

On Sea and Ocean:

New Research in Phoenician Seafaring

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## New Insights into the Iron Age Timber Trade in Lebanon\*

### Introduction and methodology

This paper looks at the evidence for the timber-trade processes in Lebanon during the Phoenician period (1200–550 B.C.). These processes encompass issues of acquisition; felling; terrestrial, fluvial, and maritime transportation; conversion; and marketing. The main focus of this paper is to consider the practicalities of inland transportation of the timber logs from the Mount Lebanon chain to the coast. By this, it aims not to solve the problem and determine the exact course path for logging in Iron Age Lebanon but to present new perspectives and considerations for studying this subject. This could be achieved by skimming through technical details of the logging operations, avoid falling into generalizations, and taking previously published hypotheses for granted.

Indeed, different aspects of the timber-trade processes have been previously studied from specific perspectives and more rarely as a whole: such as the corpus of inscriptions related to forests and forest exploitation<sup>1</sup>; the timber trade processes in the Mediterranean<sup>2</sup>; the historical perspective<sup>3</sup>; and the archaeological perspective<sup>4</sup>. The author's MA dissertation built on these works to present a comprehensive picture of the timber trade and suggest new interpretations some of which will be presented here.

This study follows a multi-disciplinary approach to try and grasp the complexity of these processes. Indeed, relevant written sources, iconography, and archaeological evidence are investigated as well as examples of ethnographic material culture, notions of topography and hydrography. The author also presents recent unpublished studies that complement the subject. The textual evidence<sup>5</sup> relies on Egyptian royal inscriptions, Assyrian and Babylonian annals, and the Bible. The absence of Phoenician sources relating to forest exploitation and timber-trade activities should be noted, most probably due to a lack of archaeological material culture related to it found within Lebanon so far.

### Geographical context and timber resources

Lebanon is located in the Eastern Mediterranean basin, and is bordered by Syria to the North and East, Israel to the south, and the Mediterranean Sea to the West. The Lebanese topography is roughly divided

into four parallel geographical structures: the coastal strip, Mount Lebanon (the western chain), the Beqa' (central plateau) and Anti-Lebanon (the eastern chain) (Fig. 1). The coastal environment with sandy beaches and protected bays holds potential for beaching logs and exporting cedar and other timbers. Mount Lebanon and Anti-Lebanon are rich in forests of cedar and other conifers that provide the main resources for timber of exceptional size<sup>6</sup>. Indeed, Lebanon is a »forested islet« in contact with almost treeless regions such as Egypt, Mesopotamia, and Palestine<sup>7</sup>. The Beqa' valley is a passageway for timber from the Mount Lebanon forests to the Orontes River for fluvial transportation eastwards to Mesopotamia. On the western slopes of Mount Lebanon there are approximately fifteen main rivers (Fig. 2). Some of these rivers and valleys may have served for logging operations in antiquity. Spring is a favourable time for floating logs downstream since the rivers' high flow during this period allows them to be manoeuvred relatively easily as to avoid jamming the river course.

### Historical context

The Phoenician period, or Iron Age, began amid social and political confusion and disturbance in the eastern Mediterranean. »Outstanding among the socio-economic consequences of the »crisis« were the de-

\* This article is based in large part on my MA dissertation »The role of cedar in the timber trade of the Lebanon during the Bronze Age and the Iron Age« at the University of Southampton, 2007, which was supervised by Dr. Lucy Blue. I am very grateful to Dr. Anis Chaaya, Mr. Chawki Daou, Dr. Ata Elias, Dr. Wissam Khalil, and Dr. Maroun Khreich for their help and support, fruitful input and critical comments. Thanks are also due to those who kindly granted me the permission to use their images.

1 Pairman Brown 1969; Abdul-Nour 2001.

2 Meiggs 1982.

3 Elayi 1988; Elayi 2009.

4 Frost 1998–1999; Frost 2001; Frost 2002a; Frost 2002b; Frost 2004.

5 An almost exhaustive corpus of inscriptions relating to the timber trade processes is included in Appendix I of the author's MA dissertation (Semaan unpublished).

6 For example: *Pinus pinea* can reach 25–30 meters in height and 1.50 meters in diameter: Pairman Brown 1969, 157; Breton 1980, 21. Mature cedar trees can attain 24 to 36 meters in height and 1.5–2.4 meters in diameter: Hepper 1990, 45; Gale – Cutler 2000, 377.

7 Breton 1980, 15.

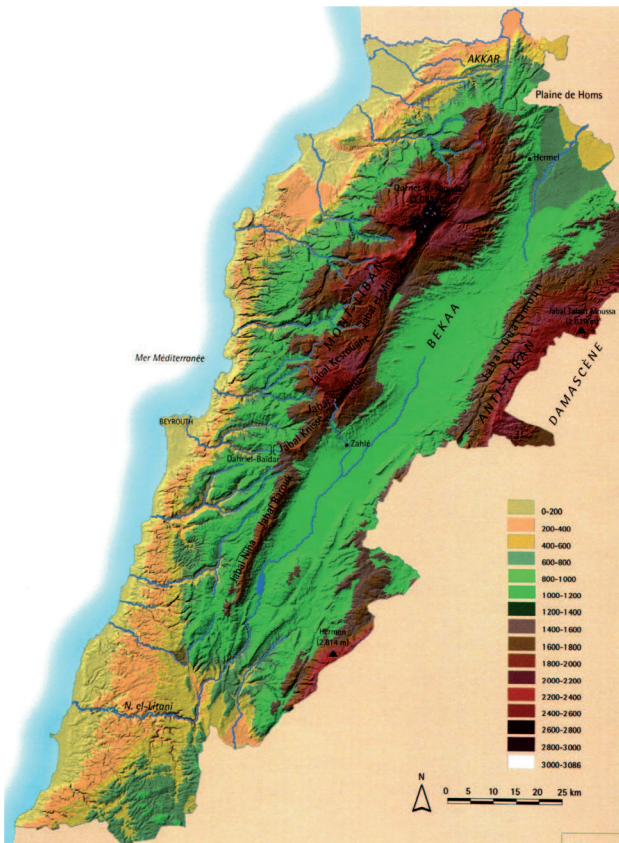


Fig. 1: A map illustrating the Lebanese topography, after Assaf – Barakat 2006, 15



Fig. 2: A map illustrating the Lebanese rivers, after Assaf – Barakat 2006, 19

centralization of the eastern Mediterranean economies and the collapse of the hierarchal regional systems of the Bronze Age», says Aubet<sup>8</sup>. What follows investigates the textual evidence of how the decentralization of the exchange systems influenced the timber trade in Iron Age Lebanon.

In the 12<sup>th</sup> century B.C., Egypt lost control over the Phoenician coast mainly due to the intrusion of the Sea Peoples in the Eastern Mediterranean and the internal divisions during the 3<sup>rd</sup> intermediate period. Egypt declined from a »first-class power to an equal trading-partner<sup>9</sup>. This newly-acquired status affected the timber trade and is reflected in the Iron Age textual evidence from Egypt which is relatively scarce, compared to the Bronze Age period. The decrease of textual data concerning the Egyptian import of wood from Lebanon may show the relative decline of cedar and other conifers trade between the Phoenician coast and Egypt. The request made by Wenamun to Zakar-Baal for wood procurement shows that timber from Lebanon was still exported to Egypt<sup>10</sup>. However, the difficulties and troubles that Wenamun encountered during his journey to Phoenicia echo Egypt's political and military decline in the region<sup>11</sup>. Four other inscrip-

tions testify to the presence of cedar wood in Iron-Age Pharaonic Egypt. The inscription of Mentehmet a »prince of the Theban principality« during the reign of Taharqa of the 25<sup>th</sup> dynasty (751–656 B.C.) mentions the construction of a barge for Amon, traditionally built of *Cedrus libani*<sup>12</sup>. The stele of Taharqa (690–664 B.C.) mentions the import of cedar wood and the donations of cedar timber in the temple of Kawa in Nubia<sup>13</sup>. An inscription dating from the times of Psamtik I (663–609 B.C.) of the 26<sup>th</sup> dynasty mentions chests of cedar wood and doors of cedar in an Osirian tomb of Amon at Thebes<sup>14</sup>. The statue inscription of Pefnefdneit, »a prominent member of the treasury administration«<sup>15</sup>, dating from the time of Amasis (568–525 B.C.) of the 26<sup>th</sup> dynasty, mentions the cedar-built sacred

8 Aubet 2000, 78.

9 Katzenstein 1973, 73.

10 Gardiner 1932, 61–76; Lichtheim 1976, 224–230; Aubet 2001, Appendix I.

11 Wachsmann 1998, 11 f.; McGrail 2001, 47 f.

12 Breasted 1962 Vol. IV, 458 §901. 460 §904; Redford 1992, 355.

13 Redford 1992, 354 f.

14 Breasted 1962 Vol. IV, 491 § 958M. 494 § 966.

15 Breasted 1962 Vol. IV, 514 § 1015.



barge of Amon<sup>16</sup>. The barges of Amon mentioned in the inscriptions of Mentehmet and Pefnefdineit do not necessarily prove the import of cedar during these periods. They could only be the reminiscence of a popular ritual tradition of building Amon's sacred barges with wood from Lebanon, at times when Egypt was still a powerful political party in the Levant.

The case of Assyria differs from that of Egypt. During the Iron Age, the Assyrian texts tell of rulers cutting cedar from Mount Lebanon and the Amanus mountain chains. Around 15 relevant inscriptions dating from the times of Tiglathpileser I (1114–1076 B.C.) to Asurbanipal (668–627 B.C.) figure in substantial studies<sup>17</sup>. These describe cedar as an important asset of political and religious propaganda, when felling cedar trees constitutes a symbol of the prestige, courage, powerfulness, glory and strength of the Assyrian kings. Indeed, the expeditions of these latter to the distant mountains of Amanus and Mount Lebanon were considered as proud achievements. These kings were strong pious rulers who built monumental palaces and temples with »mighty« cedars. The link between cedar and tribute is clear throughout the texts of this period.

Currently the timber river transport between Phoenicians and Assyrians depicted on the wall reliefs of Sargon II's palace at Khorsabad constitute the only iconographic evidence. These indicate either tribute or trade between Assyria and the Phoenicians, depending on the various interpretations suggested for these reliefs<sup>18</sup>.

#### *Phoenician economic independence?*

With Egypt's influence diminished, Assyrian and Babylonian control over forest exploitation was not permanent and fluctuated with the different reigns. The Phoenician ruling elite appear from the texts and iconography as vassal kings who offered their timber as tribute to the ruling power. However, this was not always the case in the Iron Age, during which the ruling elite of Phoenician cities obtained a certain commercial independence, along with private merchants, as »the new situation encouraged the boom in private initiative and opportunistic trade«<sup>19</sup>. Indeed, in the story of Wenamun, written in the 10th century, Zakar-Baal, king of Byblos, only agreed to deliver the wood after imposing his own conditions on the Egyptian envoy.

