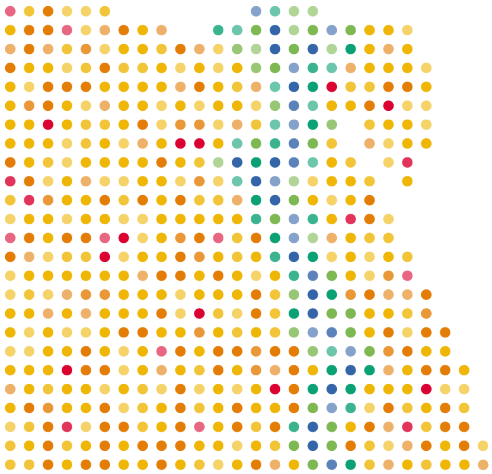

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Working Paper 3

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Recent Publications on the Environmental History of Egypt

December 2020

A number of recent publications show a growing interest in the environmental history of Egypt and more generally in the Nile Basin, during all geological and historical periods. I will present here the more recent books that have been published on the topic, to the best of my knowledge, and then I will try to focus on the strengths and weaknesses of this multidisciplinary scientific production.[1]

The Nile: Origin, Environments, Limnology and Human Use, edited by Henri J. Dumont, presents itself as a precis about works on the Nile Basin —and not only on the river itself.[2] It comes forty-three years after the publication of the last such synthesis to date, Julian Rzóska's edited volume: *The Nile: Biology of an Ancient River*.[3] The thirty-six contributions in Dumont's volume deal not only with geology, climatology, sedimentology, but also fauna, flora, microfauna, and the chemical composition of water. Human geography is almost absent from the book, except for an article on fisheries, but the contributions themselves — as well as the rich bibliographies appended to them — will be of great use for historians wishing to learn more about the state of the art on all physical and natural aspects of the river and its basin. Two chapters are specifically devoted to the Delta and the Fayyum. Except for the key articles about geology and hydrology, which cover millions of years, most of the articles use studies and statistics conducted from the beginning of the 20th century. Jack F. Talling offers a chronology of the scientific study of the river in his chapter: "The Nile: History of Scientific Research" (pp. 23-36).

The history of the Nile from the end of the last Ice Age, i.e. during the Holocene, is the topic chosen by Judith Bunbury in *The Nile and Ancient Egypt: Changing Land- and Waterscapes, from the Neolithic to the Roman Era*.[4] Her book is a state of the art aimed at non-specialists, a choice that explains its relative shortness; moreover, it is abundantly and aptly illustrated with photographs, graphics and maps. A large part of her material is based on augering, of which J. Bunbury is one of the well-known specialists in Egypt. She presents this technique in a useful Appendix, pp. 148-158. Her statements are made all the clearer by her choice of dealing with her topic in chronological order: she delivers a kind of narrative of the Nile valley between Aswan and the Mediterranean.

Several recent publications deal with the archaeology and history of Egypt's landscape, practicing a multidisciplinary approach with mixed success. The collective book edited by Yann Tristant & Matthieu

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1. I would like to thank Yann Tristant (Macquarie University) for his hints and suggestions. However, the ideas and judgements expressed in this working paper are entirely mine.

2. Henri J. Dumont ed., *The Nile: Origin, Environments, Limnology and Human Use*, Monographiae Biologicae Series, 89, (The Hague: Springer, 2019).

3. Julian Rzóska, *The Nile: Biology of an Ancient River*, (The Hague: Springer, 1976).

4. Judith Bunbury, *The Nile and Ancient Egypt: Changing Land- and Waterscapes, from the Neolithic to the Roman Era*, (Cambridge, Cambridge University Press, 2019): pp. XVI-182.

