The dating of the Island Southeast Asian Neolithic: an attempt at chronometric hygiene and linguistic correlation

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As with conventional definitions of the Neolithic anywhere, the concept in this region relies on there being an agricultural economy, the traces of which are largely indirect. These traces are artefacts interpreted as being linked to agriculture, rather than direct finds of agricultural crops, which are rare in Island Southeast Asia. This definition by artefacts is inevitably polythetic, particularly because many of the sites which have been investigated are hardly comparable. We can expect quite different assemblages from open village sites as opposed to special use sites such as burial caves, or frequentation caves that are used occasionally either by agriculturalists while hunting or by gatherer-hunter groups in some form of interaction with near-by agricultural populations. And rarely is a full range of these different classes of sites available in any one area.

Details of the history of research and a general summary of archaeological results for the region have been conveniently compiled by Bellwood (1985), with further information and some debate in *Asian Perspectives* 26(1) (1988). The defining material culture for the Island Southeast Asian Neolithic includes many of the artefact types one might expect: pottery, polished stone adzes, stone hoes and 'reaping knives', barkcloth beaters, clay spindle-whorls, and a wide range of uses for marine shell as ornaments (beads, arm-rings), adzes and fish-hooks.

Pottery is the main Neolithic marker, although evidence for a pre-ceramic Neolithic has been claimed and is discussed below. The stone tools supposedly indicate forest clearance and gardening practices, along with barkcloth manufacture. Marine shell artefacts seem to be a particularly important innovation. While there are earlier occasional uses of shell for beads or flaked scrapers, the range of shell artefact types found in Neolithic sites is unparalleled. The use of *Tridacna* (clam) shell for woodworking adzes is a Neolithic innovation, as is the manufacture of shell fish-hooks.

There are plant remains in some sites, particularly rice in Taiwan at about 4000 BP and in the northern Philippines at about 3700–3600 BP (Li 1981; Snow *et al.* 1986). Domestic animals also make their appearance in this period: pig, dog and chicken, as well as the commensal Polynesian rat (*Rattus exulans*). Few pollen cores have been taken in the region, but those that have show forest disturbance in the mid to late Holocene, sometimes massive, interpreted as agricultural clearance (Flenley 1988).

The study area and period (FIGURE 1)

Defining the study area

There are no convincing ancestral or directly related cultures in mainland China (Meacham 1988), although almost the full range of Neolithic material culture can be found there at