The biblical account of the economic associations between Hiram I king of Tyre (ca. 969–936 B.C.) and Solomon king of Jerusalem (ca. 970–931 B.C.) is conventionally ascribed to the 10th century<sup>20</sup>. The Book of Kings<sup>21</sup> describes how Hiram I sent cedars of Lebanon

to Jerusalem for the construction of the Temple and palace of Solomon<sup>22</sup>. The origin of the timber and the role of the Tyrians deserve some attention here. The topography of Tyre's immediate hinterland to the east of the coastal city is formed by hills between 200–800 meters. Indeed, Mount Lebanon's altitude starts declining around the hinterland behind al-Zahrani located some 30 km north of Tyre (Fig. 1). Therefore, cedar stands growing at a minimum of 1000–1200 meters could not have been present on those hills. The closest stands to Tyre would be the ones in the Southern Chouf area in Jabal Niha and Jabal al Barouk, where such stands are still nowadays, and which fall in Sidon's hinterland. It remains to be seen whether these stands were under the hegemony of Sidon at that period, or Tyre, or both<sup>23</sup>; or whether there were independent groups of mountaineers and lumbermen that would provide such timber. However, regardless of the geopolitical situation and the political processes, procedures and agreements that it entailed, it is safe to suggest that the forests of southern Mount Lebanon could have been the potential source for this wood<sup>24</sup>. Another source for

16 Breasted 1962 Vol. IV, 514 § 1023.

17 Pairman Brown 1969; Meiggs 1982; Elayi 1988; Bikai 2001; Briquel-Chatonnet 2001.

18 Parrot 1950; Albenda 1983; Linder 1986; Parpola 1995; Caubet 1997; Trakadas 1999; Aubet 2001, 37; Fontan 2001; McGrail 2001, 131 f.

19 Aubet 2000, 78.

20 Khreich (unpublished) suggests that Hiram I did not exist, the Hiram mentioned in the Bible is confused with Hiram II (739–730 B.C.). Therefore the biblical account mixed both personas in one ruler and linked him with Solomon's reign for establishing links between Tyre and Judah in the 10th century. To Khreich, these relations might have existed at that time but the biblical account is based on information from the 8th century.

21 Briquel-Chatonnet 1992; Finkelstein – Silberman 2002, 127.

22 For the sake of this article, only the elements that might shed light on the timber trade processes are considered since the biblical account needs to be considered under scientific interpretation. As Finkelstein – Silberman 2002, 128, say: »A close reading of the biblical description of the days of Solomon suggest that this was a portrayal of an idealized past, a glorious Golden Age«. Furthermore, »digging in Jerusalem failed to produce evidence that it was a great city in David or Solomon's time. And the monuments ascribed to Solomon are now most plausibly connected with other kings«, Finkelstein – Silberman 2002, 124.

23 In that sense, to Khreich (unpublished), Sidon's hegemony extended from the 12th to the half of the 8th century B.C., within which Tyre was an important city and not its capital. This is why the topography of Sidon's hinterland is considered here.

24 It would also be interesting to investigate the logging potential of Nahr al-Awali and its confluent (Nahr Bisri, Barouk and Aaray) for transporting the timber from its adjacent forest stands in Jabal Niha and Jabal al Barouk, down to its mouth a few kilometres north of Sidon where these logs could have been towed by sea south to Tyre. An archaeological and epigraphic survey of Nahr al-Awali was published in 2005, cf. Xella *et al.* 2005. However, further investigations are needed.

the timber could have been **Mount Hermon** (Ar. Jabal al-Sheikh). Located on the Anti-Lebanon chains of mountains, some 40 km east of Tyre, Mount Hermon contained forests of oaks and Juniper and possibly cedar in antiquity<sup>25</sup>. Mechanisms of inland transportation and routes, through adjacent wadis of Mount Hermon and then the Beqa', need to be investigated<sup>26</sup>.

In the 8<sup>th</sup> century, the Nimrud letter written by Qurdi-assur-lamur, the Assyrian representative in Tyre, and attributed to the time of either Tiglatpileser III<sup>27</sup> or Sargon II<sup>28</sup> provides speculations on the nature of timber trade during the Assyrian military and political control of the central Phoenician coast and the mountain resources<sup>29</sup>. The letter gives the first example of economic freedom of the Phoenician cities Tyre and Sidon. Despite the fact that the ongoing timber trade with Egypt and Palestine appeared as illegal to the Assyrians, Sidonian and Tyrian timbermen and merchants still answered Egypt's demands for high quality timber<sup>30</sup>. Although they were still obliged to pay a tax to the Assyrians for this timber, they were allowed to move freely to Mount Lebanon to fell trees for their needs<sup>31</sup>. In fact, it appears that the Tyrians and Sidonians enjoyed some form of economic autonomy by being actors of the forest exploitation and timber export to Egypt and Palestine although this was vetoed by the Assyrian kings<sup>32</sup>. Hence, Assyria imposes certain restrictions but allows trade to develop<sup>33</sup>. It is important to note that the Assyrians valued timber from Lebanon and the Amanus, not just to levy taxes, but also as a practical means of harming Egypt and Palestine<sup>34</sup> considered as rival of the Assyrian Empires<sup>35</sup> by depriving them of the much needed raw materials.

Furthermore, maritime long-distance trade in the Iron Age seemed to be mainly driven by independent ship-owners who operated between the Nile delta and the Phoenician harbors<sup>36</sup>. The Canaanite merchant and ship-owner Warkatil possessed 50 ships in Sidon and handled the shipping of goods and cedar wood between from the Levant to Egypt<sup>37</sup>. To avoid the »geopolitical encumbrances« and satisfy the demands of the timber market<sup>38</sup>, Phoenician traders searched for alternative sources of wood: As an example, the beams used for roofing Taharqa's kiosk at Karnak were made of cypress imported by Phoenicians from Cyrenaica or Crete<sup>39</sup>. Treumann-Warning<sup>40</sup> extrapolates the idea of private commerce to suggest that the expansion of timber exploitation and trade, among others, shaped the pattern of Phoenician contacts and settlements in the late 8<sup>th</sup> and 7<sup>th</sup> centuries across the Mediterranean. Sommer<sup>41</sup> states that merchants from Tyre were still carrying on their trading business despite »political

adverseness« created by the Assyrian assault circa 720 B.C. He also reports that Homer describes the Phoenicians »as economically independent entrepreneurs who operate on their own behalf, at least beyond their homeland«<sup>42</sup>. The last evidence supporting the idea of economic independence of some Phoenician agencies is the pact between the Assyrian king Esarhaddon (681–669 B.C.) and Baal, king of Tyre. This regulated the »duties and privileges of Tyre under Assyrian power«, and reports »ships belonging to the people of Tyre« which Sommer<sup>43</sup> interprets as »merchant vessels that were the property of individual ship owners«.

### Acquisition

The first step that triggers the timber exploitation process is the issue of acquisition. From the historical context described above, **five models of acquiring timber emerge: as tribute; as part of the royal propaganda; as war booty; as commerce between royal elites; and as private entrepreneurship of Phoenician merchants.**

Wood from Lebanon was exported in form of a tribute that could be singular, discontinuous, or annual<sup>44</sup>. Evidence for cedar wood brought from the Amanus and Mount Lebanon as a tribute is mainly found in the Assyrian inscriptions of Tiglatpileser I (1114–1076 B.C.), Salmanasar III (ca. 850 B.C.) who established an annual tribute from the Amanus, Esarhaddon (680–669 B.C.), Assurbanipal (669–627 B.C.), and

25 Vaumas 1954, 262; Rowton 1967, 266–268; Mikesell 1969, 11; Bottema 1975–1977, 265 f.

26 On the other hand, to Briquel-Chatonnet 1992, 252 and Briend 2002, 108, Hiram and Tyrian traders acted as middle-men or a »commercial intermediary« who acquired probably timber from the Byblian hinterland. Briend 2002, 109, adds that Hiram only controlled the wood trade that transited through Tyre and seemed to possess the royal monopoly over this trade.

27 Elayi 1988, 35; Redford 1992, 345; Aubet 2001, 92; Elayi 2009, 68–71.

28 Meiggs 1982, 75; Gubel 1987, 18; Treumann-Warning 2000, 8.

29 Lemaire 1987, 53 f.; Treumann-Warning 2000, 8.

30 Elayi 1988, 35; Treumann-Warning 2000, 8.

31 Meiggs 1982, 75; Gubel 1987, 18.

32 Briquel-Chatonnet 2001, 46.

33 Aubet 2001, 92.

34 Meiggs 1982, 75.

35 Elayi 1988, 35; Briquel-Chatonnet 2001, 46.

36 Katzenstein 1973, 72; Frankenstein 1979, 264 f.; Aubet 2000, 83.

37 Katzenstein 1973, 60–72; Aubet 2000, 84.

38 Treumann-Warning 2000, 9.

39 Lauffray 1970, 161.

40 Treumann-Warning 2000, 9.

41 Sommer 2010, 124.

42 Sommer 2010, 123.

43 Sommer 2010, 123 f.

44 Elayi 1988, 27.

Nebuchadnezzar of Babylon (605–562 B.C.) who was the first to establish an annual tribute from Mount Lebanon<sup>45</sup>. Elayi notes that the tribute of cedar wood from Mount Lebanon was irregular and less frequent than the one from the Amanus operated by the north-west vassals<sup>46</sup>. This supports the argument in favor of a relative independence of the Phoenician cities regarding their forests and timber exploitation.

Another means of fetching timber serves the royal propaganda and is recorded by the regal annals as a personal enterprise from the King himself as one of the means to fortify his stronghold over vassal lands. Indeed, the Egyptian and Assyrians kings boasted their pride upon felling or acquiring cedar wood, such is found in the inscriptions of Tiglatpileser I (1114–1076 B.C.), Asurnasirpal II (883–859 B.C.), Shalmaneser III (858–824 B.C.), Piankhi (817–730 B.C.), Tiglatpileser III (745–727 B.C.), Esarhaddon (680–669 B.C.), and Nebuchadnezzar of Babylon (605–562 B.C.)<sup>47</sup>. This aspect should, however, be considered while bearing in mind whether the kings truly reached the mountains for felling, or whether this action only bore a symbolic meaning in the tradition of succeeding dynasties.

A third model could be found in the unique example in the inscription of Asurnasirpal II (883–859 B.C.) where he felled cedar and other timber, and seized cedar wooden objects, amongst the booty from his military expeditions to the Levant<sup>48</sup>.

The fourth relates to the commerce between the royal elite of the Lebanon and its neighboring counterparts. Evidence for this is found in the story of Wenamun and in the story of the relations between Hiram of Tyre and Solomon of Jerusalem. In the Wenamun tale, Zakar-Baal describes himself as the owner of the forests, independent from Egyptian hegemony when he says to Wenamun: »As far as I am concerned, neither am I your servant. Nor do I serve him who sent you. If I shout to Lebanon, the heavens open and the logs lie at rest [on] the seashore«<sup>49</sup>. Furthermore, it was only when Zakar-Baal received the required payment from Egypt that he delivered the rest of timber to Wenamun, as he had only provided seven wooden ship components to the Egyptian envoy upon the latter's visit to Byblos. This illustrates the hard bargaining by the Phoenicians when they were not forced to present their timber as tribute<sup>50</sup>. Similarly, King Solomon bargained with Hiram of Tyre to acquire cedar wood for his temple and palace in exchange for agricultural products<sup>51</sup>. In addition to the textual evidence, archaeological data also testifies to the export of cedar and other conifers from Lebanon. Several wood samples were identified in various archaeological sites in ancient Palestine, among

which are ten Iron Age sites where timber was used in construction and furniture<sup>52</sup>.