Ghilardi, Landscape Archaeology: Egypt and the Mediterranean World, publishes the results of a major symposium held in Cairo in 2010.[5] The symposium also produced two special issues in the publications Géomorphologie and Quaternary International.[6] Respectively, the contributions about Egypt represent seven articles (out of a total of thirteen), three (out of seven), and five (out of fifteen). They reflect a variety of approaches and methods, based on cartography, satellite imagery, the study of sediments or microfauna, in addition to papyrology with Katherine Blouin on the prosgenèmata or alluviation; Bérangère Redon on transverse itineraries in Greco-Roman Lower Egypt. Harco Willems & Jan-Michael Dahms share the same goals in their The Nile: Natural and Cultural Landscape in Egypt, with a majority of contributions in the volume centred on the Pharaonic or Greco-Roman periods and drawing on archaeology and textual sources; however, two articles deal with geoarchaeology.[7]

With The Fayum Landscape: Ten Thousand Years of Archaeology, Texts, and Traditions in Egypt, Claire J. Malleson offers an original study about the Fayyum's environment as it has been described during the last three millennia.[8] She presents the available sources in chronological order, as well as with their context and function. Additionally, she analyses them by cutting a clear distinction between what she calls the 'imaginary landscape' and the 'real' one, i.e. the landscape the authors — or at least some of them — could see and experience. In fact, her book shows that the clear-cut distinction between the imaginary and the real landscape does not do justice to the rich aspects of these descriptions of Fayyum, which include complex religious and symbolic systems and more or less historical reminiscence, always referring to a picture larger than the Fayyum itself. One of the merits of this innovative book is to highlight the link between the pioneering works of the 19th-century archaeologists and hydrologists, the

5. Yann Tristant & Matthieu Ghilardi, eds., *Landscape Archaeology: Egypt and the Mediterranean World*, Bibliothèque d'études 169 (Cairo: IFAO, 2018): pp. X-276.

6. Yann Tristant & Matthieu Ghilardi, eds., "Charting Holocene Landscape Changes in the Mediterranean Using the Geoarchaeological Approach," Special issue of Géomorphologie: relief, processus, environnement 18:1 (2012); and, Yann Tristant & Matthieu Ghilardi, eds., "Geoarchaeology of Egypt and the Mediterranean: Reconstructing Holocene Landscapes and Human Occupation History," Special issue of Quaternary International 266 (2012).

7. Harco Willems & Jan-Michael Dahms eds., *The Nile: Natural and Cultural Landscape in Egypt*, (Mainz: Mainz Historical Cultural Sciences 36, Transcript, Bielefeld, 2017): pp. 370.

8. Claire J. Malleson, *The Fayum Landscape: Ten Thousand Years of Archaeology, Texts, and Traditions in Egypt*, (Cairo, The American University in Cairo Press, 2019): pp. XIV-326.

Two other important recent books deal with the historical geography of the Fayyum: Yossef Rapoport, *Rural Economy and Tribal Society in Islamic Egypt: A Study of al-Nābulusī's Villages of the Fayyum*, The Medieval Countryside Series 19, (Turnhout: Brepols, 2018); and Cornelia E. Römer ed., *The Fayoum Survey Project: The Themistou Meris*, vol. A: The Archaeological and Papyrological Survey, Collectanea Hellenistica Series KVAB VIII, (Leuven: Peeters, 2019). Vol. B edited by D.M. Bailey (2019) deals with ceramology.

Greek and Roman authors they knew quite well, and the Arab sources of which they had at least an indirect knowledge. In a similar vein, Katherine Blouin proposes a reconstitution of the landscape of the Mendesian nome in Lower Egypt during the Roman period, mainly based on an impressive amount of papyri as well as on literary sources.[9] She underscores the importance of the Mendesian branch of the Nile for the governance of the region as well as the interest of the administration for reclaiming wet and marginal lands.

Towards a better understanding of the Nile Basin

The history of the Nile and its hydrological basin during the Holocene, i.e. the last 11,500 years, is seemingly well known on two different temporal scales: the scale of thousands of years, and the year-by-year scale of the last one hundred years, since the Nile Basin was covered in the 1920s with a network of reporting stations that allowed a regular monitoring of its main aspects (Talling in Dumont, 2019).

The last Ice Age was a period of erosion to the interior of the canyon formerly carved by the Nile; the Holocene, which followed, was globally a period of sedimentation. Periods of wetter and more arid conditions alternated; but from the mid-Holocene on, i.e. during the 6th Millenium BCE, aridification began slowly from north to south across Egypt. In an enlightening diagram, J. Bunbury shows the results of the alternance of wetness and desertification on sedimentation, aeolian erosion, vegetation, and human occupation.[10] The latter extended itself during the 4th Millenium BCE from the mouths on the wadis towards the floodplain. Aridity pervaded northern Egypt during the Old Kingdom and then southern Egypt during the Middle Kingdom. Soil levels grew because of various combined factors: sedimentation from the annual flood, flash floods devastating the wadis and their outlet in the Valley, as well as aeolian intake. The drainage in Lower Egypt improved slowly and the number of Nile branches decreased.

