To be published in: *LH III C Late and the Transition to the Early Iron Age*. *International Workshop organized by the Österreichische Akademie der Wissenschaften. 23-24.2.2007, Wien*

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SYNCHRONISATION OF KASTANÁS AND THESSALONÍKI TOUMBA AT THE END OF THE BRONZE AND THE BEGINNING OF THE IRON AGE

The tell sites of Thessaloníki Toumba and Kastanás provide us with two of the most important LBA and EIA vertical stratigraphies for Central Macedonia. These two sites belong to different settlement categories, the one is a small, probably secondary site (Kastanás, perhaps related to the larger toumba at Axiochóri, see HÄNSEL 1989), while the other one is a dominating site, in fact one of the largest tells in the region (Thessaloníki Toumba, see ANDREOU 2001, 166–171). The two stratigraphies reflect different histories of settlement with differences in phase duration and stability. One of the most obvious differences between them is the fact that nearly every LBA and EIA settlement Level at Kastanás ended in a fiery destruction, while such wholescale destructions never devastated Thessaloníki Toumba (ANDREOU, this volume). Another remarkable difference is the development of building techniques, house plans and settlement structure. Kastanás shows a rather unstable sequence of habitation structures and an alternation between mud-brick architecture and wattle and daub houses during the LBA and EIA (HÄNSEL 1989; IDEM 2002). Thessaloníki Toumba, which is situated to the south-west in a distance of only about 30 km as the crow flies, exhibits an astonishing continuity in the lay-out of its mud-brick buildings and the course of the narrow streets (ANDREOU, this volume).

In the present paper we try to build up a comparative relative chronology of these two Central Macedonian tell sites, and from this point of view their different settlement histories have strong advantages. Phases, which were rather long-lived on the one tell, were contemporary to a number of phases of short duration on the other tell. For instance, while the time of the southern Greek Mycenaean Palace Period is mostly covered by Phase 5 of Thessaloníki Toumba, at Kastanás three settlement levels followed each other during these c. two centuries (Levels 17, 16 and 15). At the end of the Bronze Age and the beginning of the Early Iron Age, after a rather troubled time (of Levels 14b, 14a and 13) the inhabitants of Kastanás were able to inhabit the same houses for several generations (Level 12). During the same time span at Thessaloníki Toumba people rebuilt their homes several times (Levels 3, 2B and 2A). This means, during a certain time period there is a fine-phased stratigraphic sequence on the one tell allowing for a fine-phased analysis of the pottery development, while on the other tell houses were used for many decades and that only allows for stylistic subdivisions of the whole pottery assemblage, which accumulated over the years.

It then follows that in comparing the two tell sequences one can build up a fine-phased pottery chronology for the Central Macedonian region, which can act as a master sequence of local pottery style for other sites. Our study is based on Mycenaean and Protogeometric wheel-made pottery, because 1) these are the pottery classes, which show the fastest development of type and style in the region; 2) although they make up only a small part of the local pottery assemblage these two pottery classes are present in sufficient quantities all through the LBA and EIA to be chronologically relevant; and 3) these classes can be further used for inter-regional comparative chronology, in order to link the local Macedonian sequence to the central and southern Greek ones, which in turn allow historical dates of the eastern Mediterranean to be transferred to the north Aegean.

Phase 5

KA 1639 (**Fig. 1,4**) is either a linear deep bowl B FT 284/285 or a deep semi-globular cup FT 215/216. Its linear decoration consists of a rim band of slightly more than 1 cm width and a monochrome interior (decoration 9.1)[1]. At Kastanás this type of deep bowl is securely attested only in Level 13 (JUNG 2002, 96 pl. 19:218), but one should note that a large part of the profile must be preserved for any secure identification of the type[2]. At the Toumba of Prehistoric Olynthus (Áyios Mámas) no secure specimens were found in stratified contexts. In southern Greece the earliest secure attestations of deep bowls B with this type of decoration can be found in the LH IIIB Final palace destruction levels of Tiryns (VOIGTLÄNDER 2003, 96 pl. 130:Si 145; 131:Si 151–153, Si 165; PODZUWEIT 2007, 49 pl. 19:10) and Midea (DEMAKOPOULOU 2003, 84).

Fig. 1 Mycenaean vessels from Thessaloníki Toumba, Phase 5. 1 KA 200; 2 KA 646; 3 KA 1464; 4 KA 1639; 2

In the case, the Thessaloníki sherd should be restored as a deep cup FT 215/216, a similar time frame is indicated. At Kastanás secure examples of linear deep cups FT 215/216 with this type of decoration (9.1) are attested not earlier than Level 12 (LH IIIC Advanced–EPG), but at the Toumba of Prehistoric Olynthus (Áyios Mámas) there are two specimen from mixed contexts of Levels 3 and 2, one of regular size and one miniature version. Thus, the type clearly did exist before the end of LH IIIC in Central Macedonia. Judging from the Áyios Mámas sequence,

[1] For the typology of linear decoration see PODZUWEIT 2007, 311–316; Beil. 78a–78j and JUNG 2002, 575–579 pl. I–XIV.

[2] Patterned deep bowls B, from which only small rim sherds survive, would be classed as linear deep bowls with decoration 9.1without being secure attestations of the type. Therefore, at Kastanás sherds with fully preserved decoration were marked in the catalogue with the symbol #, in order to show that the linear decoration is fully preserved (JUNG 2002, 66). In the case of linear decoration 9.1 this would mean that enough of the wall is preserevd to exclude the existence of any motifs on the body.

the earliest possible date would be LH IIIB Final, if one of the specimens was ascribed to the beginning of Level 3. Linear cups FT 215/216 with decoration 9.1 are found in the destruction level of Megaron A at Dhimíni, as well as in its re-occupation phase (ADRYMI-SISMANI 2004–2005, 28, 31–32, 34 fig. 20:BE 24287, BE 25963[3]), which may be dated to LH IIIB Final and LH IIIC Early respectively (JUNG 2006, 202). The parallels at Tiryns are present in the levels from LH IIIB Final onwards (PODZUWEIT 2007, 113 Beil. 56 pl. 57:18, 19).