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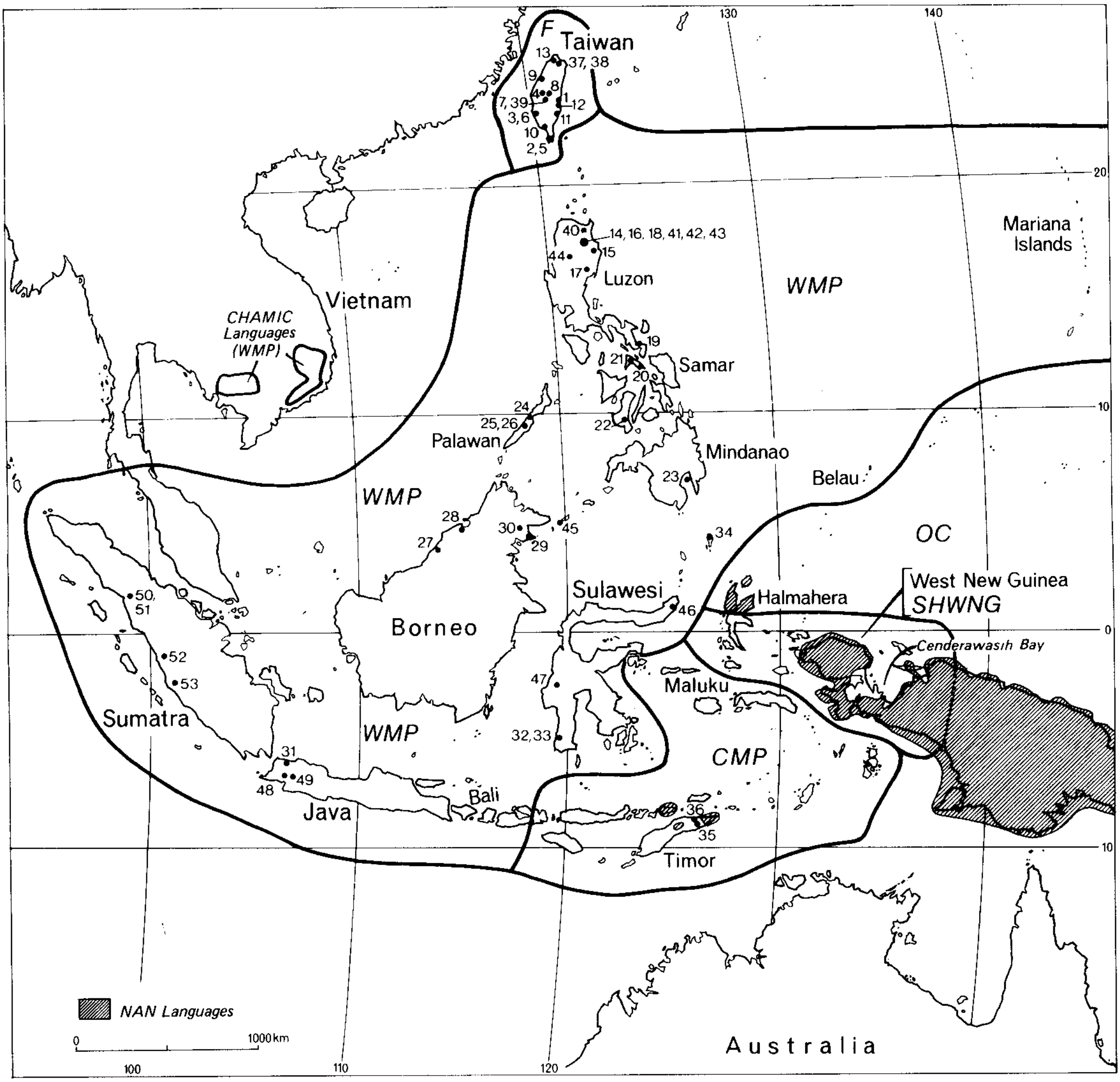

FIGURE 1. *Island Southeast Asia showing dated sites and linguistic subgroups.*
F *Formosan*
WMP *Western Malayo-Polynesian*
CMP *Central Malayo-Polynesian*
SHWNG *South Halmahera–West New Guinea*
OC *Oceanic*

earlier dates (Bellwood 1985: 216–22; Huang 1985). Despite recent Vietnamese archaeological opinion (Phong 1988; Tan 1988), there are no really convincing early Neolithic connections between Mainland and Island Southeast Asia, although later contacts doubtless existed, and Bellwood's statement still stands that the former area 'represents a totally different Neolithic world' (1985: 258). It is unclear whether Western Indonesia (Sumatra, Java, Bali) participated in the early phases of the Island Southeast Asian Neolithic, as there is not a single dated Neolithic site from any of these islands. They form a 'grey area' between the Malay peninsula and the islands, but pollen records show significant Holocene forest clearance particularly from the 5th millennium BP onwards (TABLE 1).