The Delta began its formation around 5500 BCE, mainly as a result of sediments brought by the Nile branches. Nine of these branches have been identified, with different periods of activity.[11] Nowadays only a small amount of the water and sediments carried by the Nile reaches the Mediterranean. Building the Aswan High Dam resulted in the inversion of the coastal building dynamic: the coastline is now quickly receding around the river's mouths at Rosetta and Damietta.

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9. Katherine Blouin, *Triangular Landscapes: Environment, Society, and the State in the Nile Delta Under Roman Rule*, (Oxford: Oxford University Press, 2014).

10. Bunbury, *The Nile and Ancient Egypt*, p. 58.

11. G. Sestini, "Implications of Climate Change for the Nile Delta," in L. Jeftlic, J.D. Milliman & G. Sestini eds., *Climatic Change and the Mediterranean* (New York: Edward Arnold, 1992): pp. 535-601.

By studying Greenland ices,[12] it has been possible to highlight successive phases of cooling on the Poles and aridification of the tropical zone in the Northern hemisphere: c. 7000-6000 BCE, 4000-3000 BCE, 2200-1800 BCE (corresponding to the First Intermediate Period and beginning of Middle Kingdom), 800-1000 CE and finally the "Little Ice Age" from 1350-1800 CE.[13] However, this chronology can account only partly for the factors that affected the climate in Egypt, such as: rains in the northern part of the country, the frequency of catastrophic events, as well as the Nile hydrology, which depends on rainfall in the southern part of its basin.

As is well known, the Nile flood depended on rainfall in the tropical and equatorial areas of the river's basin. During the low-water season, the White Nile provides 83% of the river flow; during the high-water season, the Blue Nile provides 68% and the Atbara 22% of its flow. Until now, the main findings concerning the Nile Basin's paleoclimate have been based on sediment analyses carried out around and beneath the Edward and Albert lakes (IDEAL Project: International Decade for the East African Lakes). They revealed two major phases: 1) from 5400 BP (ca. 3400 BCE), a decrease in the lakes' water level and an increase in the process of aridification, which culminated between 2050 and 1850 BP, i.e. 1st century BCE-2nd century CE; 2) thereafter, a reversal of this trend, with the last 1,500 years being more wet globally, with two exceptional arid episodes.

Analysis of the strontium isotope record of a sediment core taken beneath Lake Manzala makes it possible to distinguish between sediments carried by the Blue Nile Basin, which are rich in volcanic material, and those carried by the White Nile; by comparing their proportion it has been possible to establish a chronology for the last 5,000 years. P.M. Lourenço Gonçalves shows the close correspondence between the strontium isotope record curve and the Lake Fayyum level curve, on a graph that presents the additional value of combining three temporal scales: 14C dating before calibration, calendar dating (cal year BP), and historical periods such as Old Kingdom.[14] Thus, the water level of Lake Fayyum is a clear indication of heavy rainfall on the Blue Nile basin, i.e. the Ethiopian High Lands, and of higher floods on average. This correspondence ceased during the Ptolemaic period when, in the first decades of the 3rd century BCE, major works at Illāhūn succeeded in regularizing the access of the Baḥr Yūsuf waters into the Fayyum, which resulted in a dramatic lowering of the Fayyum Lake level.