The sherd KA 200 **(Fig. 1,1)** (ANDREOU 2003, 205 fig. 5:KA 200) can be classified as stemmed bowl FT 304/305 or – taking into account the local Macedonian style – rather as a deep bowl FT 284/285 A with thickened rim[4]. It shows a linear interior decoration consisting of a rim band on the in- and outside, three broad bands below the patterned zone and another band further down on the outside. The motif is a horizontal wavy band painted in wide swings. Stemmed bowls FT 304/305 / deep bowls FT 284/285 A with thickened rim are attested at Kastanás from Level 16 until Level 14b or 14a, i. e. from LH IIIA Late/IIIB Early down to LH IIIC Early (JUNG 2002, 74–75). They represent one of the most characteristic types of open Mycenaean vessels in Macedonia. Some whole profiles with low base from the level with pits and vessel depositions above the LH IIIA Late – LH IIIB Early pit tombs of Aianí-Livádhia belong to the earliest examples of the type north of the Olympus mountain. They have either linear or monochrome interiors (KARAMITROU-MEDESSIDI 2002, 605 fig. 4:middle). The lower body of one of the Aianí wavy band deep bowls with thickened rim is decorated with two broad bands framing two narrow ones (band type 3.2[5]). Such a band group is defined as "Boeotian Stripe", which in Boeotia was indeed used to decorate stemmed bowls FT 304/305 or deep bowls with thickened rim (MOUNTJOY 1983, 17; RMDP, 670 fig. 255:111, 112, 116, 117, 121; 671). A chronological fix point for this decoration type is provided by a stemmed bowl / deep bowl with thickened rim from a level of LH IIIA Late/IIIB Early at Thebes (Pelopidhou Str., Deposit 3c, see ANDRIKOU 2006, 26–27, 69 cat. no. 124; 108 pl. 8:124). In one of the pits above the tombs of Aianí two kylikes were found, one belonging to the deeper type with lipped rim FT 257 (KARAMITROU-MEDESSIDI 2003, 173, 183 fig. 7) and the second one belonging to the shallower type with out-turned rim FT 258B (IBIDEM, 173, 183 fig. 8). Although their patterned decoration does not find any close analogies in southern Greece, the types themselves can be dated on the basis of closed contexts from the Argolid and the Corinthia. FT 257 is characteristic for LH IIIA Late, but its production continued into LH IIIB

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[3] However, it seems that only in the re-occupation phase these cups have a reserved circle on the bottom on the inside (ADRYMI-SISMANI 2006, 93, 109 fig. 15:BE 25963, BE 24287 and fig. 16:BE 25963, BE 24287).

[4] While at Kastanás two stemmed bowl feet have been found (JUNG 2002, 71, 548 pl. 17:193), these feet are not present at Thessaloníki Toumba. There are, however, severeal specimens of deep bowls with thickened or everted rim and ring base (ANDREOU 2003, 205 fig. 5:KA 727, KA606/673). One such vessel is known from Kastanás, Level 14b (JUNG 2002, 156–157 pl. 7:80).

[5] Cf. n. 1.

Early and even into LH IIIB Middle[6], while FT 258B is to be classed as an innovation of LH IIIB Early[7]. These vessels – together with the grave gifts themselves (closed vessels, which cannot be dated with the same precision) – confirm the early date of the deep bowls with thickened rim and broad wavy band at Aianí and – by extension – elsewhere further to the north, in Central Macedonia. They are a regional Western and Central Macedonian type starting in LH IIIA Late or IIIB Early and being until well into LH IIIC[8].

The rim fragment KA 646 (**Fig. 1,2**) might belong to a linear deep semi-globular cup FT 215/216 or a deep bowl FT 284/285 (decoration 5.1.1). It has no exact parallel at Kastanás, but a cup FT 215/216 with a single outer rim band (decoration 1.0) from Level 15 would be an analogy for the reconstruction as a deep cup (JUNG 2002, 316 cat. no. 39 pl. 4:39).

The wall sherd KA 1395 (ANDREOU 2003, 205 fig. 4:KA 1395) belongs to a kylix FT 257 with an unidentifiable curvilinear motiv (tentacles?), a thin rim band and a group of four thin lower bands. It has no exact parallel at Kastanás, but the shape is attested with a different decoration in a mixed context of Levels 13–14a (JUNG 2002, 347 pl. 13:154). The parallel from the level above the LH IIIA Late – IIIB Early tombs at Aianí has already been discussed (see above).

The rim sherd KA 1464 **(Fig. 1,3)** (ANDREOU 2003, 205 fig. 4:KA 1464) most probably belongs to a deep bowl FT 284/285 B with thickened rim. It is decorated with a thick rim band and a monochrome interior and shows some kind of curvilinear motif. Parallels with this type of linear decoration (9.1) are found at Kastanás in Level 15 and later Levels (JUNG 2002, 72–73 with fig. 8; 454) and at LH IIIA Late – IIIB Early Aianí (see above and KARAMITROU-MEDESSIDI 2002, 605 fig. 4,top right; EADEM 2003, 180 fig. 5:right).

Judging by these datable sherds, Phase 5 at Thessaloníki must have lasted until the end of Kastanás Level 15 in LH IIIB Final, but the start of this phase is difficult to determine. It is perhaps to be situated during Level 16 of Kastanás, but not necessarily. There is evidence for two

[6] For the production period at Tiryns and Mykene see SCHÖNFELD 1988, 155 tab. 1:7; 158, 163, 165 fig. 2:12,13,15; 166, 168–169, 171 fig. 3:19; 176, 180–183, 186, 189 with n. 185. – Examples of LH IIIB Middle date were also found at Tsoúngiza, EU 2 pit 1: THOMAS 1992, 148–150, 546 fig. 12:14,16,18; 547 fig. 13:1,3,4.

[7] SCHÖNFELD 1988, 155 tab. 1:43; 158, 163, 171 fig. 3:15; 175 fig. 5:4; 176, 180, 183, 191 fig. 8:1; 199 fig. 11:4; 200, 205, 206–207. – The terrace fills of three houses at Mycenae (Terrace on the Atreus Ridge, terraces below the House of Shields and the House of the Oil Merchant), which were published as find comple xes dating to the end of LH IIIA2 late (Terrace on the Atreus Ridge, see FRENCH 1965, 174, 184), to the transition from LH IIIA2 late to LH IIIB 1 (Terrasse below the House of Shields, see IBIDEM 192), and to LH IIIA2 late or rather LH IIIB 1 (Terrasse below the House of the Oil Merchant, see IBIDEM 192 and esp. FRENCH 1963, 32), can now all be dated to LH IIIB Early based on the comparison with type frequencies in the continuous vertical stratigraphy of Tiryns (SCHÖNFELD 1988, 153–154 n. 3; 163 tab. 4; 170). These terrace fills contain mainly material of the phase LH IIIA Late, but there are some types present, which in the continuous settlement stratigraphy are only found from LH IIIB Early onwards, so that the deposition of the fill happened only by that phase (IBIDEM 180–185).

[8] Thus, there is no need to date them exclussively to LH IIIC (as RUPPENSTEIN 2007, 224 n. 968, proposed)

reconstructions in buildings E and H at Thessaloníki Toumba, but the excavated area, which belongs to this phase is too small and the characteristic Mycenaean sherds too few to provide reliable chronological distinctions. A terminus post quem for the beginning of Phase 5 may be a handle from a LH II A /II B squat jug, FS 87 that was found in the latest sub-phase of Phase 6.

Phase 4D

Deep bowls with linear interior (with or without thickened rim) showing a single broad horizontal wavy band with wide swings are common from Phase 4D onwards. KA 961 (ANDREOU 2003, 205 fig. 5:KA 961) and KA 962 (ANDREOU, this volume, fig. 7:4) are examples for these types. The deep bowls with thickened rim and single wavy bands painted in wide swings disappear after Phase 4.. After Phase 4 wavy bands on deep bowls A and B were executed in a thin way. At Kastanás the wavy band deep bowls with thickened rim (classed as stemmed bowl FT 304/305[9]) were in use from Level 16 until Level 12 (JUNG 2002, 453–454 motifs 1.6.1–1.6.1.1.). However, they had their peak in Level 14b and faded in the more recent Levels, the specimens from Level 12 being most probably throw-ups (JUNG 2002, 71 fig. 6; 72; 220 fig. 73; 223). An analogous development can be observed at the Toumba of Prehistoric Olynthus, where the type with thickened rim has nearly disappeared by Level 2, which is dated to the last phases of LH IIIC (JUNG 2004, 42 fig. 4). The deep bowls FT 284/285 A with a single broad horizontal wavy band painted in wideswings are mainly attested from Level 15 to Level 14b at Kastanás (JUNG 2002, pl. 4:35; 6:66–68; 7:69). Later on, in Level 12, the single horizontal wavy bands have become much thinner, on deep bowls A (IBIDEM, pl. 22:249) as well as on deep bowls B (IBIDEM, pl. 23:256–258).