At the other end of the Indo-Malaysian archi-

1 *Ch'ang Pin, Taiwan*
2 *O Luan Pi, Taiwan*
3 *Pa-chia-ts'un, Taiwan*
4 *Ts'ao-hsieh-tun, Taiwan*
5 *K'en Ting, Taiwan*
6 *Niu Chou Tzu, Taiwan*
7 *Tung Chiao, Taiwan*
8 *P'uli area sites, Taiwan*
9 *Ying-p'u, Taiwan*
10 *Feng Pi Tou, Taiwan*
11 *Peinan, Taiwan*
12 *Chishivayan, Ch'i Lin, Taiwan*
13 *Tapenkeng, Taiwan*
14 *Rabel Cave, Luzon*
15 *Dimolit, Luzon*
16 *Andarayan, Luzon*
17 *Pintu Cave, Luzon*
18 *Arku Cave, Luzon*
19 *Bato Caves, Luzon*
20 *Bagumbayan, Masbate*
21 *Batungan Caves, Masbate*
22 *Edjek, Negros*
23 *Kamuanan Cave, Talikod Island, Mindanao*
24 *Duyong Cave, Palawan*
25 *Guri Cave, Palawan*
26 *Manunggul Cave, Palawan*
27 *Niah Caves, Sarawak*
28 *Kota Batu, Brunei*
29 *Bukit Tengkorak, Sabah*
30 *Agop Atas, Madai 1, Sabah*
31 *Pejaten, Java*
32 *Ulu Leang, Sulawesi*
33 *Leang Burung, Sulawesi*
34 *Leang Tuwo Mane'e, Talaud*
35 *Uai Bobo, Timor*
36 *Lie Siri, Timor*
37 *Yuanshan, Taiwan*
38 *Chih Shan Yen, Taiwan*
39 *Jih Tan, Taiwan*
40 *Lal-lo/Magapit, Luzon*
41 *Musang Cave, Luzon*
42 *Callao Cave, Luzon*
43 *Laurente Cave, Luzon*
44 *Banaue, Luzon*
45 *Balobok Rockshelter, Sanga Sanga Island, Sulu*
46 *Paso, Sulawesi*
47 *Kalumpang, Sulawesi*
48 *Leuwiliang, Java*
49 *Situ Gunung, Java*
50 *Tao Sipinggan, Sumatra*
51 *Pea Simsim, Sumatra*
52 *Lake Di Atas, Sumatra*
53 *Lake Padang, Sumatra*
54 *Papitalai, Los Negros, Manus*
55 *Peli Louson, Manus*
56 *Kohin Cave, Manus*
57 *Sasi, Lou, Manus*

Sites key for FIGURE 1 *and* FIGURE 2

lab. no.	**raw date b.p.**	**calibrated date BP (intercepts)**	**site**
Sumatra			
SRR-469	7512±85	8393 (8349) 8135	Lake Padang
SRR-468	3846±95	4415 (4279) 4094	Lake Padang
Significant forest decline between these two dates, continues later. Morley 1982.			
SRR-1016	4461±45	5267 (5202, 5198, 5048) 4987	Tao Sipinggan
SRR-1015	1701±65	1705 (1608) 1536	Tao Sipinggan
Suggestion of some forest disturbance prior to earlier date, but major forest destruction after second date. Maloney 1981.			
not reported	7280±150	8179 (8055) 7929	Pea Simsim
not reported	5000±130	5919 (5734) 5639	Pea Simsim
Possible forest disturbance between the two dates, major forest clearance after the second date. Maloney 1980.			
SRR-1347	11,710±110	[out of calibration range]	Lake Di Atas
SRR-1346	6850±60	7698 (7670) 7589	Lake Di Atas
SRR-1900	4520±50	5298 (5280, 5175, 5134, 5104, 5092) 5050	Lake Di Atas
Forest disturbance between the two earlier dates, further between second and third dates, major clearance after the latest date. Newsome & Flenley 1988.			
Java GrN-8340	7720±40	8549 (8507, 8479, 8447) 8418	Situ Gunung
GrN-8339	4810±50	5636 (5582, 5501, 5498) 5473	Situ Gunung
Major forest disturbance associated with the later date. Some possible disturbance between the two dates. van Zeist *et al.* 1979.			
Taiwan Y-1612	4200±60	4853 (4829, 4747, 4731) 4616	Jih Tan
Forest clearance at this time. Tsukada 1966.			

TABLE 1. *Island SE Asian pollen core dates associated with human impact on forest vegetation.*

pelago we also run out of dated sites in Eastern Indonesia (Maluku) and Indonesian-controlled West New Guinea (Irian Jaya). Evidence from the eastern half of New Guinea (Papua New Guinea) suggests again a very different Neolithic world with an early agricultural focus dated back to 9000 b.p. (Golson 1977; White & O'Connell 1982). The islands of the Bismarck archipelago further to the east, however, have produced Neolithic assemblages comparable in many ways to those of Island Southeast Asia (Gosden *et al.*, below, p. 00). Echoes of the Island Southeast Asian Neolithic have even been claimed for Australia to the south. The dingo was certainly introduced to Australia as a semi-domestic dog during this period, and the dating and distribution of backed-blade and related stone-tool technologies have long been interpreted by some Australian prehistorians as evidence of a stimulus from the north (Flood 1983: 186–99; for a contrary view see White & O'Connell 1982: 121).