Until c. 3100 BCE monsoon rainfall was heavy, and the river flow higher than what was measured

12. Bunbury, *The Nile and Ancient Egypt*, fig. 2.3 on p. 17.

13. P.A. Mayewski et al., "Holocene Climate Variability," *Quaternary Research* 62 (2004): pp. 243-255.

14. P.M. Lourenço Gonçalves, *Landscape and Environmental Changes at Memphis During the Dynastic Period in Egypt*, (PhD Thesis, Cambridge University, 2018): fig. 6 on p. 24.

in recent centuries. Precipitation decreased in a dramatic way until c. 2200 BCE, i.e. around the end of the Old Kingdom; then, after a quick reversal, the second millennium and first half of the first millenium BCE become characterized by a long era of average high floods combined with fast deforestation in the Ethiopian High Lands. The curves revert between the 5th and the 2nd centuries BCE, a transition that leads to a new period that had characteristics similar to the current climate until c. 550 CE.[15]

Aggradation, i.e. the depositing of sediment, is far more intense when the proportion of water and sediment from the White Nile increases, which matches the two periods 3100-2200 BCE and 100 BCE-550 CE; when this proportion decreases, aggradation weakens and may even reverse into degradation (i.e. erosion). As a matter of fact, sediment size differs between the two major rivers, as does their tendency to deposit quickly or remain suspended (an assumption expressed by Willem Toonen during the symposium on Egyptian Riverine Harbours, see below). Thus, the rise of the floodplain level is not as regular as ordinarily thought, and the average of one meter per millennium conceals wide discrepancies in time and place. Furthermore, Lower Egypt experiences subsidence because of the weight of its alluvium.

How can we explain these variations? Pierre Camberlain provides a useful summary of recent work largely based on the analysis of data collected between 1951 and 2000.[16] Broadly speaking, rainfall over the Nile Basin is linked with the ITCZ (Intertropical Convergence Zone) oscillations. Camberlain identifies three zones in the Nile Basin according to their characteristics in terms of interannual rainfall fluctuations. In the equatorial regions as well as in southwest Ethiopia (zone 3) rainfall has remained stable during the late 20th century. In the two other regions (zone 1: from northern Darfur and Kordofan to the borders of Sudan and Ethiopia; zone 2: between 7° and 14° North latitude) the trend is a decrease in rainfall. These variations are affected first by the monsoon on the Indian Ocean, then by El Niño — which offers a smaller degree of correlation — and finally by differences in temperature between the North Atlantic, South Atlantic, and Indian Oceans. This explanatory scheme may be used for past climatic variations. It also shows the scale of the task before scientists.

Advances in the environmental history of the last five millenia

15. A. Foucault and D.J. Stanley, "Late Quaternary Paleoclimatic Oscillations in East Africa Recorder by Heavy Minerals in the Nile Delta," *Nature* 339 (1989): pp. 44-46; and, M.D. Krom, et al., "River Nile Sediment Fluctuations Over the Past 7000 Years and Their Key Role in Supropel Development," *Geology* 30:1 (2002): pp. 71-74.

16. Pierre Camberlain, "Nile Basin Climates," in Henri J. Dumont, ed., *The Nile: Origin, Environments, Limnology and Human Use*, Monographiae Biologicae Series, 89, (The Hague: Springer, 2019): pp. 307-333.

Attempts to promote the meeting of historians, archaeologists, geoarchaeologists, geomorphologists, and hydrologists have produced contrasting results thus far. In this area, the agenda of Egyptologists and archaeologists is concentrated on a limited range of issues: the immediate surroundings of major political and religious centres, especially Memphis, the Pyramids and Memphis necropolis, Hierakonpolis (Ihnāsya), Abydos, Thebes (Luxor-Karnak); variations of Nile channels related to the same sites and to major cities in Lower Egypt as identified by archaeology, such as Avaris, Bouto, Saïs, Tanis, etc.; and the history of the Fayyum.

One of the main results in the geoarchaeology of Egypt has been to show that most major urban centres in antiquity stood on harbour sites. This was the case with Memphis during the Middle and New Kingdoms as well as the successive royal residences established in the Delta from the Ramesside Period onward. One of these residences, Avaris/Tell Dabʿa, which stood on the ancient Pelusian branch of the Nile, was already a capital during the Second Intermediate Period, then resumed this function during the Ramesside Period. Exemplary works conducted by Manfred Bietak, then resumed by Irene Forstner-Müller, have used an impressive array of techniques: systematic geomagnetic survey, excavations beneath the surface of current agricultural fields, drilling, dating by OSL Optically Stimulated Luminescence. Their results converge in reconstructing a fascinating ancient landscape with a Nile branch, islands, secondary channels and natural harbours that were slowly silted.[17]