KA 547 (ANDREOU 2003, 207 fig. 7:KA 547; IDEM, this volume, fig. 7:7) is a deep semi-globular cup FT 215/216 with a wide rim band as its only decoration (decoration 1.2). An approximate parallel can be found in Level 15 at Kastanás (JUNG 2002, 316 cat. no. 39 pl. 4,39), while another possible parallel from Level 14a cannot be definitely assigned to a cup, because nothing is left from its handle(s) (JUNG 2002, 341 pl. 12:129). Furthermore, it is worth noting that at Kastanás deep cups FT 215/216 with linear interior disappeared after Level 13 and were replaced by cups FT 215/216 with monochrome interior (JUNG 2002, 150 with fig. 57).

KA 1459, a stemmed bowl FT 304/305 or deep bowl FT 284/285 B with thickened rim (ANDREOU this volume, fig. 7:5) is remarkable because of its decoration, a monochrome interior, a rim band and another band below (decoration 9.3). It has a good parallel at Kastanás Level 14b (JUNG 2002, 73, 323 pl. 6:64). In the Peloponnese decoration type 9.3 is common on bowls with thickened rim during LH IIIB Final, as examples from the debris of the palace destruction at Tiryns show. One of the published specimens should be a stemmed bowl FT 304/305 (VOIGTLÄNDER

[9] See n. 4.

2003, 93–94 pl. 67:Si 119; 129:Si 119), while the other one has a ring foot (IBIDEM, 94 pl. 67:Si 121; 129:Si 121). Stemmed bowls with decoration 9.3 are also attested earlier, at LH IIIB Middle Tsoúngiza (THOMAS 1992, 203, 557 fig. 23:15[10]).

Parallels for the Mycenaean cooking pot KA 1466 (ANDREOU, this volume, fig. 8:2) are attested at Kastanás from Level 16 to Level 14a (JUNG 2002, 196–197, 441–442 pl. 62:513, 515, 518), but these kitchen vessels are not specially relevant for building up a fine chronology.

Phase 4C

The linear amphoriskos KA 455 from Thessaloníki is interesting because of its dotted handle decoration (ANDREOU this volume, fig. 8:1), which at Kastanás is not securely attested earlier than Level 12 (JUNG 2002, pl. 32:337; 33:340; 35:345). However, this may not reflect the ancient reality, because one fragmentary belly-handle of a closed vessel from a mixed context of Levels 14b and 14a at Kastanás preserves the rest of such a dotted decoration (JUNG 2002, 508 [no. 78/3716]).

Phases 4D and 4C can be approximately paralleled with Levels 14b and 14a at Kastanás. Kastanás Level 15 must have already come to an end during Thessaloníki Toumba Phase 5 (see above). There are no characteristics in Phases 4D and 4C of Thessaloníki, which would force us to lower their end to the time of Level 13 at Kastanás.

Phase 4B

At the outset it is necessary to note that the deposits assignable to Phase 4B are very few and that the picture we can gain from them is rather fragmentary.

Some kraters with monochrome interior may be ascribed to this Phase, but the stratigraphical evidence is not beyond doubt for any of them. KA 881, a large part from the belly down to the ring base of a huge vessel, was reconstructed from many sherds scattered through a number of find contexts. One sherd is from a secure Phase 4B context, while the rest cannot be given a more precise assignation than Phases 4B–4A (ANDREOU, this volume, fig. 9:7). Similarily a wall fragment of another vessel can only be asssigned to Phases 4A–4B (ANDREOU, this volume, fig. 9:10), while a rim sherd of a third krater with a broad rim band and part of a wavy band motif belongs with certainty already to Phase 4A (ANDREOU, this volume, fig. 9:5). At Kastanás monochrome decoration is first used for the interior of kraters during Level 14a (JUNG 2002, pl. 9:103), but it became common on this vessel shape only in the succeeding Levels dating to the middle and late phases of LH IIIC (JUNG 2002, 112–113 with fig. 35). The multiple band groups of the of the best

[10] Although one has to note that the stem of this example is not preserved.

preserved example from Thessaloníki (Andreou, this volume, fig. 9:7) are unusual for southern and central Greek kraters, but they are quite well matched by another Central Macedonian krater found at the Toumba of Thérmi A (Rey 1921, pl. 48:on top[11]). Again from Thérmi A there is a good parallel for the chain of rhomboid motifs with semi-circle fill found on the wall fragment (cf. Andreou, this volume, fig. 9:10, and Rey 1921, pl. 48: bottom). This same motif is also found on a better preserved example, again with monochrome interior, which comes from Phase 4 at Thessaloníki Toumba, but cannot be assigned to any of its sub-phases (KA 665, see Andreou – Psaraki 2007, 413 pl. 9; 414 fig. 17:KA 665). Unfortunately the kraters from the Toumba of Thérmi A cannot be dated by stratigraphical context.

The almost complete profile of a krater with linear interior, which either belongs to Phase 4B or to Phase 4A (Andreou, this volume, fig. 9:8), compares well to a krater from Levels 16–14a at Kastanás because of its shape and rim type (type 1 at Kastanás: Jung 2002, 106) and because of its general style (Jung 2002, 339–340[12] pl. 11:123). However, no exact parallel for the motif and linear decoration of the Thessaloniki vessel is known from the toumba at the Axiós river bank.

Perhaps since Phase 4B, but not later than Phase 4A the typical Macedonian horn motifs (Jung 2002, 83–85 with fig. 16) were used to decorate deep bowls FT 284/285 with and without thickened rim at Thessaloníki Toumba (Andreou, 2003, 205 fig. 5:KA 879 from 4B or 4A, but more likely from 4B). At Kastanás the earliest simple horn motif is attested in Level 14b and found on a deep bowl FT 284/285 A (Jung 2002, 323–324 pl. 6:65), which would date the invention by or introduction of the motif to the Central Macedonian potters workshops to LH IIIC Early. The only good parallels outside Macedonia are found in Thessaly. They date to LH IIIC Middle (probably Developed, see Batziou-Efstathiou 1994, 219 fig. 8: top row, middle; 222 fig. 16:α, β). One possible example from Dhimíni may be earlier, i.e. LH IIIB Final or LH IIIC Early (Adrymi-Sismani 2006, 110 fig. 17:group on the right, 2nd row from bottom, right sherd[13]).

Phase 4A

KA 94/1067 (Andreou, this volume, fig. 9:3) is a well-preserved deep bowl FT 284/285 B, which belongs to the earliest vessels of this type to be decorated with a simple horn motif. Analogous vessels were used at Kastanás from Level 14a onwards (Jung 2002, 91 pl. 12:128 ecc.).