Defining the study period

The boundaries in time for the Island Southeast Asian Neolithic are a major concern of this paper, particularly the exaggerated claims for time-depth encountered in some of the recent archaeological literature (Solheim 1988; Thiel 1988). There is a range of cave and rockshelter sites throughout the region with very different assemblages stratified below Neolithic levels (Bellwood 1985: 175–203). These pre-Neolithic assemblages are conveniently defined negatively: they lack the variety of Neolithic material culture items mentioned previously. But they often have stone flake and blade industries, sometimes highly developed. Importantly, these industries carry on into Neolithic levels in some sites (Glover & Presland 1985), providing a measure of continuity.

The end of the Neolithic is defined, again somewhat conventionally, by the introduction of metals. Iron and bronze appear in Island Southeast Asia at the same time, along with glass beads. While the presence of occasional metal or glass artefacts may not seem to represent a significant cultural change, quite soon after their initial introduction parts of the region enter a period of rapid Indianization with the rise of trading states and urban settlements in the early centuries AD (Coedes 1975; Mabbett 1977).

An attempt at chronometric hygiene

Island Southeast Asia has produced very few radiocarbon-dated sites compared with adjacent regions such as Mainland Southeast Asia, the Pacific Islands and Australia (Bronson & Glover 1984: 37). The paucity of dates has led archaeologists, in pursuit of a skeletal cultural chronology, to accept uncritically almost any ^{14}C result. In Island Southeast Asia the first Neolithic dates run were by chance often surprisingly early (Ellen & Glover 1974; Peterson 1974; Spoehr 1973). Now that many more dates are becoming available, these early results appear questionable. It is both possible and necessary to examine anew the corpus of ^{14}C dates, as has been done for other regions where chronology is critical (e.g. Hassan & Robinson (1987) for Egypt), in order to assess their reliability, to weed out those which cannot be depended on, and to build a secure chronology with those that remain.

In addition to dates directly from Neolithic assemblages, there are dates available from pre-Neolithic levels of the same or related sites and from Metal Age assemblages, which allow us to bracket the Neolithic chronologically.

The sample and its selection

The sample of dates considered here totals 141. Twelve of these date Holocene forest clearance evidence from pollen cores, 18 relate to pre-Neolithic levels, and 13 have Metal Age associations (3 of these were rejected). This leaves 98 samples dating actual Neolithic assemblages, of which 21 have been rejected for various reasons. Setting these latter dates aside, a previously obscured pattern can be detected showing a north-to-south spread of Neolithic culture in the region. This pattern only has the status of a plausible hypothesis, however, because the number of securely dated early Neolithic sites is small. Some suggestion of support for the putative sequence is provided by correlation with linguistic evidence which shows a similar patterning in the direction of Austronesian language spread (Blust 1988). Radiocarbon dates from Manus in island Melanesia are included as relevant to the discussion.

The sample of radiocarbon dates (TABLE 2) does not include any samples on (usually human) bone. Major problems with dating bone have still not been resolved (Gurfinkel 1987; Hedges 1989; Stafford *et al.* 1987), and most of