Immediate surroundings of major sites have been the topic of decisive advances. The Nile Valley at Luxor and Karnak has been systematically explored by regular drilling, drawing lines of boreholes perpendicular to the river. The floodplain knew a degradation period until c. 2000 BCE and was characterized by several river branches. From the Middle Kingdom (2000-1500 BCE) on, as a result of aggradation (i.e. sedimentation) the floodplain gradually took its present shape main channel formed that has not substantially changed until now, flanked on the left bank in the 2nd millennium BCE by two secondary channels, which vanished after the New Kingdom. Aggradation was fast during the 2nd millennium BCE, then very weak between 1100 and 600 BCE, very fast again (3 meters) between 600 BCE and the Roman period i.e. during a thousand years; then weaker for the remaining fifteen centuries.

The environment surrounding Memphis during the Pharaonic age is the topic of P.M. Lourenço Gonçalves' 2018 PhD thesis at Cambridge University: Landscape and Environmental Changes at Memphis

17. Hervé Tronchére, et al., "Geoarchaeology of an Ancient Fluvial Harbour: Avaris and the Pelusiac Branch (Nile River, Egypt)," *Géomorphologie: relief, processus, environnement* 18:1 (2012): pp. 23-36.

During the Dynastic Period in Egypt.[18] His work is exemplary by its methodological stance and its careful combination of geomorphological, archaeological, and historical data. It is based on the analysis of seventy-seven drillings conducted in the immediate surroundings of Memphis and in the western area between the archaeological kōms and Saqqāra necropolis. His findings lead to a reconstruction of the changes in environment between the Predynastic and the Roman periods. The results show successive urban and functional reshapings close to those affecting the site of Avaris/Tell Dabʿa.

The question of variations in the course of the Nile must be studied within the frame of the classification set up by hydrologists. Morgan de Dapper emphasized this point during the symposium on "Egyptian Riverine Harbours" held at the Institut français d'archéologie orientale in Cairo, 16-18 September 2019, in a contribution entitled "Geomophorlogical Observations on the Evolution of the Fluvial Landscape in the Nile Delta Since Late Pleistocene". In short, hydrologists distinguish between three types of rivers: (1) rivers with a unique, straight or moderately curved channel; (2) meandering rivers including anastomosis, i.e. abandoned channels, which are formed when the flow is regular and sedimentation continuous; and (3) braided rivers, with several active, interweaving channels, which create braid bars or islands between different channels, as can be seen with such classical examples as the Brahmaputra and the Jamuna in Bengal. Rivers move from one type to another according to the gradient, nature of sediments, and flow rate. A faster and less regular flow, a higher gradient, and coarser sediments favour braided rivers. In contrast, narrow floodplains put an obstacle to braiding, as can be seen in Upper Egypt because of the narrowness of the canyon between whose cliffs the Nile is forced to flow; braiding was however possible in Middle Egypt as well as in Lower Egypt.

Based on this classification, one can assume that the Nile Valley looked similar to the landscape familiar to us today during the periods when thin sediments conveyed by the Blue Nile were predominant, i.e. between c. 2200-100 BCE, then from c. 500 CE on: a meandering river moving sideways and downstream. To the contrary, the Nile had a tendency to create more secondary channels during the 3rd millennium (i.e. Predynastic and Old Kingdom) and then the Roman Period, two ages of fast aggradation in the Theban floodplain. This assumption matches the results presented by John P. Cooper: the number of Nile branches in Lower Egypt decreased in a dramatic way during the 1st millennium CE.[19] Here one must take into account human action in order to explain the relative stability of some landscape features,

18. P.M. Lourenço Gonçalves, *Landscape and Environmental Changes at Memphis During the Dynastic Period in Egypt*, (PhD Thesis, Cambridge University, 2018). Online: https://www.repository.cam.ac.uk/handle/1810/287733.

19. John P. Cooper, *The Medieval Nile: Route, Navigation, and Landscape in Medieval Egypt*, (Cairo: The American University in Cairo Press, 2015).

such as the embankment of major waterways, transformation of temporary islands to areas constantly cultivated, etc.