Several large fragments of large and medium sized belly-handled amphorae, collar-necked jars or hydriae with purely linear decoration or with a horizontal zig-zag or wavy band, such as KA 827 (Andreou 2003,

[11] Jung 2002, 563–564 pl. 72:5 shows only the upper part of the vessel, as the lower part with the ring base could not be located at the Thessaloníki museum store-rooms.
[12] With another parallel from Phase 6 at Ássiros Toumba.
[13] In the case that wall fragment shows the motif under discussion, it should be turned upside down. It is not clear from the publication, if the sherd comes from the re-occupation phase of LH IIIC Early or from the destruction level of LH IIIB Final.

208 fig. 8,KA 827; ANDREOU, this volume, fig. 10:1), KA 884, KA 880/883 and KA 877/1428 (ANDREOU, this volume, fig. 10:2–4), were found in contexts of Phase 4A. Such large closed vessels are attested at Kastanás since Level 15 at the earliest (JUNG 2002, pl. 3:28; 5:46, 47; cf. also IBIDEM pl. 9:99 from Level 14b for the wavy band).

The sub-phases 4B and 4A of Thessaloníki Toúmba are difficult to synchronise exactly with the Kastanás sequence. They might both overlap with the time of Level 14a, but one cannot exclude that Phase 4A is already partly contemporary with Level 13, if some of the kraters with monochrome interior should indeed belong to Phase 4B. This stylistic feature is rather innovative for Kastanás Level 14a and might thus offer an argument to lower the date of the next phase (4A) to a time contemporary with Kastanás Level 13. If however, all kraters with monochrome interior should belong to Phase 4A, no real stylistic argument is left to support even a partial synchronisation of this Phase with Level 13.

Phase 3

In Phase 3 for the first time in the Toumba Thessaloníki sequence deep bowls with monochrome interior are slightly more common than deep bowls with linear interior. This statistics comprises all deep bowls, those of the regular FT 284/285 shape as well as those with thickened rim. At Kastanás Level 12 bowls FT 284/285 B are more than seven times as common as deep bowls FT 284/285 A (JUNG 2002, 220 fig. 73; 225–226 with fig. 78; IDEM 2003, 223 fig. 9). However, in Kastanás Level 13 percentages of bowls FT 284/285 B and deep bowls FT 284/285 A are approximately the same (JUNG 2002, 224 with fig. 77). If stemmed bowls/deep bowls with thickened rim are included also into the Kastanás statistics, the numerical proportions do not change in any significant way[14].

An important – though late (see below) – innovation of the potters' workshops during this phase was the decision to produce monochrome deep bowls FT 284/285 (decoration 11.0) for the first time (ANDREOU, this volume, fig. 11:5). This might have happened contemporaneously with the time of Kastanás Level 13, because a small monochrome ring base from this level should belong to that type (JUNG 2002, pl. 18:198). Otherwise the earliest rim sherds definitely proving the use of monochrome deep bowls FT 284/285 in the small settlement at the Axiós were found in Level 12 (JUNG 2002, 99 fig. 26; 100, 224 pl. 25:275, 276). It has already been commented upon that this is a retarded production start judging by the southern Greek potters' traditions (JUNG 2002, 99–

[14] Level 13 would have 16 stemmed/deep bowls with linear interior and 14 with monochrome interior, while Level 12 would have 18 with linear and 128 with monochrome interior, see JUNG 2002, 453–462.

100), because regularly shaped deep bowls with decoration 11.0 were already in use by LH IIIB Final[15].

From Phase 3 onwards, different vessel types such as deep cups FT 215/216 or deep bowls were painted occasionally with multiple (double or triple) horizontal wavy lines at Thessaloniki Toumba (ANDREOU, this volume, fig. 11:6, 7). At Kastanás this was an innovation, which occured during the time of Level 13 (JUNG 2002, 186, 224, 226 pl. 18:205). These multiple horizontal wavy lines then became a characteristic of the pottery style of the subsequent Level 12 and the following Levels of the Early Iron Age (JUNG 2002, 226, 228), just as is the case at Thessaloniki Toumba. The finds from Thessaloníki now verify the hypothesis – based at that time on the single attestation in Level 13 (see above) – that this motif was in use earlier than PG in central Macedonia (cf. JUNG 2003, 136). On the Peloponnese double and triple wavy lines are found from LH IIIC Advanced onwards on different open shapes (PODZUWEIT 2007, 39, 66 pl. 14:1, 5; 26:1 [IIIC Advanced], 2; 27:2; POPHAM – SCHOFIELD – SHERRATT 2006, 168 fig. 2.11:7; 172, 193, 194 fig. 2.24:3, 4 pl. 51:6–8 [Phases 2b and 3]), but also on closed ones (cf. JUNG 2002, 180 n. 1034).

Fig. 2 Open and closed vessels from later LH IIIC Levels of Kastanás, Thessaloníki Toumba and Lefkandí. 1 from Kastanás, Level 12 (after JUNG 2002, pl. 23,254); 2 from Lefkandí, Phase 2a (after POPHAM – SCHOFIELD – SHERRATT 2006, 191 fig. 2.22:4); 3 from Kastanás, Level 12 (after JUNG 2002, pl. 37,349); 4 from Kastanás, Level 12 (after JUNG 2002, pl. 37,362); 5 from Kastanás, Level 12 (after JUNG 2002, pl. 33,342); 6 KA 2/1187 from Thessaloníki Toumba, Phase 3.

A large closed vessel from Phase 3 attests to the use of groups of vertical wavy lines during that phase at Thessaloníki Toumba (ANDREOU, this volume, fig. 12:7). There are good parallels from Level 12 at Kastanás, which carry the wavy line groups on the shoulder like on the Thessaloníki example (**Fig. 2,5**) (JUNG 2002, 175, 186 pl. 33:342; 36:347).

KA 2/1187 and KA 1190 (**Fig. 2,6** – ANDREOU, this volume, fig. 12:6) prove the start of the use of tassel motifs on large closed vessels during this phase. At Kastanás this was the case in the settlement of Level 13 (JUNG 2002, 185–186 pl. 19:208). Tassel motifs also appear for the first time with certainty on deep bowls FT 284/285 during Phase 3 of Thessaloníki Toumba. These are deep bowls B with monochrome interior: KA 1074 (ANDREOU, this volume, fig. 11:3) and perhaps also KA 1069 (but horn cannot be excluded, see ANDREOU, this volume, fig. 11:2). This combination of vessel shape and motif is a good example for the local Central Macedonian taste, as all kinds of tassels were typically used to decorate closed and not open vessels in the central and southern Greek regions. Some pieces in central Greece are exceptions from that rule, such

[15] Tiryns, LH IIIB Developed and IIIB Final: PODZUWEIT 2007, 54 Beil. 16, 17. – Thebes, palace destrcution of LH IIIB Final: ANDRIKOU 2006, tab. 6; 33. – Nichória, LH IIIB Final: SHELMERDINE 1992, 510–511 tab. 9-6 and 9-7; 513; 609 fig. 9-62:P3816.

as a monochrome deep bowl with reserved decorative zone from Phase 2a at Lefkandí. It shows, what has been explained as a version of the antithetic streamer pattern, but it is stylistically quite close to the Macedonian tassels (**Fig. 2,2**) (POPHAM – SCHOFIELD – SHERRATT 2006, 188, 191 fig. 2.22:4)[16]. At Kastanás the first tassels used on deep bowls FT 284/285 B were painted during Level 13 and became common in the subsequent Level 12 (**Fig. 2,1**) (JUNG 2002, 91–92 with fig. 22 pl. 15:168; 23:252–255).