The fifth figures the private entrepreneurship of Phoenician merchants as discussed above.

## Felling

Once the demand for wood has been made, trees would be fallen in required quantities. This section reviews the evidence for issues relating to felling in the Phoenician period Lebanon such as the tools, the felling operation, and season.

## Tools

The important work of Deshayes is probably the only published inventory to date that comprises several types of felling and woodworking tools found in modern Lebanon, essentially from the excavations of Dunand at Byblos<sup>54</sup>. These include several axes and adzes, drills, chisels, a gouge, and a hammer. The date of some of these tools and the function of certain blades are not always determined because Dunand often did not provide the context in which these tools

45 Elayi 1988, 17–27; Bikai 2001, 54; Briquel-Chatonnet 2001, 46.

46 Elayi 1988, 27.

47 Pairman Brown 1969, 196–199; Meiggs 1982, 73–74, 77–78; Bikai 2001, 54; Briquel-Chatonnet 2001, 46; Hepper 2001, 5.

48 Elayi 1988, 19 f., says that the cedar and the cedar objects mentioned in this fragmentary inscription did not come from Mount Lebanon.

49 Pritchard 1975, 20; Lichtheim 1976, 226–227; Aubet 2001, 359.

50 Mikesell 1969, 13. Aubet 2001, 135, sees the reciprocity between Zakar-Baal and Wenamun as an exchange of gifts, as Wenamun aims at renewing the trading relationship between Egypt and Byblos that was based on continuous exchanges of gifts. She adds that Zakar-Baal's refusal of the cedar delivery is »due to an absence of balanced reciprocity or of return gifts, which the Giblete king expects as a gesture of good will and recognition of his social status.« (*ibidem*).

51 Lipinski 1991, 2–3, 6; Briquel-Chatonnet 1992, 46, 250, 266. Bunnens 1976, and Aubet 2001, 135 f., see this exchange as a gift-to-gift system that regulated royal relations and not a commercial transaction. Briquel-Chatonnet 1992, 46, explains this exchange as trade because to her, the goods traded, including cedar, did not consist of items with symbolic and prestigious significance but goods of daily consumption. This hypothesis should be refuted since the ancient written sources from Egypt and Mesopotamia all point toward the prestige and high symbolism linked with the cedar trade (cf. Arnaud, 1997). Also, in a later publication, Briquel-Chatonnet 2001, supports the concept of prestige linked with the cedar tree.

52 Breton 1980, 16; Meiggs 1982, 71; Liphshitz – Biger 1991, 168–174; Briquel-Chatonnet 1992, 253; Briquel-Chatonnet 2001, 48; Cartwright 2001, 111–113.

53 Deshayes 1960.

54 Dunand 1926–1932; Dunand 1933–1938.

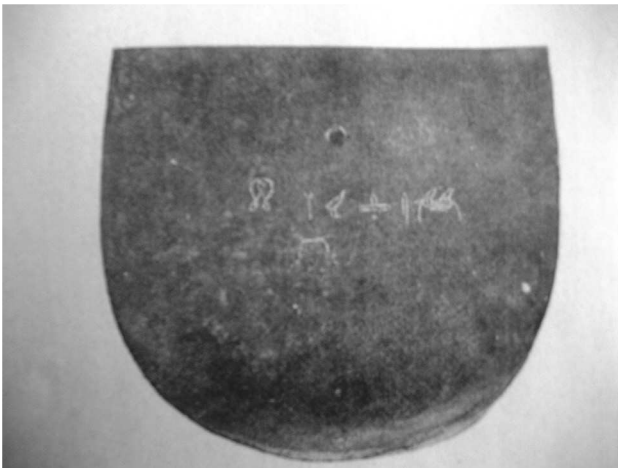


Fig. 3: The semi circular axe blade in hardened copper found around the Nahr Ibrahim river mouth, after Mallon 1925, pl. I, 1



Fig. 4: Bronze axe blade found in Jezzine. Courtesy of Dr. Wissam Khalil

were found. In his discussion, Deshayes states that most of the blades studied are for adzes used in ship construction, carpentry, and wood sculpture during the Bronze Age<sup>55</sup>. Considering the current state of research, it is not possible to determine which of these tools, if any, were used for felling trees. However, there are four blades worthy of examination and that were found in Lebanon. Three Egyptian axe-heads: a hardened-copper axe from Nahr Ibrahim (7 km south of Byblos) (Fig. 3), and two from Byblos<sup>56</sup>. This type of axe was common in the 3<sup>rd</sup> and 4<sup>th</sup> dynasties<sup>57</sup>. The Egyptian axes were probably used as tools for wood working – either for felling trees or in carpentry. They appear in Egyptian naval construction scenes and were sometimes used to square logs<sup>58</sup>. Although these axes cannot be accurately located in the Byblos stratigraphy, they might suggest the presence of a potential shipyard or a site for processing tree logs for export around the Byblos area from at least the Bronze Age. A bronze lugged axe blade was found by Wissam Khalil during a survey near Jezzine, 22 km east of Sidon, in the summer of 2003<sup>59</sup> (Fig. 4). It has not been studied and published yet, but preliminary typology places it in the Late Bronze Age. This testifies to felling or logging activities in the southern part of Mount Lebanon at least since the Late Bronze Age. From this evidence, it can be inferred that presently no Phoenician period wood-working tools are known to have been found, or at least studied and published.

#### *Felling operations*

Evidence for felling operations in the Iron Age is poor. The relief from the Temple of Amun at Karnak

depicts princes of Lebanon felling trees for the Pharaoh Seti I's (1290–1279 B.C.)<sup>60</sup>. The stylized and schematic trees are identified as fir by Loret and Montet, and as cedar by Meiggs<sup>61</sup>. Dalix and Chaaya associate them with pine and not cedar because, they say, that the artist reproduced leaves that are not needle-like as are the leaves of a cedar, and the tree trunks are represented almost without branches, which does not correspond to the lateral branching of the cedar tree<sup>62</sup>. However, this interpretation is erroneous for the following reasons:

- The foliage of a pine tree and of a cedar tree is made of needle-like leaves.
- The artist(s) might have not ever seen a cedar tree and thus represented what he thinks a tree looks like i.e. with broad leaves.
- When growing in dense stands the cedar tree trunks can shoot up and not develop lateral branches<sup>63</sup>.
- Finally, pine branches grow in various ways depending on the pine species and lateral branching might occur in some species.

55 Deshayes 1960, 79 f.

56 Deshayes 1960, I 245–247; II 103.

57 Rowe 1936, 283; Wachsmann 1998, 11.

58 Deshayes 1960, 247.

59 W. Khalil (pers. com. on 12/3/2011).

60 Montet 1923, 183; Contenau 1926, 281; Pritchard 1954, 108 fig. 327; Breasted 1962 Vol.III, 48–49 § 94; Mikesell 1969, 12; Meiggs 1982, 16. 331; Gubel 1987, 19; Wachsmann 1998, 310.

61 Loret 1916, 43–45; Montet 1923, 184; Meiggs 1982, 524.

62 Dalix – Chaaya 2007/2008, 236.

63 Mikesell 1969, 14; Pulak 2001, 25.

Therefore, contextualising the Karnak relief scene helps in identifying the trees or rather tends toward one identification and not the other: The scene is part of the records of the victorious campaigns of Seti I in the Levant, and shows the submission of the royal class of Lebanon. It is clearly a scene of tribute to the Pharaoh, and it involves precious wood. Thus, cedar would be the more adequate interpretation, since it was acquired during military campaigns as stated in written sources from Egypt and Mesopotamia in the Bronze and Iron Ages.

In addition to the iconographic evidence for felling operations, textual evidence is found in the Wenamun story from the 11<sup>th</sup> century B.C. Zakar-Baal tells to Wenamun: »Give me the ropes [that] you have brought [to lash the cedar] logs which I am to cut down/I must fell«<sup>64</sup>. Perhaps the ropes mentioned here are needed for the felling operations to guide the tree in its fall.

When it comes to the operational system of felling and forest exploitation, the Iron Age sources are silent and no evidence of that period for this activity has been found yet in Lebanon. Evidence for systematic forest management and exploitation in Lebanon is found much later in the rock inscriptions of the Roman emperor Hadrian (117–138 A.D.), dating from 2<sup>nd</sup> century A.D.<sup>65</sup>. More than 200 inscriptions are recorded, scattered in the Lebanese mountains north of Beirut until the Hermel between 250 and 2500 meters elevation<sup>66</sup>. They constitute the boundary markers of what must have been the limits of the Hadrianic forest domain<sup>67</sup>. The texts they bear were decreed by the emperor Hadrian and prohibited the felling of the four tree species that were necessary for shipbuilding: cedar, fir, juniper and oak<sup>68</sup>. The forest inscriptions of Hadrian do not however represent felling scenes or give information about the technicalities of cutting trees.

What remains unclear is whether there was any regime of economic exploitability of the Lebanese forests during the Phoenician period, as in the times of Hadrian<sup>69</sup>, or if there were any other exploitation patterns followed wood-cutters. However, considering the accessibility to forests and the difficulties of extraction and transportation, it is suggested that the most reachable forest stands were felled first for convenience<sup>70</sup>, especially the ones near watercourses as to facilitate their transportation by fluvial means<sup>71</sup>. The issue of logging will be investigated below.

### *Season and Seasoning*

From a practical point of view, the felling of timber should have been done in winter time so that in early spring, around March–April, the logs could be

floated down rivers to the coast. It is at that time that the water from snow-melt enriches the springs and rivers with an adequate volume. Upon reaching the beach the logs could have been left to season until the early summer, which corresponds to the sailing period in the Mediterranean<sup>72</sup>. Alternatively, timber could be felled during the autumn and left to season in the mountains until spring when it was floated downstream.

After felling, the tree would be stripped of its branches with an axe<sup>73</sup>. Meiggs suggests that the treatment of the trunks depends on the demand: if long lengths were required the tree-trunks were transported to the timber-yard without cutting, but in the absence of any special orders the trunk probably would have been cut into parts to make transport easier<sup>74</sup>. Seasoning wood before use is important. The logs felled by Zakar-Baal for Wenamun were left to dry on the mountain in winter for around a year before they were transported to the coast<sup>75</sup>. This is most probably the only mention of seasoning timber mentioned in the texts dating from the Bronze and Iron Ages. Dalix and Chaaya<sup>76</sup> are right to locate the drying area, if such a place existed, away from the felling area, which considering the Lebanese mountain topography, would not be possible due to the lack of space and deep encased valleys.

