (Punt) of Neko's canal, which should be used only southwards, but not vice versa. Under Darius the canal was a part of Persian strategic communications' network (Herodotus, p. 152).

[130] Egypt was primarily a strategic breadbasket for Rome and less a strategic outpoint for further expansion. The Amnis Trajanus seems to be a rather different project from the Ptolemaic canal; Trajan just maybe cleaned some older canals and/or riverbeds for agricultural and shipping reasons; the older project of the Ptolemaic ruler might leave for some reasons a deeper impact on the population and also eponym trace in Tumaylat (see note 2 above).

[131] Places are spaced apart about 20 km.

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