A sherd from unit 261093 (ANDREOU, this volume, fig. 12:2) testifies to the practice of shaping a hollow rim with a heavy overhanging outer lip for closed vessels. This example is close to the rim variety 6 of Kastanás (cf. JUNG 2002, 162). At Kastanás closed vessels with hollow rims first appeared in Level 13, but did not become common until the following Level 12. Heavy varieties like the one from Phase 3 at Thessaloníki are only found from Level 12 onwards (**Fig. 2,3.4**) (JUNG 2002, 183 fig. 63; 184–185 pl. 37:349, 350, 362).

Another new morphological feature of large closed vessels in this phase is the shape of their neck. In some cases the neck widens strongly towards the rim (funnel-shaped neck). These neck fragments show a monochrome decoration on the outside and strokes on the lip (ANDREOU, this volume, fig. 12:1, 3). They find good parallels in Level 13 at Kastanás (JUNG 2002, pl. 18:202, 204).

In the production of kraters FT 281/282 the invention of the horizontal, markedly protruding lip with flat upper surface (rim variety 4 at Kastanás) is the new feature of Phase 3 at Thessaloniki Toumba. This is another element, which links Phase 3 to Kastanás Level 12, and as is the case with other inventions of that time, its adoption in Central Macedonia happened later than its invention by the potters' workshops of southern Greece (JUNG 2002, 107 fig. 29; 108).

Innovations can also be found in the linear decoration. One example is the fragment of a large belly-handled amphora or a hydria (ANDREOU, this volume, fig. 12:5) with a horn motif and a banded belly decoration, which can most probably be reconstructed as a thick band framed by thin a band above and below (band type 4.1), which is not attested earlier than Level 12 on large closed vessels at Kastanás (JUNG 2002, pl. 41:388).

From the arguments outlined, one can conclude that Phase 3 does not only run parallel to Level 13, but certainly also to the first part of Level 12 at Kastanás.

[16] Other central Greek examples include conical kylikes from Lefkandí, phases 2a and 2b(?) (POPHAM – SCHOFIELD – SHERRATT 2006, 185 fig. 2.17:7 [standing tassel]; 186 fig. 2.18:1 [hanging tassel]) and from Kalapódhi, Level 9 (JACOB-FELSCH 1996, 145 cat. no. 219 pl. 34:219 [standing tassel]). But these kylikes all show regular tassels of the type principally used for closed vessels in the Greek south. An Argive deep bowl FT 284/285 B shows a similar tassel (JUNG 2002, 92, 572–573 pl. 74:4), but is a very rare exception on the Peloponnese.

Phase 2B

During this phase strap-handled bowls FT 295 with flat rim and a stroke decoration on it (ANDREOU, this volume, fig. 13:4) were used for the first time at Thessaloníki Toumba. Based on the present evidence, it might seem that at Kastanás these decorated bowls were invented earlier, as there is one example from a Level 13 context (JUNG 2002, 130 pl. 16,176), which should be contemporary with Thessaloníki Toumba Phase 3 (see above). However, even at Kastanás the type became only common during the more recent Level 12 (JUNG 2002, 130–131 pl. 29,297–299; 44,407).

264057 (ANDREOU, this volume, fig. 13:5) is a wall sherd, which most probably can be assigned to a monochrome deep bowl FT 284/285 with broad reserved outer zone. At Kastanás this type of monochrome decoration (11.11) is not attested earlier than Level 12 (WENINGER – JUNG, this volume, fig. 10: 1, 4, 7) and has parallels in southern and central Greece mainly in Submycenaean and EPG contexts. LH IIIC reserved zones seem to be narrower (JUNG 2002, 103).

KA 947 (ANDREOU, this volume, fig. 13:9) is the shoulder fragment of a neck-handled amphora or hydria with part of a hanging spiral (or a spiraloid part of a tassel motif) and triple vertical wavy lines next to it. Combinations of similar motifs are only found from Kastanás Level 12 onwards (JUNG 2002, pl. 31:336; 38:368, 369; 56:482).

The well-preserved belly-handled amphora with monochrome neck, reserved and stroke-decorated lip and triple horizontal wavy lines on the belly would not be out of place in Level 13 of Kastanás (cf. JUNG 2002, pl. 18:204, 205), but their characteristics are very common in the more recent Levels 12 and 11 (cf. JUNG 2002, pl. 35:345; 55:481).

Phase 2B seems to have been inhabited contemporaneously with a later part of the use period of Level 12 at Kastanás, which would probably include the Submycenaean phase.

Phase 2A

In this phase the groups of compass-drawn concentric circles made their appearance at Thessaloníki Toumba. From that first phase on they were used to decorate large closed vessels (ANDREOU, this volume, fig. 15:7, 8) as well as open vessels (IBIDEM, fig. 15:5, 6), just as at Kastanás, where they first appeared in Level 12 (JUNG 2002, 118–119, 187–191, 384–385, 409–410 pl. 28:293, 294; 40:386, 387; 41:388–390). The stratigraphy of Thessaloníki Toumba proves that this motif group represents the last innovation from the south taken up by the potters' workshops producing during the time of Level 12 of Kastanás – a fact that previously could only be surmised based on the relative chronology of the typological parallels from southern and central Greece (JUNG 2002, 226–227).

The earliest multiple tassel motifs with lateral multiple spirals or multiple horns are found in this settlement phase, on open (ANDREOU, this volume, fig. 14:6) as well as on closed vessels (ANDREOU, this volume, fig. 15:3). At Kastanás multiple tassels are amongst those motifs, which were not common before Level 12, although it cannot be excluded that they were introduced a little earlier than that ultimate Level of the LBA (cf. JUNG 2002, pl. 20:222; 21:241; 26:283; 35:345; 36:346; 38:369–371; 39:372, 373, 375).

A deep bowl FT 284/285 A with very wide interior rim band and no outer rim band (ANDREOU, this volume, fig. 14:3) has a parallel in Level 12 at Kastanás (JUNG 2002, pl. 22:249).

Phase 2A can be dated to EPG and is thus parallel with the end of Level 12 at Kastanás.

In conclusion one notes that the developments of the local Mycenaean pottery production at the two sites of Thessaloniki Toumba and at Kastanás were very comparable (see ANDREOU this volume Tab. 1). This parallel development of the Macedonian Mycenaean style in the wider region of the Thermaikos Gulf is a very good precondition for building up a relative chronology of the region. This relative chronology can be based on vertical stratigraphies that can complement each other because of this very fact of a considerably uniform stylistic development. The Mycenaean repertories of the Langadhás Basin, as exemplified by Ássiros Toumba (WARDLE 1980, 250–252), and of the Chalkidhikí peninsula, as represented by the Toumba of Prehistoric Olynthus, are comparable to those of Kastanás and Thessaloníki Toumba, but they also show several diverging, local production trends (cf. JUNG 2003, 213, 216–218).