Various methods of seasoning are referred to in classical sources. The simplest was, according to Vitruvius (II 9.3), to ring the tree before it was felled, cutting through the sapwood so that the sap, the main source of rot, could drip and the trunk dry out; however a

64 Pritchard 1975, 20; Lichtheim 1976, 227; Wachsmann 1998, 310; Aubet 2001, 359. The different authors present slightly different translations of this passage. For example: Lichtheim 1976, 227, and Wachsmann 1998, 310, substitute »cedar« with »pine«.

65 Breton 1980; Abdul-Nour 2001; Pairman Brown 2001, 136; Abdul-Nour 2006; Gèze – Abdul-Nour 2006. Breton's preliminary studies of the inscriptions of Hadrian published in 1980 were revised and updated by Abdul-Nour 2001; Abdul-Nour 2006.

66 Abdul-Nour 2001, 65.

67 Hadrian's forest domain was most probably a Seleucid asset, which goes back to the Achaemenid and Neo-Babylonian kings; W. Khalil (pers. com. on 12/10/2011).

68 Breton 1980, 22; Abdul-Nour 2001, 65.

69 Breton 1980, 30.

70 Churchill Semple 1931, 269.

71 Elayi 1988, 30; Arnaud 1997, 161.

72 McGrail 2001, 93; Sauvage 2007.

73 Meiggs 1982, 70. 332.

74 Meiggs 1982, 70. 332.

75 Pairman Brown 1969, 180; Pritchard 1975, 22; Lichtheim 1976, 229; Meiggs 1982, 349; Wachsmann 1998, 310; Aubet 2001, 360; Briquel-Chatonnet 2001, 44.

76 Dalix – Chaaya 2007/2008, 242.



Fig. 5: El-Skbinay beach south of Byblos is an example of the stretch of sandy beaches in Lebanon. Image © author

tree is considerably less easy to fell when it is dead than when the timber is green<sup>77</sup>. Additionally, timber dries by the action of salt water so logs might have been stocked on the many sandy beaches of Lebanon (Fig. 5). Alternatively, they could have been buried in sand to dry<sup>78</sup>.

### Conversion

Once the timber reached the timber-yard it may have been left on site to dry out, but more often it was squared with axes to be either exported, sold to local timber merchants, or further processed. The conversion to beams, boards, and battens was also done with saws but no evidence for this tool has been inventoried in Lebanon<sup>79</sup>. The issue here is the conversion treatment the logs underwent in the timber or ship yard for export; whether it was already treated upon felling in the mountains or not. The main evidence for log conversion dates from the Late Bronze Age and the Iron Age from Egypt and Mesopotamia. Here again the lack of Phoenician sources and evidence for matters of wood conversion is remarkable.

Glanville suggests that Egyptians sometimes imported semi-worked or converted timber logs from Lebanon<sup>80</sup>. This is attested in the text of Kamose (1554–1549 B.C.) the last king of the 17<sup>th</sup> dynasty. He mentions »wooden planks« amid the ships' cargoes he captured from the Hyksos upon the conquest of Avaris<sup>81</sup>. The iconographic evidence from the tombs of Useramun and Rehmire displays reliefs of cut timber amongst other Syro-Canaanite trade products. Wachsmann tentatively identify these as cedar wood and describes them as »straight with rounded ends and with semi-circular mortises cut into one of their extremities.

They are painted light brown, with red lines indicating the wood's grain«<sup>82</sup>. However, the timber planks could have been finished by the Egyptian carpenters and not delivered in that form. An interesting passage in the tale of Wenamun states that Wenamun the latter received the first batch of timber from Zakar-Baal in the shape of seven ship's timbers: a stempost, a sternpost, an item identified as a keel, and four hewn timbers<sup>83</sup>. The conversion may have depended on the demand and supply pattern so the timber would be cut and converted accordingly.

Regarding Mesopotamia, Akkadian texts show that cedar derived products were exported more frequently than logs and beams<sup>84</sup>. In fact, the conversion of transported timbers correspond to the building needs: an inscription of Esarhaddon (680–669 B.C.) reports how »big logs, long beams (and) thin panels (or boards) from cedar and pine trees as building material« were transported from Sirara and Lebanon by the kings of Hatti for Esarhaddon's palaces in Nineveh and Assur<sup>85</sup>.

### Transportation

#### Land

Subsequent to felling operations, logs would be transported from the forests to their point of export. There are three main ways of terrestrial transportation, each using animals: hauling by yoked cattle (Fig. 6), dragging by cattle the chariot filled with timbers, and sledging with horses (Fig. 7).

In the story of Wenamun, Zakar-Baal sent three hundred men and three hundred cattle to cut timber and drag it down to the coast<sup>86</sup>. Meiggs gives an example that a single fir, of 100 feet and probably weighing more than three tons could not be pulled by a single yoke of oxen; and he adds that »in the ancient sources I can find no evidence of multiple yoking for timber«<sup>87</sup>.

77 Meiggs 1982, 350.

78 Meiggs 1982, 350.

79 Deshayes 1960, I 355–362; II table p. 152–154

80 Glanville 1932, 9 f.

81 Wachsmann 1998, 39, 312.

82 Wachsmann 1998, 312.

83 Pritchard 1975, 21; Lichtheim 1976, 227; Wachsmann 1998, 312; Aubet 2001, 360.

84 Elayi 1988, 39.

85 Mikesell 1969, 15; Elayi 1988, 22 f.; Bikai 2001, 54.

86 Pritchard 1975, 21; Lichtheim 1976, 228; Meiggs 1982, 68, 332; Gubel 1987, 19; Elayi 1988, 30; Aubet 2001, 360; Briquel-Chatonnet 2001, 44; Pulak 2001, 26. Aubet 2001, 360, translation is »three hundred beasts«, Lichtheim's 1976, 228, is »three hundred oxen«.

87 Meiggs 1982, 341.



Fig. 6: Ethnographic example from Sydney, Australia, of hauling a timber log using yokes of cattle. Repository: Tyrrell Photographic Collection, Powerhouse Museum. No known restrictions on publication



Fig. 7: Ethnographic example of sledging from Dalarna, Sweden. The logs were extracted from the forest by sledging during the winter to take advantage of the snow. Postcard, 1940's

But I do believe that the three hundred cattle sent by Zakar-Baal must have formed several yokes. An interesting study by Vila on the fauna of Early Bronze Age Sidon revealed cattle bones of the *Bos taurus* species that were probably used as draught animals<sup>88</sup>. This provides a *terminus post quem* date to further investigate this issue throughout the Lebanon and archaeologically support the idea of timbers being hauled by cattle from the mountains. Manpower was also used for hauling instead of, or alongside, cattle. The oldest evidence from the Iron Age is provided by the Wenamun story when three hundred men were sent with the cattle to direct or maneuver the dragging of the logs. The Bible offers another insight into the manpower mobilized to this end. The first Book of Kings states that Solomon sent 30,000 laborers to Lebanon in monthly relayed shifts of 10,000 to strip the branches from the trunks and haul them out of the forest. This number seems exaggerated especially when considering the modest dimensions of Solomon's temple and palace (I, Kings 5, 27–32)<sup>89</sup>. When Hiram refused Solomon's offer by stating »My men shall bring down the logs from Lebanon to the sea«, it shows how much the Phoenicians were eager to keep full control over the cedar exploitation. This passage does not however mention the extraction method<sup>90</sup>.

Evidence for hauling with carts is very scarce. It is implied in the inscription of Tuthmosis III in his 8<sup>th</sup> campaign in Syria in 1457 B.C.: »[...] I had many ships of cedar built on the mountains of God's Land near the Lady of Byblos. They were placed on chariots, with cattle drawing (them)«<sup>91</sup>. A substantial network of roads in the mountains is needed for hauling and carrying purposes. Indeed, recent studies by Khalil<sup>92</sup> on rural

areas, showed the existence of such networks, at least from the 8<sup>th</sup> century B.C.<sup>93</sup>. Also, Breton traced several Roman-period extraction paths in Mount Lebanon based on the distribution of Hadrian's forest inscriptions<sup>94</sup>. Thus, non-paved carriageways that were laid-out for this purpose must have existed in antiquity.

88 Vila 2004, 94.

89 Scientific analyses of this story show that Solomon's great building projects are not consistent with the archaeological evidence. Indeed, »Judah remained relatively empty of permanent population, quite isolated and very marginal right up to and past the presumed time of David and Solomon, with no major urban centers and with no pronounced hierarchy of hamlets villages and towns«, Finkelstein – Silberman 2002, 132. Furthermore, Finkelstein – Silberman 2002, 132–142. 340–344, demonstrate how excavations in Jerusalem and other sites in ancient Palestine failed to produce substantial evidence for a 10<sup>th</sup> century occupation relating to »Davidic« and »Solomonic« remains.

90 Meiggs 1982, 70; Gubel 1987, 19 f.; Briend 2002, 107–109.

91 Gubel 1987, 19.

92 Khalil (unpublished).

93 W. Khalil (pers. com. on 12/3/2011): Mount Lebanon offers many sites and settlements that prove the occupation of rural areas in ancient Lebanon at least from the Iron Age. As such there are sites in the Chouf area that date from the 8<sup>th</sup> and 7<sup>th</sup> century B.C. such as the Semqaniye site, from the 4<sup>th</sup> century B.C. such as the sites of Maasser el Chouf and Baadaran, and the 3<sup>rd</sup> century B.C. such as the site of Kahlouniyye. There are even some remains of the Neolithic occupation at Moukhtara. The Roman temple at Marj Bisri, located at 600 meters of altitude, possesses four black granite columns imported from Turkey. These were unloaded at Sidon harbor and dragged to the site in the mountain. All this supports the idea that the existence of important centers of occupation suggests a substantial network of routes for the movement of human beings, animals and resources. The paths for transporting timber would have been custom made for this purpose to accommodate the sizes of the logs and the resources invested in their transport.