fig. no.	lab. no.	raw date b.p.	material	calibrated date BP (intercepts)	site and context
Taiwan					
1	NTU-70	5340±260	charcoal	6409 (6179, 6140, 6112) 5771	Ch'ang Pin (aceramic)
1	NTU-69	5240±260	charcoal	6299 (5986, 5963, 5957) 5729	Ch'ang Pin (aceramic)
1	NTU-71	4970±250	charcoal	5983 (5729, 5680, 5676) 5337	Ch'ang Pin (aceramic)
1	Y-2638	4870±300	charcoal	5939 (5640) 5299	Ch'ang Pin (aceramic)
Radiocarbon 12(1) [1970]: 189–90; Chang 1969a.					
2	Beta-6159	5232±100*	marine shell	5704 (5594) 5476	O Luan Pi (Phase 1) (aceramic)
2	Beta-6727	5202±120*	marine shell	5679 (5573) 5439	O Luan Pi (Phase 1) (aceramic)
2	Beta-6725	3532±60*	marine shell	3467 (3404) 3352	O Luan Pi (Phase IV)
2	Beta-6726	2730±120	charcoal	[rejected: out of sequence]	O Luan Pi (Phase III)
Li 1983: 79–81.					
3	SI-1229	5892±55*	marine shell	6362 (6298) 6269	Pa-chia-ts'un (Tapenkeng culture)
Chang 1973: 525.					
4	NTU-244	4000±200	charcoal	4829 (4513, 4490, 4448) 4158	Ts'ao-hsieh-tun (Red corded ware)
Chang 1974: 271.					
5	GX-6997	3985±145	marine shell	4199 (3975) 3809	K'en Ting (Red corded ware)
Li 1981: 15.					
6	NTU-304	3937±70*	marine shell	3996 (3910) 3828	Niu Chou Tzu (Red corded ware)
Li 1983: 45.					
7	NTU-57	3840±380	charcoal	4835 (4264) 3710	Tung Chiao (Plain Red Ware, Early Ying-p'u)
Triestman 1972; *Radiocarbon* 12(1) [1970]: 189.					
8	NTU-201	3282±98	charcoal	3634 (3541, 3517, 3477) 3396	P'uli, 30, C-2 (Grey Black Ware, Later Ying p'u)
8	NTU-203	3207±96	charcoal	3559 (3460) 3360	P'uli, 30, G (Grey Black Ware, Later Ying p'u)
8	NTU-202	2994±90	charcoal	3346 (3211) 3044	P'uli, 30, D-2 (Grey Black Ware, Later Ying p'u)
8	NTU-200	2381±71	charcoal	2702 (2354) 2343	P'uli, 21, B-3 (Grey Black Ware, Later Ying p'u)
8	NTU-196	2197±66	charcoal	2329 (2301, 2260, 2179, 2159) 2126	P'uli, 21, D-3 (Grey Black Ware, Later Ying p'u)
8	NTU-195	2104±63	charcoal	2148 (2103, 2094, 2069) 2000	P'uli, 21, D-5 (Grey Black Ware, Later Ying p'u)
8	NTU-194	1846±55	charcoal	1864 (1814) 1717	P'uli, 21, C-4 (Grey Black Ware, Later Ying p'u)
8	NTU-193	1837±55	charcoal	1839 (1808) 1712	P'uli, 21, A-4 (Grey Black Ware, Later Ying p'u)
Chang 1974: 273; Stamps 1975: 88.					

fig. no.	lab. no.	raw date b.p.	material	calibrated date BP (intercepts)	site and context
9	Y-1630	2970±80	charcoal	3325 (3204, 3189, 3170) 3004	Ying-p'u ('Lungshanoid')
9	Y-1631	2810±100	charcoal	3049 (2934, 2904, 2893) 2789	Ying-p'u ('Lungshanoid')
9	Y-1632	2250±60	charcoal	2343 (2323) 2156	Ying-p'u ('Lungshanoid')
Chang 1969b: 265–6; *Radiocarbon* 11(2) [1969]: 639–41.					
10	Y-1580	3722±80*	marine shell	3726 (3632) 3545	Feng Pi Tou, lower shell mound ('Lungshanoid')
10	Y-1581	3322±80*	marine shell	3275 (3179) 3051	Feng Pi Tou, lower shell mound ('Lungshanoid')
10	Y-1649	3312±120*	marine shell	3319 (3167) 2969	Feng Pi Tou, lower shell mound ('Lungshanoid')
10	Y-1578	3192±80*	marine shell	3102 (2972) 2866	Feng Pi Tou, lower shell mound ('Lungshanoid')
10	Y-1584	3082±80*	marine shell	2938 (2841) 2756	Feng Pi Tou, lower shell mound ('Lungshanoid')
10	Y-1648	3082±60*	marine shell	2915 (2841) 2769	Feng Pi Tou, lower shell mound ('Lungshanoid')
10	Y-1577	2852±100*	marine shell	2731 (2674) 2442	Feng Pi Tou, upper shell mound ('Lungshanoid')
Chang 1969b: 265–6; *Radiocarbon* 11(2) [1969]: 639–41.					
11	Beta-4363	2820±110	charcoal	3103 (2942) 2789	Peinan, base of cultural layer
11	Beta-10984	2740±70	charcoal	2935 (2850) 2772	Peinan, charcoal in coffin
11	Beta-10983	2720±110	charcoal	2949 (2841, 2831, 2797) 2749	Peinan, middle of cultural layer
Lien 1985.					
12	NTU-55	3060±280	charcoal	3589 (3331, 3290, 3270) 2869	Chishivayan, Ch'i Lin, 'Megalithic Culture' (cf. Peinan Culture)
Radiocarbon 12(1) [1970]: 189.					
13	Y-1551	2850±200	charcoal	3325 (2957) 2759	Tapenkeng (Yuanshan culture)
13	Y-1498	2030±80	charcoal	2109 (1992) 1891	Tapenkeng (Yuanshan culture) (metal association?)
13	Y-1496	3080±350	charcoal	[rejected by excavator as too young]	Tapenkeng (Tapenkeng culture)
Chang 1969b: 265–6.					
Philippines					
42	Gak-10529	5840±140	charcoal	6849 (6721, 6708, 6677) 6484	Callao Cave, Luzon (aceramic)
Bronson 1984.					
43	Gak-7256	7830±170	charcoal	[rejected: suggested pottery association unlikely at that date]	Laurente Cave, Luzon
Meacham 1988: 102; W. Ronquillo pers. comm.					