Radiocarbon Dates from Thessaloníki Toumba

In this last chapter we will discuss the new ^{14}C-ages (**Tab. 1**) on different charred plant remains from the sub-phases of Phase 4 at Thessaloníki Toumba. Due to the achieved high dating precision (nearly all standard deviations are ≤ 35 ^{14}C-yrs) these new ^{14}C-ages are especially promising for comparisons with the Near Eastern historic-archaeological dates for the LH IIIC Early phase, as well as for comparisons with the ^{14}C-ages from Levels 14b to 13 at Kastanás. In the following we will integrate the new ^{14}C-ages first into the detailed relative chronology between Thessaloníki Toumba and Kastanás, as worked out in the previous paragraphs. As set out by ANDREOU (this volume) and JUNG (2002), this combined settlement chronology is age-calibrated to the southern Greek pottery sequences, based on synchronisms obtained for the Mycenaean pottery from both sites. Due to the high complexity of all underlying dating components and procedures, then, the new ^{14}C-data from Thessaloníki offer us a hopefully sensitive and at any rate very welcome test-case for the validity of the combined dual-settlement age-model.

Laboratory	^{14}C-Age (BP)	Material	Architectural Phase	Historical age expectation (calBC)
Poz-17441	2900 ± 35	Seeds	4A (end)	1150
Poz-17431	2880 ± 30	Seeds	4A (end)	1153
DEM-1285	3036 ± 25	Charcoal	4A (end)	1155
DEM-1284	3147 ± 35	Charcoal	4B (end)	1170
Poz-17429	2990 ± 30	Seeds	4C–4B	1172
Poz-17428	2980 ± 30	Seeds	4C–4B	1175
Poz-17430	2980 ± 35	Seeds	4C–4B	1180
DEM-1652	2803 ± 30	Charcoal	4C (end, disturbed?)	1182 (but cf. text)
Poz-17426	3030 ± 35	Seeds	4C–4B	1185
DEM-1704	3088 ± 30	Charcoal	4C–4A	1195
DEM-1443	3045 ± 46	Charcoal	4D (beginning)	1210

Table 1 ^{14}C-ages from the phase 4 deposits of Thessaloniki Toumba. Phases in bold indicate a higher probability of phase assignation. Note that tree-ring calibrated ages are purposely not given (see text). For the complete radiocarbon data set from Thessaloniki Toumba cf. (Andreou this volume, tables 1–2; Andreou – Maniatis – Kotsakis forthcoming).

The samples that were dated using the ^{14}C-AMS-technique in Poznan (Lab Code: Poz) were all carbonized seeds from hearths, while those dated using the ß-decay-method by Demokritos (Lab Code: DEM) in Athens were small charcoal fragments from secure deposits of Phase 4. The samples POZ-17429, -17428, and -17430 are more likely to belong to Phase 4B than to Phase 4C, while POZ-17426 is more likely to be Phase 4C end. It is not possible to prove either case.

The sample DEM-1652 is very likely from a spot that was disturbed in EIA. Sherds joining a dark burnished, knobed jug with cut-away neck and incised decoration (similar to an example from Ássiros Phase 2: Wardle 1980, 256, fig. 16:41. – Wardle – Newton – Kuniholm 2007, 485–486 fig. 2:4) were found in close vicinity to the charcoal. Probably a LBA pithos was taken out from this area of room A 10 during the EIA. Such a disturbance, which apparently was not recognized during the excavation, may explain the late date of the sample, which otherwise came from the bottom of the trench. Given that this interpretation is correct, the sample

DEM-1652 (2803 ± 30 BP) should then date to the early Protogeometric phase. This is confirmed by its calibrated age 960 ± 40 calBC (± 68%)[17].

For the calculation of the historical age expectations as given for each sample (Tab. 1, right column) the same criteria were applied as for the Kastanás dates. Charcoal was judged to represent the beginning of an architectural phase (construction of buildings), rather than the middle or end. We acknowledge that all such estimates are error-prone interpolations. We are aiming at achieving minimal errors. As goes for secondary use or recycling of construction materials ("old wood effect"), we can admittedly only hope to identify such data as "outliers". As an alternative effect, the insertion of freshly cut beams ("young wood effect") for secondary repairs of long-standing buildings during a later sub-phase we judge is a rather minor factor. Seeds can be clearly assigned to different use phases, with much more confidence than for charcoal, due to their typically well-defined position in fire-places on house floors. In consequence, we can expect the ^{14}C-ages on seeds to have phase positions that are defined with greater security within the overall relative sequence (Tab. 1, right column) than the ^{14}C-ages on charcoal.

As at Kastanás, we have again based the site stratigraphy ultimately on historical dates of Egyptian/Near Eastern derivation, the application of which requires a large number of interpolations, to allow for factors such as: (i) the duration of Mycenaean pottery phases, (ii) the numbers of building horizons in southern Greek key sites, and (iii) site-internal stratigraphic and architectural details. Despite their complexity, when finally combined, these factors are all the more useful since they supply us with a set of absolute dates than can be applied – not only to the individual architectural phases – but also to selected historical events (e.g. house-specific building activities, burning events, garbage disposal) within these phases. It is these events we are targeting as a background for the envisaged ^{14}C-analysis, finally, since this is the level of stratigraphic modelling that is required in the ^{14}C-age calibration (i.e. comparison with independently dated tree-ring samples, cf. below).

To illustrate this procedure, let us focus on the ^{14}C-sample sequence we have generated for phases 4D–4B. These phases are all assigned to LH IIIC Early, the overall length of which we may estimate as ~ 40 years – if only for the aim of arranging each ^{14}C-sample at some specific position within this time-span. Following this decision (and which remains open to future stratigraphic challenge), a schematic (site-specific) subdivision of LH IIIC Early was chosen, alloting 15 calender years to the first two phases (4D and 4C) and 10 years to the last phase (4B), which is also stratigraphically less well attested. This interpolation resulted in the following historical age-expectations (as given in Tab. 1): phase 4D:

[17] Tree-Ring ^{14}C-Age calibration based on INTCAL04 data (REIMER ET AL. 2004) using CalPal-software (WENINGER – JÖRIS 2008).

1210–1195 hist.BC[18]; phase 4C: 1195–1180 hist.BC; phase 4B: 1180–1170 hist.BC. As a final allotment, phase 4A was assigned a duration of 20 years, because judged by its deposits it should have had a longer duration than Phase 4B. We note that our estimate for the extent of phase 4A is more error-prone than for previous phases (4D–4B), due to its unclear assignation either to LH IIIC Early or to the start of LH IIIC Developed (ANDREOU, this volume)[19]. It will have become clear, now, that we have chosen to quantify and subdivide the length of the LHIIIC Early phase in this manner only for the purposes of ^{14}C-analysis.