94 Breton 1980, 34 f.

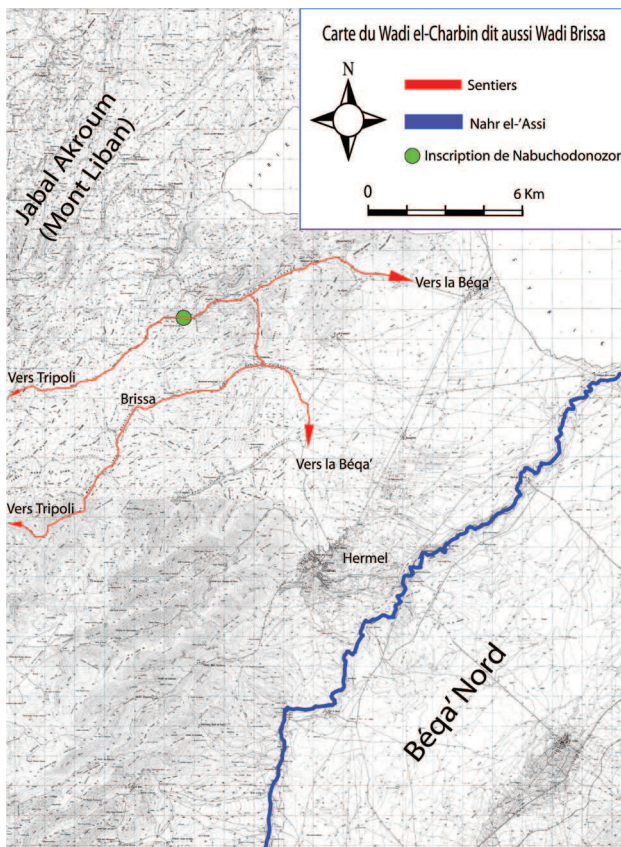


Fig. 8: The map illustrates the potential paths that Nebuchadnezzar took to haul the logs from Wadi Brissa towards the Béqa' in order to float them on the Orontes north towards the Euphrates. This map was arranged by adding around seven maps of 1/20000. Courtesy of Dr. Wissam Khalil

Sledging is common practice in Scandinavian regions as seen from ethnographic examples (Fig. 7). Dalix and Chaaya suggested this method for conveying logs out of forests<sup>95</sup>. However, there is no archaeological or textual evidence for the use of sledges or for horse remains showing strain marks, in the Bronze Age or Iron Age in Lebanon. The size of the logs transported need also to be considered as to whether they are suitable for this type of transportation.

The last written source that provides information on terrestrial transportation of timber is Nebuchadnezzar's (605–562 B.C.) inscription in Wadi Brissa (Fig. 8) on the northern end of the eastern slope of Lebanon, 45 km southwest of Homs. An analysis of the potential paths for extracting timbers by the Babylonian king is presented here to suggest a new interpretation for these and shed light on previous misconceptions. The inscription, now heavily eroded, shows the Babylonian king in the act of cutting a cedar<sup>96</sup>. Nebuchadnezzar describes his harvesting of the Lebanese cedars accompanied by the construction of a road through the

mountains for the movement of the trunks<sup>97</sup> and then floating them downstream like reeds: »I cleft the high mountains, I cut blocks of stone from the mountains, I opened paths, prepared roads for the transport of the cedars. On the canal Arahtu, as though they were reeds of the river, I floated large cedars, tall and strong, of great beauty, of imposing aspect, rich products of Lebanon«<sup>98</sup>. This inscription is open to several interpretations<sup>99</sup>. The logs were probably floated separately and not in rafts<sup>100</sup>. »Arahtu« has not been precisely identified but it might be either one of Mount Lebanon's rivers<sup>101</sup>; the Orontes or the Euphrates<sup>102</sup>; or the western branch of the middle Euphrates<sup>103</sup>.

Meiggs believes that from the inscription and its location, Nebuchadnezzar »did not send the timber down the Orontes, as he might have done, to take the easier route to the Euphrates, but chose the shorter route available, which runs from the coast by the valley of the Nahr al-Kabir (Eleutherus) a little north of Tripoli and proceeds through the Homs gap to the Euphrates.«<sup>104</sup>. However, Elayi suggests that a certain section of the Orontes, when enriched by the snow melting, was in fact used for floating, and from there to the Euphrates<sup>105</sup>. Wadi Brissa is oriented west-east and is perpendicular to the Béqa' valley. Therefore, the most logical road would have been to follow the natural topography from the Wadi Brissa to the Béqa' valley, then to the Orontes and the Euphrates<sup>106</sup>. Indeed, the Wadi Brissa is the first accessible passage to potential forests on the eastern slope of the north end of Mount Lebanon. The Assyrian and neo-Babylonian kings followed the Orontes canyon and the northern part of the Béqa' to reach Mount Lebanon from the north-east<sup>107</sup>.

95 Dalix – Chaaya 2007/2008, 248.

96 Gubel 1987, 19; Da Riva 2008.

97 Breton 1960, 16; Mikesell 1969, 15 f.; Katzenstein 1973, 320; Meiggs 1982, 52; Elayi 1988, 23; Briquel-Chatonnet 2001, 47; Da Riva 2008.

98 Pairman Brown 1969, 196–199; Meiggs 1983, 336; Hepper 2001, 5.

99 Da Riva 2008, 303, 332, in his recent study of the inscription does not mention floating the timbers but translates this passage as »I perfumed the Arahtu with them«. He does not specify if it suggests a potential floating of the logs. Although Da Riva presents a detailed transliteration and translation of the Wadi Brissa inscriptions, he does not provide any interpretation as to the paths and means that Nebuchadnezzar used to transport the cedar wood.

100 Elayi 1988, 30.

101 Elayi 1988, 30.

102 Mikesell 1969, 15.

103 Meiggs 1982, 345.

104 Meiggs 1982, 345.

105 Elayi 1988, 31.

106 W. Khalil (pers. com. on 12/3/2011); Vaumas 1954, 275.

107 Elayi 1988, 24.





Fig. 9: The AO 1988 panel. Image © author



Fig. 10: The AO 19891 panel. Image © author

Moreover, the topography of northern Lebanon and the Akroum region (Fig. 8), makes it hard for Nebuchadnezzar to go further north, up the Akroum Mountain and from there down to the valley of Nahr al-Kabir, which is not the »shorter« route. Thus, this negates Meiggs suggestion<sup>108</sup>. However, this route could have been valid in the case of timber cut from the western slopes of Lebanon which held the best cedar forests as they received considerably more rain. Timber, when brought down to the coast could have been taken by land to the north end of the Lebanon Range and then along the land route to the Euphrates along the valley of the Al-Kebir<sup>109</sup>, but this is an impractical option. On the other hand, Moscati extrapolates Nebuchadnezzar's inscription to suggest that caravans were transporting timber from Lebanon to Mesopotamia as far as the Euphrates then floated down the river<sup>110</sup>. Caravan routes were also used in the Assyrian period<sup>111</sup>.

The iconographic data mainly rests in the 8<sup>th</sup> century B.C. wood-transport frieze at Sargon II's palace in Khorsabad. If we agree that the current arrangement in the Louvres of these five panels reflects a relative chronological order of the different scenes, then the panel AO 1988 (Fig. 9) can be interpreted as a post-felling scene where manpower is used as means of extracting the logs from the mountains for their fluvial transportation (AO 19889 and AO 19890). The panel AO 19891 (Fig. 10) also illustrates the use of manpower to haul logs. This scene can be interpreted as the arrival of the logs in Assyria to be delivered to the palace of Sargon<sup>112</sup>. Two elements need to be considered to support this hypothesis: Firstly, the location of this panel immediately after the scene of unloading the logs from boats. Secondly, the stacked logs that are represented here as pierced on one end after been towed with ropes by ships as shown in the middle panels. This is the difference with the panel AO 1988 that shows the logs without piercing and the mountains where they were felled (Fig. 9).

Some hypotheses seem to underestimate the difficulties entailed by the mechanisms of terrestrial

108 Meiggs 1982, 345.

109 Meiggs 1982, 346.

110 Moscati 1973, 113 f. A comprehensive study about the terrestrial and fluvial routes from Mesopotamia to the west, as well as the navigation on the Euphrates and the Tigris, has been published by Joannès 1996.

111 Frankenstein 1979, 273; Elayi 1988, 39.

112 Dalix – Chaaya 2006/2007, 238, erroneously interpret this scene as the starting point by stating that the logs are being placed to prepare them for export. Also, they say that the schematic mountain represented above the stacked logs indicated their place of origin.

transportation of timber. Gubel has suggested that transporting timber may have been »extremely uncomplicated«<sup>113</sup>. To him, upon their felling on the slopes of the Lebanon range the cedars and pines were rolled or carted down to the adjacent coastal plains, and subsequently towed in rafts to their destination to reduce the distance covered by terrestrial transportation means as much as possible<sup>114</sup>. However, according to Frost it is unlikely that the logs would have been tossed over the cliffs or dragged over the flat terrain round Byblos headland to the coast<sup>115</sup>. This method is unknown before the time of Virgil but it is not known whether it was ever used in Mount Lebanon even during his time<sup>116</sup>.

In fact, considering the natural topography and relief of the mountain ranges in Lebanon, the idea of the rolling or sliding of timbers is possible for the initial transport down steep inclines, but it is complicated by the number of valleys and ravines along the way<sup>117</sup>. Unlike floating and hauling, this method has no literary or iconographical sources to support it and is unlikely to leave any trace in the archaeological record. The potential damage to rolling logs is another factor to consider in favor of the adoption of a more controlled method of descent.

#### *Fluvial transportation*

Those in favor of the use of rivers for transporting logs from the mountains to the coast seem to underestimate the substantial effort invested in logging operations. Logging is defined by Frost as »rolling timber downhill towards the sea, possibly helped along by the flow of a stream or river«<sup>118</sup>. Indeed, fluvial transportation may not seem more straightforward and easier than terrestrial means, as it particularly requires preparation parameters. Textual sources for such a practice and ethnographic examples of river use, as well as the suitability of Lebanese rivers need to be examined in order to investigate possibilities of logging in ancient Lebanon. Three rivers south of Byblos are considered here as a study case: Wadi Qassouba, Nahr Fidar and Nahr Ibrahim<sup>119</sup>.

#### *Evidence for floating*

The following inscription of Gudea, the King of Lagash in the 22<sup>nd</sup> century B.C., is probably one of the oldest mentions of logging operations during the Bronze Age »[...] like giant snakes, rafts of cedar have floated on the water from the cedar mountain«<sup>120</sup>. The passage in the Iron-Age Wenamun story says: »If I shout aloud to the Lebanon, the sky opens and the logs

lie here on the shore of the sea«<sup>121</sup>. This is interpreted by Pairman Brown<sup>122</sup> as a potential allusion to the floating of logs »down on a spring spate in the Adonis«<sup>123</sup>. The aforementioned inscription of Nebuchadnezzar in Wadi Brissa also alludes to use of rivers in wood transportation. A large number of the Hadrian forest inscriptions are located near water courses<sup>124</sup>. This probably led Breton to suggest several wadis and rivers in Mount Lebanon where floating could have been undertaken in Roman times, if not earlier<sup>125</sup>. As for the iconography related to fluvial transportation in the Iron Age, the Khorsabad reliefs (AO 19889 and 19890) illustrate ships towing logs of wood, attached to their sterns with a rope passing through one end of the logs<sup>126</sup>.

#### *Logging process*

Due to the lack of published archaeological evidence for logging operations so far<sup>127</sup>, ethnographic data sheds light on what logging operations were like in recent times, and whether such endeavors were possible in Iron Age Lebanon.

The first examples of ethnographic material are pictures of logging operations undertaken at the end of the 18<sup>th</sup> century and the beginning of the 19<sup>th</sup> century in North America<sup>128</sup>. The first phase of such operations occurred in autumn and winter, and consisted of establishing camps in the forest. Lumberjacks fell trees and set up clear roads. Preparation also included clearing waterways and riverbeds of boulders, weeds, and other obstructions that might cause a log jam. Riverbanks were also cleared by lumberjacks who were often

113 Gubel 1987, 19.

114 Gubel 1987, 19; Briquel Chatonnet 1992, 253. 268.

115 Frost 2002b, 66.

116 Elayi 1988, 30.

117 Vaumas 1954, 305–312; Sanlaville 1977, 3–6.

118 Frost 2002b, 66.

119 *Nahr* is the Arabic word for river.