14	Gak-9932	4260±380	charcoal	5319 (4852) 4347	Rabel Cave, Luzon
14	Gak-9929	4260±360	charcoal	5319 (4852) 4409	Rabel Cave, Luzon
14	Gak-9933	3690±310	charcoal	4513 (4079, 4023, 3994) 3629	Rabel Cave, Luzon
14	Gak-9892	3410±270	charcoal	4072 (3686, 3662, 3655) 3369	Rabel Cave, Luzon
14	Gak-9893	3130±220	charcoal	3619 (3369) 3049	Rabel Cave, Luzon
14	Gak-9896	2910±230	charcoal	3369 (3049) 2779	Rabel Cave, Luzon
Ronquillo 1981: 38; pers. comm.					
15	Gak-2938	5100±220	charcoal	[rejected: too early compared to other dates from same house floor]	Dimolit, Luzon
15	Gak-2937	3900±140	charcoal	4529 (4406) 4096	Dimolit, Luzon
15	Gak-2939	3280±110	charcoal	3680 (3519, 3477) 3389	Dimolit, Luzon
Peterson 1974.					
16	SFU-86	3240±160	charcoal	3683 (3468) 3278	Andarayan, Luzon
Snow & Shutler 1985: 145.					
16	RIDDL-? (AMS date)	3400±125	charcoal	3829 (3682, 3670, 3646) 3479	Andarayan, Luzon
Snow *et al.* 1986.					
17	Gak-2943	3880±240	charcoal	4809 (4402, 4372, 4347) 3979	Pintu Cave, Luzon (aceramic)
17	Gak-2942	3290±230	charcoal	3829 (3547, 3511, 3480) 3270	Pintu Cave, Luzon
17	Gak-2940	2260±150	charcoal	2359 (2328) 2073	Pintu Cave, Luzon (Metal Age)
Peterson 1974.					
18	Gak-7041	3040±130	charcoal	3389 (3263) 3049	Arku Cave, Luzon
18	Gak-7040	2740±120	charcoal	2969 (2850) 2759	Arku Cave, Luzon
Thiel 1980: 68.					
18	ISGS-495	2460±80	charcoal	2736 (2704, 2647, 2486) 2354	Arku Cave, Luzon
Thiel 1980: 68; *Radiocarbon* 28 [1986]: 102.					
18	Gak-7042	2390±160	charcoal	2739 (2356) 2213	Arku Cave, Luzon
18	Gak-7038	2010±90	charcoal	2100 (1959) 1873	Arku Cave, Luzon
18	Gak-7039	$6300\pm^{1600}_{1300}$	charcoal	[rejected: excessive standard deviation]	Arku Cave, Luzon
Thiel 1980: 68.					
19	M-728	2962±200*	marine shell	2939 (2736) 2459	Bato Cave 2, Sorsogon, Luzon
19	M-727A	2692±250*	marine shell	2729 (2345) 2069	Bato Cave 1, Sorsogon, Luzon
Fox & Evangelista 1957; *Radiocarbon* 1 [1959]: 196.					
20	Har-4808	5610±80	marine shell	6098 (5979) 5916	Bagumbayan, Masbate (aceramic)