Analysis and Age-Calibration the Radiocarbon Dates

Methods

The technical background (software, mathematical procedures, algorithms, data) to the methods used in the present ^{14}C-analysis is described in detail by WENINGER – JÖRIS 2008. This allows us to focus our attention here on the archaeological ^{14}C-data. A general description of the applied software methods may nevertheless be useful to the reader interested in similar applications. We describe here, for the first time, a new software dialog for radiocarbon calibration called "*Reservoir Explorer*". We have used this dialog in the analysis of the Thessaloniki ^{14}C-data (**Tab. 1**). It is a component of the CalPal program, which is a (freeware) tool developed for explorative research in archaeology and paleoclimatology (www.calpal.de). Despite its maybe curious name, the "*Reservoir Explorer*" is actually a procedure that supports the detailled visual-graphic analysis of archaeological ^{14}C-data. This is as follows.

One of the main applications of the CalPal software is the automated and rapid update of ^{14}C-age calibration curves, which is highly advisable (even with ~ annual schedule) due to the rapidly advancing research in all paleoenvironmental sciences. Fortunately, many of the mathematical and programming procedures involved in the construction of ^{14}C-age calibration curves can be defined as modules. This allows for some large degree of automation in the construction of the requested calibration curve update. For such purposes, the CalPal software is equipped with a variety of dialogs (including the *Reservoir Explorer*), as well as with a large collection of tree-ring and archaeological databases, climate proxies, topographic and bathymetric data. Although most of the CalPal modules and dialogs (others are e.g.: *CalCurveComposer*, *ClimateComposer*) have been programmed for the special purpose of calibration curve construction in the Glacial periods, they are equally applicable to the construction of radiocarbon-based chronologies in the Neolithic and Bronze Age.

[18] The only secure historic-archaeological synchronism for this time period is provided by the Sea Peoples destructions in Syria as a *terminus ante quem* for the start of LH IIIC (cf. WENINGER – JUNG, this volume).
[19] The dates proposed here differ from those in ANDREOU (this volume table 1) where a more traditional approach to the absolute dating of the sub-phases of LH III C is adopted.

Needless to say, it makes little difference to any formal software specification whether the requested application should be the construction of an extended Glacial ^{14}C-age calibration curve (covering e.g. large amounts of marine data that must first be analysed in terms of marine carbon reservoir factors, or of climate data that must first be age-synchronised), or else – why not ? – use the same software to synchronise via ^{14}C-ages a large number of archaeological sites (or cultures). This readily explains why - although the ^{14}C-calibration software we are using is called "*Reservoir Explorer*" – the corresponding dialog is actually a tool equally dedicated to the analysis of archaeological ^{14}C-data. Indeed, both kinds of applications (archaeological and palaeoclimate) have a variety of interests in common, well beyond the simple ability to conveniently introduce and visualize age-shifts on different time-scales (which is the main purpose of the *Reservoir Explorer*). To continue with the given example, marine carbon reservoirs show major variations all over the world's oceans, with especially strong dependence on latitude, such that a typical marine-reservoir study will require major mapping facilities, with high topographic resolution both on land (topographic) and under water (bathymetric). But this applies just as much to the archaeological analysis of ^{14}C-ages. Studies in cultural chronology equally require major cartographic facilities, including facilities to produce bathymetric maps, which will allow for major changes in the past distribution of land areas and sea due to changing sea-levels.

Despite all such similar requirements, in both applications (archaeological and palaeoclimate), the necessary minimal data structure for any ^{14}C-analysis is (i) a list of ^{14}C-ages and (ii) a list of corresponding calendric ages. With this data structure given, in the case of paired tree-ring and ^{14}C-ages, we may use the *CalCurveComposer* (or, for more detailled analysis, the *Reservoir Explorer*) in the routine construction of a new ^{14}C-age calibration curve. But this is the data structure now available for the Thessaloniki ^{14}C-data. As shown in **Tab. 1**, here we also have a set of ^{14}C-ages and a list of independently calculated calendric ages. Hence, we can immediately analyse the Thessaloniki data using the same software as otherwise used in the construction of a new ^{14}C-age calibration curve

Fig. 3 Software Dialog (*Reservoir Explorer)* used in the analysis of the Thessaloniki ^{14}C-Data (Tab. 1).

Of specific interest for the analysis of the Thessaloniki ^{14}C-data set is the ability of the *Reservoir Explorer* to produce graphs of any given quantitively seriated archaeological ^{14}C-ages. Most important hereby is the ability of this dialog to add in other requested (database-selectable) components of the Holocene tree-ring ^{14}C-age calibration.

Using the Reservoir Explorer, quite generally, the construction of an archaeological (or palaeoclimate) calibration graph is reduced to a small number of consecutive steps: (1) manual ^{14}C-data entry, (2) update of the corresponding database log-file, (3), selection of the new data set and of additional ^{14}C-dates from a list box (SELECT CALDATA SETS), (4) choice of colours, symbol-type, symbol-size, (5) optional shift of the new data set using steering bars on one (or both) of the time-scales (^{14}C- and calendric), (6) choice of additional graphic representation of any requested (old/stored or newly-built) ^{14}C-age calibration curve (including error analysis) and – finally – by pressing a button (STORE) (7) the requested storage of the new calibration curve to disk (e.g. for further processing by standard graphic software). Optionally, the overall aesthetic impression of the calibration picture may be enhightened by choice e.g. of colour and symbols for each data set.

Results

What this means for the present application is illustrated first in **Fig. 3** and – in higher graphic resolution – in **Fig. 4 (upper and lower).** In both cases we are using the *Reservoir Explorer* – quite simply – to draw a picture of the historically seriated Thessaloniki ^{14}C-data set. Note that the Thessaloniki dates are *not* being wiggle-matched to the calibration curve. Nor is the calibration curve being used for any other analytical purposes. Both the Thessaloniki data and the calibration curve are simply drawn on the screen. The drawing is performed within an adjustable time-window (here: 1500–1000 calBC). The underlying zoom-function of the *Reservoir Explorer* enables us to compare the Thessaloniki data, in high graphic resolution, with the shape of the calibration curve. It appears that the Thessaloniki data and the shape of the calibration curve have very little in common, so little, that we decided to avoid the ^{14}C-calibration of the individual archaeological ages. That is why Tab.1 does not show numeric cal-age values for the given data. But this property of the Thessaloniki data is entirely as we expected. It corresponds to the results achieved in Weninger and Jung (this volume). These results are, in brief, (i) that the internationally recommended INTCAL04-data (Reimer et al., 2004) has been constructed with far too much *general smoothing* applied and (ii) that in the age-range under study (1500–1000 calBC) *two specific wiggles* of the calibration curve appear to exist, that is at ~1180 and 1130 calBC.

Since these effects may be related to some quite extreme (centennial scale) distortion of any unknowledged ^{14}C-chronology, they must be taken seriously, even to the point of supporting an entirely explorative approach. In the illustration of our new calibration method (**Fig. 3; 4 lower**) let us now project onto the picture three additional, independently established ^{14}C-datasets. These are: (i) Kastanas archaeological ^{14}C-sequence, (ii) Belfast laboratory INTCAL04 tree-ring raw-data, and (iii) Seattle laboratory INTCAL04 raw data. The Belfast and Seattle laboratories have supplied major raw data sets for calibration curve construction in the entire Holocene, but here we focus on values that fall into the age-range of the LBA (window: 1500–1000 calBC). Again, none of the selected tree-ring (Belfast, Seattle) and archaeological data (Kastanas) are in use, for analytical purposes. We are simply drawing all this data togetther in one picture.