120 Breton 1960, 16; Rowton 1967, 272; Mikesell 1969, 15; Meiggs 1982, 337. 345; Briquel-Chatonnet 2001, 45.

121 Lichtheim 1976, 226.

122 Pairman Brown 1969, 180.

123 The river Adonis is the Roman name of Nahr Ibrahim.

124 Breton 1980.

125 Breton 1980, 35.

126 For the sake of this article, a detailed interpretation of these reliefs will not be presented here. Cf. Parrot 1950; Albenda 1983; Linder 1986; Parpola 1995; Caubet 1997; Trakadas 1999; Aubet 2001, 37; Fontan 2001; Mc Grail 2001, 131 f.

127 The results of the archaeological survey of the Fidar valley for evidence on riverine transportation of wood are not published yet to date, A. Chaaya (pers. com. June 2011).

128 <http://www.geo.msu.edu/geogmich/river-logging.html> (Accessed 6 May 2011).



Fig. 11: Rollways during logging operations in Michigan. Source unknown. Available at <http://www.geo.msu.edu/geogmich/river-logging.html>



Fig. 13: A typical scenery of a massive river drive. The logs are guided by men with spikes and with small boats. The 1886 drive down the Muskegon River. This site was between Jonesville and Temple. The wanigans were put into the river at Leota, and followed the main drive. Ewart Public Library. Available at [http://www.flickr.com/photos/smartee\\_martee/1867773554/sizes/l/in/photostream/](http://www.flickr.com/photos/smartee_martee/1867773554/sizes/l/in/photostream/)

aided by oxen. Rollways were created to hold the piles of logs ready to be rolled into the river at the start of the drive (Fig. 11). Slides were often used to assist the transport of logs from the uplands to the river (Fig. 12). Before being put afloat, timbers were marked with log marks for each logging company. At the spring floods, the bottom logs would either be pulled out causing the whole pile to roll into the river or they would be chuted down to it. Once in the river, the drive would be guided by men using pike poles to keep the timber moving. They worked either on foot following paths, called »gig paths« laid out on the riverbanks, or by riding on the logs themselves. Whenever the river allowed, men



Fig. 12: Slides for facilitating the transport of logs into the river ahead of the drive. Source unknown. Available at <http://www.geo.msu.edu/geogmich/river-logging.html>

would also follow the drive in small boats (Fig. 13). If the logs became stranded or drifted out of the current, they could undergo major damage before getting in the drive again. The arrival points of the drive were generally the sawmills usually positioned at the river mouths. These operations are arduous, hazardous and time-consuming, especially when a jam formed on the river. Rosholt provides details on how dams with sluice-gates were sometimes built and manoeuvred in the river to help the logs over the rapids of shallow stretches<sup>129</sup>.

A second example, related with logging operations on the Nile, is provided by an interesting illustration<sup>130</sup> that depicts a man riding a log on a tumultuous Nile (Fig. 14). In the 18<sup>th</sup> and 19<sup>th</sup> centuries, timber was imported to Egypt from Nubia in the form of rafts or logs ridden by their owners down the rapids of the First Cataract during the Nile flooding. These were subsequently sold in Egypt<sup>131</sup>.

129 Rosholt 1980, 120.

130 This was kindly shown to the author by John P. Cooper.

131 Cooper 2011, 354 f.



Fig. 14: Log-swimming down the [First] Cataract. Illustration by R. Talbot Kelly, in: Penfield, 1899, 487

These ethnographic examples of the 18<sup>th</sup> and 19<sup>th</sup> century illustrate the implications and needs of logging operations. Hazards often entailed loss of lives: Therefore, the human effort of the different agencies involved need to be considered no matter the period. What remains is to investigate whether logging on the scale of what occurred in North America, or the efforts of the Nubians to import wood into Egypt, is applicable to Lebanese Rivers. But before this tackling this question, some variables regarding the topography and water bodies of the rivers need to be examined.

#### Logging parameters

In the context of suggesting a new methodology for looking at the logging potential of rivers in ancient Lebanon, some parameters should be considered before stating *a priori* that floatation was systematically used to transport logs from the mountains to the coast. The first set of parameters relates to the rivers themselves:

- The estimated ancient width and palaeotopography of the river in question need to be established to determine whether the river was wide enough to accommodate large sized wood logs.
- The characteristics of the river bed and river-banks are equally important to avoid log jams.



Fig. 15: Cedar log (length 4.92 m, diam max: 1.37 meter) cut from a 9.5 meter long log found in Beirut and aged 300 years. Image © author

- The depth of the water column, *i.e.* the gage height needs to be examined to verify if the volume of water is substantial enough.
- The carrying capacity, *i.e.* the volumetric flow rate (volume of fluid which passes through a given surface per unit time).

The second set of parameters relates to the timber log: firstly, the dimensions of the log and its density are important for determining whether the log could get stranded or not. As an example: a mature cedar log (Fig. 15) could be 35 meters long and 2.4 meters in width, and with the density of cedar at 560 kg/m<sup>3</sup>, the log would have 56% (*i. e.* around 1.2 meters) of its bulk under water; the number of logs in one operation should be considered to avoid jams; and the final element is the time it would take for the required logs to reach the coast.

#### Three rivers and valleys south of Byblos

Byblos and its southern rivers and wadis – Wadi Qassouba, Nahr el-Fidar, and Nahr Ibrahim – are considered here as a case-study to determine whether the foregoing logging parameters might be applicable, and if so what are the potentials of these rivers to host floatation operations. The issue of logging in ancient Byblos was previously investigated by Frost<sup>132</sup>, Morhange<sup>133</sup> and Stefaniuk<sup>134</sup>. It was also mentioned in other studies related to the area such as that by Elayi<sup>135</sup>.

132 Frost 1998–1999, 247; Frost 2001, 201; Frost 2002a; Frost 2002b, 67 f.; Frost 2004, 341 f.

133 Morhange 1998–1999.

134 Stefaniuk *et al.* 2005.

135 Elayi 2009, 36–49.



Fig. 16: Map illustrating the Qassouba Wadi topography. The Qassouba valley is drawn in blue. The elevations (circled in green) show the Qassouba starting to flow around 329 m of altitude. The red arrow indicates Nabr el Fidar. Modified from Map of Jbeil 1/20000. Courtesy of Dr. Wissam Khalil

### Wadi Qassouba

Wadi Qassouba is a valley south of Byblos, stretching inland from the coast approximately 2.5 km (Fig. 16). It drains the water from rainfall and other surface-water runoff from the adjacent hills and discharges it into the Mediterranean Sea. The Qassouba has been suggested as the river used for logging activities during the Bronze Age<sup>136</sup>. Indeed, the Qassouba lies adjacent to both the Byblos site to the north, where the center of the ancient administration and ruling elite was based, and the Skhiny Bay to the south, where logs are thought to have been stored for export to Egypt during the Bronze Age. A reconsideration of this hypothesis, however, illustrates its shortcomings.

There is no mention of the Qassouba in any known ancient source. This may seem slightly odd if this wadi was linked with the flourishing Byblian timber trade.

The Qassouba wadi reaches a maximum elevation slightly above 300 meters, which is considerably below from the lowest cedar stands at 1000–1200 meters (Fig. 16). Therefore, if the Qassouba was used for logging operations, the alternative terrestrial means, as detailed above, need to be applied at the start of the timber's journey to the coast. The Qassouba, reduced nowadays to a stream (Fig. 17), is not a perennial river. Its regime largely relies on rainfall since it constitutes the hydrological regime of a minor wadi<sup>137</sup>. This wadi type is only active during heavy rainfall that lasts from a few days to a few weeks. This places substantial constraints on fluvial transportation in both available time

136 Cf. Frost 1988–1999, 247; Morhange 1998–1999; Frost – Morhange 2000; Frost 2001, 201; Frost 2002a; Frost 2002b, 66–68; Frost 2004, 341 f.; Stefaniuk et al. 2005.

137 Sanlaville 1977, 98 f.



Fig. 17: Qassouba stream. Image © author

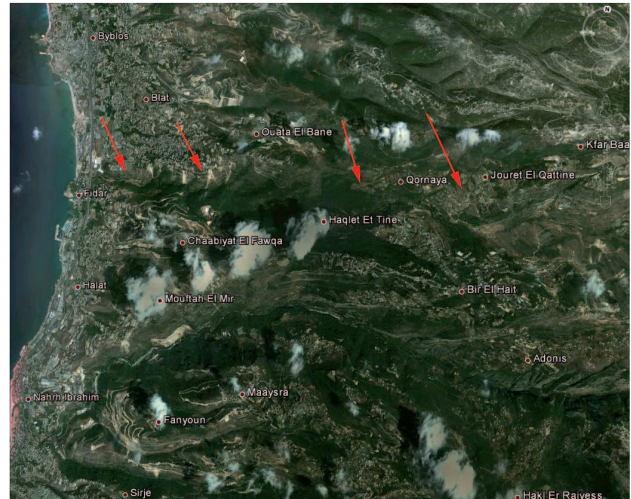


Fig. 18: Aerial view of the start of the Fidar valley, illustrating how the valley starts widening inland towards the west. Modified from Google Earth

and adequate water flow. Finally, the coring samples that were done in the Skhiny Bay area and at the mouth of the Qassouba Wadi need re-interpreting<sup>138</sup>. According to Frost, »the cores across this estuary [Qassouba] were bringing up water-worn river-pebbles from depths of some 4m, showing that the river to have been bigger in antiquity«<sup>139</sup>. However, a closer look at these three coring samples (BI, BII and BIII)<sup>140</sup> shows that they are too few in number and placement to determine the complete paleoenvironment of the river and its palaeomorphology. Also, they do not provide any insights about the hydrological characteristics. The sedimentological facies give evidence for an infralittoral environment progressively covered over, reflecting the westward progradation of the shoreline. The progradation is due to riverine sediment deposition, as well as to sediment transportation from the south by the dominant southwest littoral currents<sup>141</sup>. The torrential deposits recorded in these cores indicate periodic sedimentary inputs and do not seem in accordance with the presence of a perennial river with flow adequate for wood floating. Coring further up the river bed is crucial for the investigation of this issue and help determine the shoreline morphology in antiquity. Additionally, the chrono-stratigraphy of the cores is limited to 2500 BP (?)<sup>142</sup>. As no Iron Age data is recorded in the sedimentary dynamic, the river regime for that era is hard to determine. In summary, the sedimentological analysis of the coring for the Byblos area did not reveal any information on the presence of a river in the Qassouba but rather shed light on the ancient shoreline and the potential open beach harbor in Skhiny Bay<sup>143</sup>.