fig. no.	lab. no.	raw date b.p.	material	calibrated date BP (intercepts)	site and context
20	Har-4805	3620±90	marine shell	3622 (3509) 3401	Bagumbayan, Masbate
20	Har-4806	3510±60	marine shell	3451 (3380) 3336	Bagumbayan, Masbate
Bay-Petersen 1982; 1987.					
21	L-274	2710±100	charcoal	2935 (2792) 2749	Batungan Cave 2, Masbate
Solheim 1968; Broecker *et al.* 1956: 164.					
22	Beta-1117	3470±235	charcoal	4083 (3815, 3795, 3721)	Edjek, Negros
Hutterer & Macdonald 1982: 213.					
23	Sua-258/1	4170±90	marine shell	4178 (4084) 3985 (Sua-258/1 and Sua-258/2 combined)	Kamuanan Cave, Talikod Island, Mindanao (aceramic)
23	Sua-258/2	3950±90	marine shell		
Solheim *et al.* 1979: 117.					
44	BX-2183	2950±250	charcoal	[rejected: cultural context unclear]	Banaue, Mountain Province
Maher 1974: 55.					
Palawan, Borneo					
24	UCLA-288	7000±250	charcoal	8039 (7789) 7579	Duyong Cave, Palawan (habitation) (aceramic)
Fox 1970; *Radiocarbon* 6 [1964]: 336–7.					
24	UCLA-994	5680±80	charcoal	6618 (6468) 6409	Duyong Cave, Palawan (habitation) ('aceramic Neolithic')
Fox 1970; *Radiocarbon* 8 [1966]: 478–9.					
24	UCLA-287	4630±250	charcoal	5639 (5320) 4879	Duyong Cave, Palawan (burial) ('aceramic Neolithic')
Fox 1970; *Radiocarbon* 6 [1964]: 336–7.					
25	UCLA-698	4482±80*	marine shell	4809 (4684, 4667, 4656) 4537	Guri Cave, Palawan (aceramic)
26	UCLA-992A	2840±80	charcoal	3074 (2952) 2858	Manunggul Cave, Palawan
26	UCLA-992B	2660±80	charcoal	2850 (2767) 2746	Manunggul Cave, Palawan
26	UCLA-992C	2140±100	charcoal	2319 (2135) 1999	Manunggul Cave, Palawan (Metal Age)
Fox 1970; *Radiocarbon* 8 [1966]: 478–9.					
27	GX-1428	3175±105	charcoal	3539 (3391) 3274	Niah Caves, Sarawak, Jar Burial 159
B. Harrisson 1968: 64; Harrisson 1974: 142.					

27	Grn-7204	3410±100	matting	3385 (3367) 3347	both Niah Caves, Sarawak, Burial 75 (no pottery in direct association)
27	Grn-7202	3080±40	wood		
Harrisson 1975: 162.					
27	Grn-1907	2695±65	wood	2855 (2782) 2755	Niah Caves, Sarawak, Coffin Burial 60 B–D
Radiocarbon 6 [1964]: 358–9; Harrisson 1959: 136–8.					
27	GX-721	2620±220			
B. Harrisson 1967: 166.					
27	Grn-1905	2700±70	charcoal	2865 (2787) 2756	Niah Caves, Sarawak, W2, Subsurface Ash 'Seal'
B.Harrisson 1967: 147; *Radiocarbon* 6 [1964]: 358–9; Harrisson 1959: 136-8.					
27	?	2300±80	wood	2354 (2341) 2207	Niah Painted Cave, Sarawak, Coffin (Metal Age)
27	?	2115±150	wood	2329 (2113, 2082, 2077) 1920	Gua Samti, Niah, Sarawak, Coffin (Metal Age)
Harrisson 1967: 96; 1971a: 70.					
27	Grn-1963	4280±70	Peat	[rejected: claimed by Harrisson (1959: 136-8) as coming from 'Niah Cave 12 ins.', 'Niah Cave Subsurface', and 'Niah Cave, Surface'. Actually from a pollen sequence in Marudi Swamp]	
27	Grn-1962	3860±55	Peat		
27	Grn-1960	2265±60	Peat		
Radiocarbon 6 [1964]: 367–8 and see text.					
28	GX-1807	2045±110	charcoal	[rejected. No artefact association]	Kota Batu, Brunei
Harrisson 1971b.					
29	ANU-5769	2700±110	charcoal	2935 (2787) 2749	Bukit Tengkorak, Sabah
29	ANU-6544	2870±80	marine shell	2730 (2688) 2492	Bukit Tengkorak, Sabah
29	ANU-5770	2330±170	charcoal	2714 (2346) 2149	Bukit Tengkorak, Sabah
29	ANU-5768	2320±250	charcoal	2749 (2344) 2049	Bukit Tengkorak, Sabah
Bellwood (above, pages 00–00).					
30	ANU-2396	2590±100	charcoal	2783 (2748) 2548	Agop Atas, Madai 1, Sabah
30	ANU-2943	2320±70**	fresh-water shell	2356 (2344) 2323	Agop Atas, Madai 1, Sabah (Metal Age)
30	ANU-2945	2020±100	charcoal	2119 (1985) 1870)	Agop Atas, Madai 1, Sabah (Metal Age)
Bellwood 1988a: 120.					
45	GX-?	7062±180*	marine shell	[rejected: pottery association not confirmed by subsequent excavations]	Balobok Rockshelter, Sanga Sanga Island, Sulu
Spoehr 1973: 111, 190.					
Java					
31	ANU-1520	2550±200	charcoal	2859 (2740) 2349.	Pejaten (Metal Age)
31	ANU-1519	1830±250	charcoal	2059 (1804, 1786, 1760) 1510	Pejaten (Metal Age)
48	ANU-1109	4370±1190	charcoal	[rejected: excessive standard deviation]	Leuwiliang (Metal Age)
Sutayasa 1979: 68–9.					