P.M. Lourenço Gonçalves' 2018 PhD thesis is the first work that fully takes into account hydrological data. At the beginning of the 3rd millennium BCE the landscape surrounding Memphis still had the features of a braided river bed, with an archipelago of sandy islands amidst several channels and swampy areas. At the end of the 3rd millennium, the former channel between Saqqāra and Memphis had been converted into a swamp. Then during the 2nd millennium BCE, human activity gradually transformed this western area into cultivated fields, whereas the former islands were united into one tell.[20] Human action played a major role, as Lourenço Gonçalves emphasizes, and the successive settlements that created Memphis are the product of a continuous adaptation effort.[21]

During the last two millennia the Nile showed all the characteristics of a meandering river, in Upper as well as in Lower Egypt. The effects are of two types: the river digs and erodes the cut bank and on the opposite side creates sandy bars humans strive to consolidate,[22] and anastomosed channels that humans transform into marshes for fishing and then into fields. Besides, catastrophic breaks in the natural levees alongside the minor bed of the river may create crevasse splays, i.e. build an alluvial cone within the floodplain originating from the rupture point. Whether disastrous events that would cause the river to suddenly get out of its bed and dig a new one, ravaging in the meantime the floodplain for tens of kilometres, is doubtful.

A short inventory of gaps in research

Research on the environmental history of Egypt during the last five millennia still suffers from wide gaps. The geoarchaeology of Egypt during the Islamic period is a sort of black hole, due to the almost complete absence of major excavation specifically dealing with that period. A brilliant exception has been offered these last years with the survey and excavation at Tinnis, just published by Alison L. Gascoigne.[23] Broadly speaking, the bibliographies of articles in natural sciences (or hard science) con-

20. P.M. Lourenço Gonçalves, *Landscape and Environmental Changes at Memphis During the Dynastic Period in Egypt*, fig. 43 on pp. 222-223.

21. Ibid., pp. 243-245.

22. Bunbury, *The Nile and Ancient Egypt*.

23. Alison L. Gascoigne, ed., *The Island of Tinnis: A Postmortem*, FIFAO 84, (Cairo: Institut français d'archéologie orientale, 2020).

cerning the period seldom include publications by historians.

With ancient times, most of the problems are linked with the methodology employed, i.e. drilling campaigns in the surroundings of major archaeological sites. These campaigns suffer from two limitations specific to Egypt. The Egyptian Antiquities Service grants or denies authorization on a yearly basis and on a limited area that is very difficult to extend afterwards. Additionally, the exportation of samples is forbidden. The IFAO lab is the only laboratory able to carry out 14C dating in Egypt, but only on samples of consistent size, which excludes the dating of the tiny fragments of charcoal or other organic material found in sedimentary deposits or elsewhere. OSL dating is practiced at Mansura University; this technique allows the dating of grains of quartz sand contained within sediments.[24] To sum up, geoarchaeologists working in Egypt do not possess the instruments necessary for their study that are available to their colleagues elsewhere; archaeometry is falling behind in Egypt.

Dating core samplings is mainly practiced by analysing the tiny fragments of ceramics trapped in sediment deposits; this leads to rough dating at best, such as 'New Kingdom' or 'Late Antique'. Historians who deal with a much finer chronology can hardly be satisfied with such a broad dating. Sediments are described by considering their grain size, colour, smell etc., which allows for distinguishing between flood alluvial deposits (from the river itself or from wadis), aeolian deposits (a sure indication that the surrounding desert had become arid), deposits from running waterways or from swamps, and more or less oxygenated environments. Thus, drilling highlights the existence of major river beds, i.e. the Nile branches, according to a chronology that is drawn with broad strokes. Additionally, systematic campaigns of drilling enable geoarchaeologists to reconstruct the larger picture: a meandering or a braided river, marshes or a running waterway.

Yet we lack a useful and practical reflection on the environmental footprint of human activity during the last five millennia. This may be explained first by the historians' dismay in front of the key issue of human capacity for environmental action. Scholars agree that the ancient Egyptians were not able to dam the river Nile itself. But too little is known about the obscure efforts made by local communities, not by the state, in order to recharge field soils, consolidate embankments, build and maintain dykes, unsilt waterways, etc., efforts that primary sources may allude to but seldom measured. This limitation may be illustrated by an often-reproduced map: the virtual reconstruction of the Nile riverbed movements in the Memphis area during the last five millennia, an attempted reconstruction by Katy Lutley and Judith

24. Willem Toonen, "Holocene Development of the Interconnected Fluvial and Cultural Landscape of the River Nile Near Luxor", *Communication at the Symposium Egyptian Riverine Harbours*, (Cairo: IFAO, 16-18 September 2019).