#### Nahr el-Fidar

The Nahr el-Fidar is located around 3 km south of Byblos and stretches westward to around 17 km inland to the bottom of Jabal Laqlouq *i.e.* Laqlouq Mountain (Fig. 18, 19). Nahr el-Fidar is called a *nahr* which is the Arabic word for river, but in fact it is a seasonal river which passes through a large drainage valley or wadi<sup>144</sup>. Thus, wadi Fidar seems a more appropriate name than Nahr el-Fidar. Indeed, it does not have a perennial source, and does not receive water from snow melt. It is only filled with rain water, reaching its highest flow in January/February, and could sustain a continuous flow of water after a heavy rain season until the beginning of summer. A preliminary observation of the topographical features of the Fidar presents insights for investigating the logging potential of this wadi<sup>145</sup>. At around 1 km of its mouth, the wadi bed presents a series of narrow, sinuous curves (Figs. 19 and 20) that might cause jamming of logs. In this particular part of

138 The results of which were published by Stefaniuk *et al.* 2005.

139 Frost 2001, 201.

140 The coring BI was made at the mouth of the Qassouba Wadi, BII at the mouth of Saidet Martine Wadi and BIII slightly north of BI at the bottom of the Ras Byblos cliff: Stefaniuk *et al.* 2005, 21. 25 f.

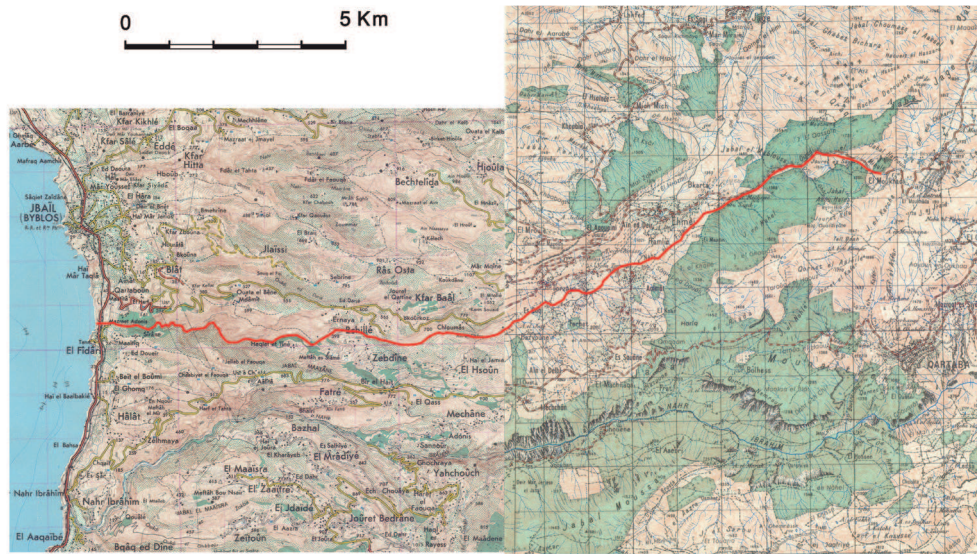
141 Beydoun 1976.

142 The date of 2500 BP is questioned by the author; Stefaniuk 2005, 34.

143 Indeed, there seem to be no suggestions related to the »Qassouba River« in Stefaniuk *et al.* 2005.

144 Sanlaville 1977, 92. 99.

145 The author is aware of the potential change in the topography of the valley since antiquity. However, these preliminary observations are a first step toward more comprehensive investigations of the paleo-topography of the Fidar wadi.



Assemblage de cartes d'après :

- Carte du Liban au 1:50 000e, File NI-36-XVIII-2b, dressée, dessinée et publiée par le Service Géographique de l'armée en 1940, Révisée et imprimée par la Direction des Affaires Géographiques de l'Armée Libanaise en 1965
- Carte du Liban au 1:50 000e, File NI-36-XVIII-2a, dessinée et publiée par la Direction des Affaires Géographiques de l'Armée Libanaise en 1963

Fig. 19: Map of Fidar valley 1/50 000. Courtesy of Dr. Wissam Khalil



Fig. 20: Picture of the sinuous curbs close to the river mouth. The Mediterranean sea is visible in the background. Taken from Blat overlooking the valley from the north. Image © author

the valley between Zebdine and Bshelli, one can observe a seasonal river bed of Fidar. It does not seem wide enough – at least in its current size – to hold large and tall logs (Fig. 21). The valley at this point starts to become larger in its North-South axis and bears villages along small plateaus such as Qornaya, Bshelli, and Zebdine, at 500 meters of altitude (Figs. 22. 23). After this point, the wadi bed continues as a narrow path that likely would be suitable for dragging logs, rather than floating them, in the absence of a substantial or adequate water level. Arriving then to the area between Beziyoun, Tourzaya and Aalmat, at around 9 km from the coast, the wadi bed flattens and widens substantially where any important watercourse seems to be lost,



Fig. 21: Picture of the dried-up Fidar river at Zebdine. Image © author



Fig. 22: Aerial view of the area where the Fidar valley widens into small plateaus. Google Earth



Fig. 23: Picture of the Fidar valley around the Bshille-Zebdine area. The area of Bezjoun can be observed in the background. Image © author

at an altitude between 600 and 900 meters (Figs. 24. 25. 26). The last section of the wadi from Ehmej to Moukhada, does not present a wide river bed but rather traces of dried out small streams. Furthermore, in the absence of any hydrometric and in-depth topographical studies, it is difficult to ascertain the use of Nahr el-Fidar for floating timber logs to the coast. The valley seems more adequate for land transportation of the logs. Indeed, the Hadrianic inscriptions in this region, related to Roman imperial forestry, indicate that the valley of Fidar was used for the extraction of logs from the forests of Ehmej and Laqlouq<sup>146</sup>. In earlier archaeological studies of the Nahr el-Fidar, Renan reports the remains of a Roman aqueduct near the river mouth for the transporting of water from Nahr Ibrahim to Byblos<sup>147</sup>. This indicates that when substantial water amounts were needed in antiquity, it was not taken from Nahr el-Fidar but from its neighboring river, Nahr Ibrahim. Thus, the method of transporting logs

onland rather than by floating seems a more plausible hypothesis.

Dalix<sup>148</sup> cites a passage in Plutarch<sup>149</sup> (46–120 A.D.) relating to the role of Fidar in the Byblian timber trade. Plutarch mentions the **River Phaidros**<sup>150</sup> and its mouth as being the place from where the goddess Isis returned to Egypt after retrieving from Byblos the cedar coffin of Osiris. The myth reports how the goddess in a moment of madness dried out the river<sup>151</sup>. This is a strong allusion to the seasonal regime of Nahr el-Fidar. To Dalix<sup>152</sup>, this mythical story might refer to the local forest exploitation and timber transport from the mountains to the coast via the Fidar; although it is not clear how she reaches such an interpretation.

In 2004, Dalix and Chaaya undertook a survey of the Fidar valley to investigate the dynamics of the cedar transportation from the forests of Byblos' hinterland to its port of export. Elements of several types of installations were identified<sup>153</sup>. According to Dalix there is evidence for modifications in the river bed as well as rectangular or triangular notches in the rocks of the river course that may be related to activities of

146 Breton 1980, 35.

147 Renan 1998, 222.

148 Dalix 2005.

149 The Giblete episode in chapters 15–16 of »On the worship of Isis and Osiris (*De Iside et Osiride*)«.

150 The Phaidros is only mentioned by Plutarch but has been accepted as the ancient Greek transcription of *Nahr Fidar*, according to Dalix 2005, 34.

151 Dalix 2005, 30. 37.

152 Dalix 2005, 30.

153 A. Chaaya (pers. com. on 15/11/2007).



Fig. 24: Aerial view of the Fidar valley encompassing the area between Bezjoun, Tourzaya and Aalmat. Google Earth





Fig: 25: Picture of the Fidar valley around the Tourzaya and Aalmat area. The Jabal Laqlouq occupies the background. Image © author



Fig: 26: Picture of the Fidar valley uppercourse at Aalmat where a narrow dried-up river bed is visible. Image © author



Fig: 27: Picture of the Fidar wadi mouth. Image © author

heavy-materials transport<sup>154</sup>. No dating or definite interpretation could be provided in absence of parallels and ceramic material. Chaaya<sup>155</sup> also mentions well-preserved roads and tracks or ramps extending from the high forest zones down to within 500 meters from the coast. These preliminary results seem to confirm a land and fluvial transport for logs or other products which future potential survey seasons may reveal<sup>156</sup>.

Finally, at this point, not much analysis or criticism can be made or added to the above since results have not been published yet, and future work is needed in this area. A preliminary topographical overview of the Fidar wadi seems more in favor of the terrestrial means of timber transportation. **If logging was possible, it must have only been occasional and dependent on the rainy seasons, and probably only in certain sections of the valley's bed.** Once at the wadi mouth, logs could have directly been exported from the river mouth and did not need to be shipped north to Byblos for export (Fig. 27).

#### *Nahr Ibrahim*

Nahr Ibrahim, known as the Adonis River<sup>157</sup> in

classical times, is a 26 km long perennial river some 6 km south of Byblos<sup>158</sup>. It is continuously fed by the high altitude sources of the Afqa and Rouiss springs<sup>159</sup>, by direct rain and snow melt, and by its wide Karstic wide basin that collects and drains rain water (Fig. 28). The river's longitudinal profile is steep at higher altitudes and therefore does not present the possibility for floating timbers. But at around 400–500 meters of elevation, 17 km from the river mouth, the river's course becomes smoother and offers the possibility of floating timber<sup>160</sup> (Fig. 29). Nowadays, Nahr Ibrahim has an average annual volume of 464 million m<sup>3</sup><sup>161</sup>. Throughout the year, it sustains an important flow of water never less than 2.5 m<sup>3</sup>/sec<sup>162</sup>. For example, flows recorded for Nahr Ibrahim in April 1940 showed a peak

154 Dalix 2005, 38.

155 Pers. com. on 15/11/2007.

156 Dalix 2005, 38.

157 Cf. Lightfoot 2003, 249–253. 328–330.

158 Montet 1923, 190; Vaumas 1954, 242; US 1957, II-2; Sanlaville 1977, 92. 99.

159 Vaumas 1954, 243.

160 This assumes that the longitudinal profile has not substantially changed over the years. This needs however to be established.