By this procedure, based on the *Reservoir Explorer*, we have at our disposal a visual representation of the (historically age-calibrated) Thessaloniki ^{14}C-data. It is important to note that using the *Reservoir Explorer*, in this manner, does not require any prior assumptions towards the validity of the applied archaeological age-model. Indeed, the *Reservoir Explorer* is equipped with a steering bar (situated directly under the main graphic window, cf. **Fig. 3**) by which it is immediately possible to shift the Thessaloniki data *en block* to younger (or older) calendric ages. The steering bar is equipped to apply (and measure the statistical consequences of) such data-shifts, with annual resolution. This allows both for testing the input archaeological age-model and – conveniently – would also allow the immediate storage of any necessary changes in the archaeological age-model.

Fig. 4 upper. Thessaloniki ^{14}C-ages (data bars: circles) positioned on the calendric time-scale according to the archaeological age-model of Tab. 1, in comparison with the Kastanas ^{14}C-ages (data bars: squares, also set according to the archaeological age-model cf. WENINGER – JUNG, this volume), and the internationally recommended INTCAL04 tree-ring calibration curve (shown as line). Charcoal dates from Thessaloniki are shown as data bars with small circles. Seed dates are shown as data bars with large circles. The respective settlement phases of Thessaloniki and Kastanas are shown at the top of the upper graph.

Fig. 4 lower. Thessaloniki ^{14}C-ages (data bars: circles) positioned on the calendric time-scale according to the archaeological age-model of Tab. 1, in comparison with tree-ring raw-data of Laboratories Seattle and Belfast. Charcoal dates from Thessaloniki are shown as data bars with small circles. Seed dates are shown as data bars with large circles. The settlement phases of Thessaloniki are shown at the top of the lower graph.

In both figures (**Fig. 4 upper and lower**), perhaps the most important result to note is the strong jump in Thessaloniki ^{14}C-ages (by ~ 100 ^{14}C-yrs) for short-lived seed samples from phase 4B and late Phase 4A (i.e. within one generation), in comparison to the essentially flat INTCAL04 calibration curve (for ages 1200–1150 calBC). This jump in ^{14}C-ages also appears at Kastanas from Level 14b (N=3 charcoal) to early phase 13 (N=2 terrestrial animal bones, N=1 charcoal) (upper graph, ~ 1170 hist.BC), but is not well-documented in the Seattle and Belfast calibration raw-data (lower graph). The existence of this strong jump of ^{14}C-ages down from 1200 calBC (~3050 BP) to 1180 calBC (~2900 BP) was previously derived from the Kastanas ^{14}C-data, with additional support by high-precision ^{14}C-data measured by the Heidelberg laboratory (cf. WENINGER – JUNG, this volume Fig. 5). We judge it significant that the Thessaloníki ^{14}C-data show essentially the same jump, both in terms of ^{14}C-amplitude (~ 100 ^{14}C-BP) and calendric age (~ 1180–1150 hist.BC), as the Kastanas data. Notably, it appears that strong fluctuations in atmospheric ^{14}C-values occurred in this age, as previously inferred. Nevertheless, we would like to refrain from any further interpretation of this observation, since ^{14}C-measurement on archaeological samples – even if processed with numeric precision quite similar to the INTCAL04-data – do not correctly adhere to the strict quality criteria that must be upheld for requested standardized ^{14}C-age calibration purposes.

Even finally leaving aside this observation, we conclude that the near-perfect agreement between ^{14}C-ages achieved at Thessaloniki and Kastanas for architectural phases that were independently synchronised (by archaeological criteria), is quite remarkable. This good agreement between the two site-chronologies is especially evident for Kastanas phases 14b/a–early 13, which have been derived to run parallel to Thessaloniki phases 4D–4A, with historical dates ~ 1210–1170/50 hist.BC[20]. Admittedly, even a quick glimpse at the wide spread of data in both graphs (**Fig. 4 upper and lower**) demonstrates it is entirely possible to shift each of the site chronologies any number of calendric decades to the older, or younger. However, such a negative approach would not be making best use of the available data. We propose this is better achieved by putting positive focus on the achieved, excellent agreement between so many different sources of absolute and relative dating, as are now quite effectively integrated within the combined dual-settlement chronology from Thessaloníki and Kastanas. E.g. a shift of the Kastanás data set to the younger would eliminate the good fit of the N=6 dates on construction timbers of early Level 12 with the upward wiggle around 1130 calBC, a wiggle the existence of which has been confirmed e.g. by the dendrochronologial wiggle match of the Ássiros timbers (JUNG – WENINGER 2002, 290; IDEM – IDEM 2004, 217; IDEM – IDEM in the present volume). A shift to the older by several decades would bing the ^{14}C-data for the start of LH IIIC Early from both Thessaloníki Toumba and Kastanás in serious disagreement with historical dates that can be linked to

[20] The overlapping of Phase 4A of Thessaloniki with Level 13 of Kastanas, suggested by the ^{14}C-dates and shown in **Fig. 4 upper**, is not clearly supported by the correlation of the ceramic data of the two sites that were discusses earlier in this paper. On the other hand however, it can neither be precluded, since several stylistic features present in the 4A wheel-made assemblage are not out of place in LH III C Developed (ANDREOU this volume) with which phase Kastanas Level 13 is mainly correlated (WENINGER – JUNG this volume). One may note on the other hand that Thessaloniki Phase 4A could have overlapped, at least partly, with Kastanas Level 14a (see above in this paper and ANDREOU this volume, Tab. 1), if the length of time allotted for the duration of the earlier subphases of Phase 4 in table 1 would have been shortened and a longer period would have been allowed for the development of Phase 4A. The substantial deposits of the latter subphase could support this alternative interpretation for the duration of the earlier part of Phase 4.

Mycenaean relative chronology at the Syrian sites of Ugarit and Tell Kazel (cf. WENINGER – JUNG, this volume).

In conclusion, the dates from Thessaloníki Toumba, especially those on seeds, confirm the results obtained at Kastanás. Most important, the jump in ^{14}C-ages in the first two decades of the 12th century calBC is documented at both sites by two groups of short-lived samples stratified at an earlier stage of LH IIIC Early and the end of that phase or the beginning of LH IIIC Developed. One might now go a step further and suppose that the dates of final Phase 4A at Thessaloníki Toumba and of early Level 13 at Kastanás can be ascribed to the same downward wiggle ~1180 calBC (**Fig. 4 upper and lower**). If this is accepted, both sites provide evidence for the conclusion that 1180 or 1180/75 calBC (WENINGER – JUNG, present volume, Fig. 5: Seattle and Heidelberg data) is a *terminus ante quem* for a developed stage of LH IIIC Early. This conclusion can be very well combined with the historical dating evidence available from the Near East and Egypt. In this way ^{14}C-dates from Macedonia can confirm the historical chronology of Mycenaean Greece and one arrives at a date for the Mycenaean palace destructions of LH IIIB Final a few decades earlier than 1180 hist.BC, probably 1210/1200 hist.BC (cf. WENINGER – JUNG, in the present volume). This would exclude any major updating (in the range of 50 calendric years) of the post-palatial age of Mycenaean Greece.

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