Bunbury.[25] This beautiful map, which calls to mind a colourful spaghetti dish, shows the river bed moving quite freely within an environment from which mankind seems utterly absent: embankment, dykes, drains etc. do not seem to have had any effect. What did the ancient hydrological system look like anyway?

Many historians and archaeologists still ignore the seminal article published by Ghislaine Alleaume: "Les systèmes hydrauliques de l'Égypte prémoderne. Essai d'histoire du paysage".[26] Here, she showed that the model of the 'basin system' or 'basin chains' as described by engineers at the end of the 19th century is not relevant for the understanding of the hydrology of earlier periods. It is still commonly believed that the dykes attested in 1800 or 1900 were already in use in Pharaonic Egypt, and some have tried to find them in ancient written documentation, thus unconsciously developing a circular reasoning. On the other side, Harco Willems, Hanne Creylman, Véronique de Laet & Gert Verstraeten highlight how fruitful the exploitation of the Description de l'Égypte atlas maps may be, in their case those of southern Middle Egypt, i.e. the al-Ashmūnayn/al-Minya province.[27] Their article draws the network of transverse (sultanic) and longitudinal dykes and from there, proposes to reconstruct the irrigation system of the whole area in pre-modern times. The study allows them to assume the existence of several crevasse splays in the region (fig. 10 on p. 323) and to extend their analysis further downstream, to northern Middle Egypt and the Fayyum.

Few geoarchaeologists and archaeologists use printed maps; their cartographic documentation consists mainly in satellite images, which reproduce current transformations such as the dramatic increase in area of settlements and the subsequent erasing of older delineations, adding new changes to a landscape deeply altered already by the move towards perennial irrigation and the subsequent reshaping of fields. Older maps dating from the eighteenth and early nineteenth centuries are mainly used in order to localize ancient ruins. As a rule, the extremely rich data provided by the Survey of Egypt maps from the early twentieth century remain under-exploited. A counterexample may be offered by Lennart Strömquist, a geomorphologist, and Ake Engsheden, an Egyptologist.[28] They propose to reconstruct in a

25. Katy Lutley and Judith Bunbury, "The Nile on the Move," *Egyptian Archaeology* 32, (2008): pp. 3-5.

26. Ghislaine Alleaume, "Les systèmes hydrauliques de l'Égypte prémoderne. Essai d'histoire du paysage," in: Christian Décobert, ed., *Itinéraires d'Égypte. Mélanges offerts au père Maurice Martin s.j.*, Bibliothèque d'étude 107 (Cairo: Institut français d'archéologie orientale, 1992): pp. 301-322.

27. Harco Willems, Hanne Creylman, Véronique de Laet & Gert Verstraeten, "The Analysis of Historical Maps as an Avenue to the Interpretation of Pre-Industrial Irrigation Practices in Egypt," in: Harco Willems & Jan-Michael Dahms, eds., *The Nile: Natural and Cultural Landscape in Egypt*, (Mainz: Mainz Historical Cultural Sciences 36, Transcript, Bielefeld, 2017): pp. 255-343.

28. Lennart Strömquist & Ake Engsheden, "An Integrated Study Approach to the Geographical Distribution of Ancient Settlements in the Kafr el-Sheikh Governorate in Northern-Central Delta, Egypt,"

systematic way the archaeological tells in Kafr el-Sheikh governorate, by cross-checking satellite images, the Survey maps, older maps like those of the Description de l'Égypte atlas, as well as place names (toponymy), the latter allowing them to distinguish between ancient ('pre-Arab') and more recent settlements. It is unfortunate that the two authors could not work with a specialist of the history of the Islamic period, for most of these sites date from the 1st millennium CE.

in: Yann Tristant & Matthieu Ghilardi, eds., *Landscape Archaeology: Egypt and the Mediterranean World*, Bibliothèque d'étude 169, (Cairo: Institut français d'archéologie orientale, 2018): pp. 75-98.

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