161 Sanlaville 1977, 96.

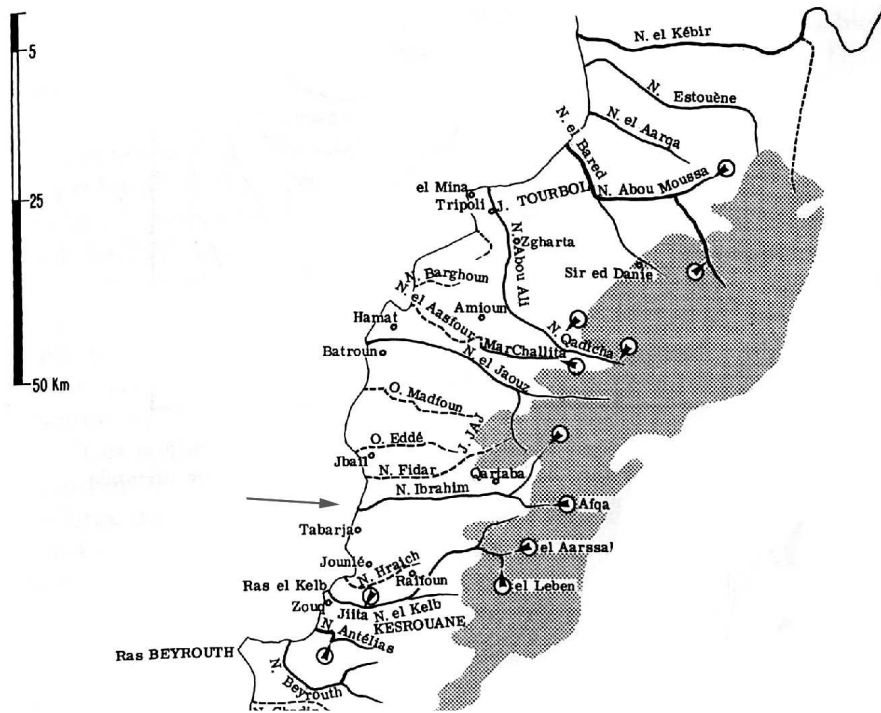


Fig. 28: Map of Nahr Ibrahim with its two sources. Modified from Sanlaville 1977, 109 fig. 38

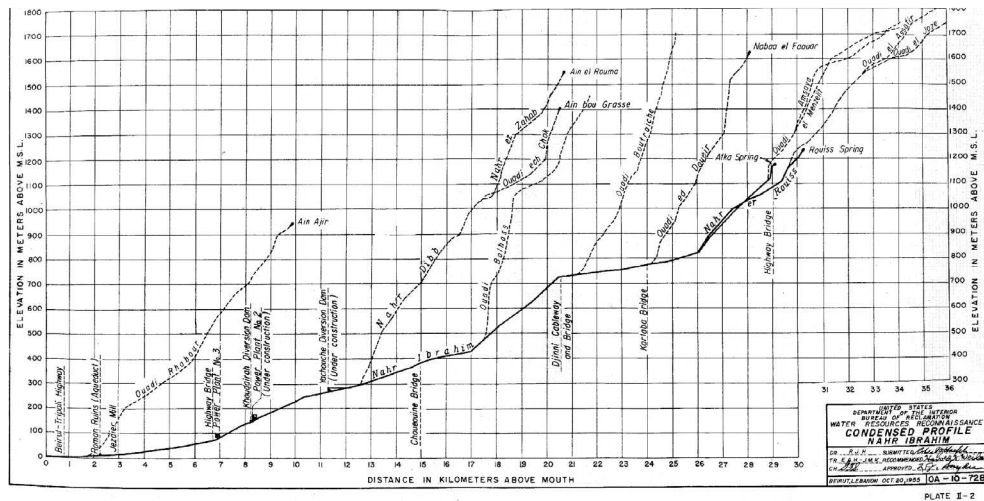


Fig. 29: Condensed profile of Nahr Ibrahim, after US, Plate II-2

of 25 m<sup>3</sup>/sec, and in April 1942 a peak of 22 m<sup>3</sup>/sec was noted. Nahr Ibrahim can reach a flow of 118 m<sup>3</sup>/sec in heavy rains<sup>163</sup>. Therefore, if logging was done during the spring time, there should be sufficient water to drive the logs. As an example, the Little Wolf River in Wisconsin, USA, used for logging operations in the 19<sup>th</sup> century<sup>164</sup>, has an average volume of 10.4 m<sup>3</sup>/sec<sup>165</sup>. Logging on this river centers on pine, which, with a density of around 510 kg/m<sup>3</sup> is only slightly lighter than cedar. Taking these comparative elements into account, we can gauge the potential Nahr Ibrahim

has for logging cedar and other timber. However, the other abovementioned parameters such as the type of maneuvers, river and log dimensions, as well as manpower, need still to be investigated<sup>166</sup>. In addition, the

162 Vaumas 1954, 243 f.  
 163 Sanlaville 1977, 104.  
 164 Rosholt 1980, 119.  
 165 [http://waterdata.usgs.gov/wi/nwis/uv/?site\\_no=04080000&Parameter\\_cd=00065,00060%20for%20numbers](http://waterdata.usgs.gov/wi/nwis/uv/?site_no=04080000&Parameter_cd=00065,00060%20for%20numbers) (Accessed 5 September 2011).  
 166 It is important to note here that the riverbanks have been substantially altered by the construction of dams and electrici-



Fig. 30: The Nahr Ibrahim valley as seen nowadays in summer. Image © author

Nahr Ibrahim valley and its surrounding mountains are still rich in forests of carobs, oaks, pines, cypress, and cedar (such as the cedar forest stands of Arz Jaj and Tannourin)<sup>167</sup>. All these species could have been used as timber resources and floated down the river.

The valley of Nahr Ibrahim (Fig. 30) is characterized by important archaeological potential<sup>168</sup>. Numerous sites dot the valley from the river's source in Aphca, where there is a cultural complex dedicated to the god Adonis and his consort Astarte. This sites include the Romano-Byzantine site of Yanouh, the Roman site of Machnaka, and the Roman aqueduct and bridge located a short distance from the river's mouth, to name but a few.

Meanwhile, Egyptian texts<sup>169</sup> indicate that the land of Negau (ngw), which Montet<sup>170</sup> identifies with Byblos and the valley of Nahr Ibrahim, acted as a main exporter of cedar wood. This is an indication of the use of the valley and the river for transporting timbers felled in its forest-rich hinterland. This is supported by the finding of around fourteen imperial Hadrianic inscriptions on the right bank of Nahr Ibrahim and on the plateaus dominating its river basin<sup>171</sup>. Breton suggests from his study of the inscriptions that floating was possible on the Nahr Ibrahim<sup>172</sup>. Another archae-



Fig. 31: The Nahr Ibrahim river mouth as seen nowadays. Image © author.

ological vestige is revealing as well: an Early Bronze-Age hardened-copper axe was found in 1911 near the Roman Bridge<sup>173</sup>, close to the Nahr Ibrahim mouth<sup>174</sup>. The axe-head (Fig. 3) probably belonged to one of the royal ship crews acquiring cedar wood from Lebanon for either Cheops or Sahure<sup>175</sup>. Moreover, that the object came from the Nahr Ibrahim area may indicate that timber logs were floated down the stream from the hinterland and exported directly from the river mouth<sup>176</sup> (Fig. 31). Thus, the Nahr Ibrahim valley and its river course have high archaeological potential for riverine

cal power stations. The adjacent cliffs are also threatened by modern quarries and some parts of the river course have been turned into cultivation lands. Therefore, there is an urgency in studying the ancient topography of Nahr Ibrahim and its paleoenvironment. This should help in determining which parts of the river were used for floating.

167 Montet 1923, 190 f.; Mikesell 1969, 2. 10.

168 Pairman Brown 1969, 64–69; Redford 1992, 45 Renan 1998, 282–320.

169 See Montet 1923, 184–187, for these texts: Beni-Hassan inscription, Tutankhamen stele in Thebes, a text by Hatshepsut, etc.

170 Montet 1923, 191 f

171 Breton 1980, 9. 12; Abdul-Nour 2001, 64.

172 Breton 1980, 35, identifies Nahr Ibrahim as the river used for floating logs in the Wenamun story. Through these inscriptions he could also establish the exploitation pattern of the forests adjacent to Nahr Ibrahim in Roman times.

173 Recent in-situ observations by the present author and Dr. Khalil suggest several phases of construction of this bridge, from Roman times to the Ottoman period.

174 This axe has been published and studied by Mallon 1925; Rowe 1936, 283, and Redford 1992, 42.

175 Rowe 1936, 287; Wachsmann 1998, 11. The inscription on the axe blade holds the expression »The two falcons of God« that was a title of both kings that are known to have been involved in the Byblian trade. For further explanation on this refer to Rowe 1936, 288.

176 Rowe 1936, 288.

timber transportation, from the Bronze Age until at least Byzantine times. Considering the above evidence (topography, geomorphology, hydrology and archaeology), it can be asserted that Nahr Ibrahim was likely used for fluvial transport for timbers from the Byblian hinterland to the coast. A systematic survey of the river's banks and the valley is needed to establish this and integrate Nahr Ibrahim into the timber trade pattern of ancient Lebanon.

## Conclusion

Written evidence and the iconography of the Iron Age for forest exploitation and the timber trade processes in Lebanon was re-interpreted here in the light of new evidence and theories. This paper aimed at suggesting new parameters to consider when studying the logging potential of Lebanese rivers and not adopt this method a priori. Essentially, logs were transported from the mountains to the coast via combined means of transportation: wherever the terrain was rocky or precipitous, rendering difficult the transportation by dragging with use of cattle and men, waterways were used for floating logs. This was mainly done during the snow melt in spring to take advantage of the river flooding. Of the three rivers and wadis south of Byblos, Nahr Ibrahim appears as the best candidate for logging operations. It is suggested, and probable, that the river mouths held harbor installations for exporting wood from Lebanon. Therefore, it is crucial that the river/wadi mouths and their surrounding topography undergo substantial surveying to determine their role in ancient logging practices and export.

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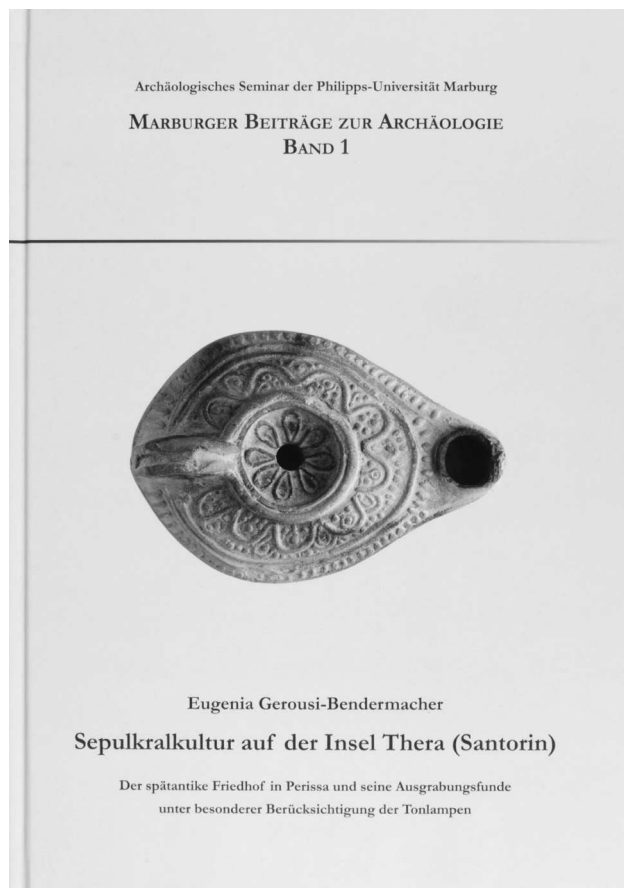
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