fig. no.	lab. no.	raw date b.p.	material	calibrated date BP (intercepts)	site and context
Sulawesi/Talaud Islands					
32	ANU-394	5740±230	charcoal	6847 (6609, 6590, 6539) 6299	Ulu Leang 1 (aceramic)
Ellen & Glover 1974: 376; Mulvaney & Soejono 1970.					
32	PRL-231	4390±110	charcoal	5257 (4980, 4915, 4889) 4859	Ulu Leang
Glover 1978: 93; *Radiocarbon* 19(2) [1977]: 229–36.					
32	Har-1734	4050±90	charcoal	4814 (4533) 4419	Ulu Leang
Glover 1979a; given with 5730 half-life in Glover 1979b.					
32	PRL-230	3550±130	charcoal	4072 (3844) 3689	Ulu Leang
Glover 1978: 93; *Radiocarbon* 19(2) [1977]: 229–36.					
33	ANU-1264	4880±480	charcoal	6189 (5642) 4979	Leang Burung 1 (aceramic)
Glover 1976: 138; John Mulvaney pers. comm.					
33	ANU-390	3420±400	charcoal	4239 (3689) 3218	Leang Burung 1 (aceramic)
33	ANU-391	2820±210	charcoal	3259 (2942) 2749	Leang Burung 1
Ellen & Glover 1974: 376; Mulvaney & Soejono 1970.					
34	ANU-1717	4860±130	marine shell	5309 (5210) 4959	Leang Tuwo Mane'e, Talaud (aceramic)
34	ANU-1515	4030±80	marine shell	4807 (4525, 4480, 4459) 4417	Leang Tuwo Mane'e, Talaud
Bellwood 1976: 261.					
Timor					
35	ANU-187	5520±60	charcoal	6406 (6307) 6291	Uai Bobo 2 (aceramic)
35	ANU-239	3740±90	charcoal	4249 (4130, 4115, 4091) 3983	Uai Bobo 2
Glover 1986: 167.					
35	ANU-414	3470±110	charcoal	3889 (3815, 3795, 3721) 3629	Uai Bobo 1
35	ANU-326	2450±95	charcoal	2739 (2701, 2658, 2479) 2350	Uai Bobo 1
35	ANU-237	2190±80	charcoal	2332 (2297, 2265, 2156) 2073	Uai Bobo 1 (Metal Age)
Glover 1986: 130.					
36	ANU-172	3545±120	charcoal	4057 (3839) 3689	Lie Siri
36	ANU-235	3530±90	charcoal	3968 (3835) 3695	Lie Siri
36	ANU-173	2660±110	charcoal	2869 (2767) 2739	Lie Siri
Glover 1986: 55.					
Manus					
54	ANU-3145	4290±100	charcoal	4981 (4862) 4657	Papitalai, Los Negros Island (aceramic)
54	ANU-3146	4360±70	marine shell	4572 (4503) 4409	Papitalai, Los Negros Island (aceramic)

55	ANU-3142	4610±90	marine shell	4881 (4830) 4787	Peli Louson, Manus (aceramic)
Kennedy 1983.					
56	ANU-2248	3900±100	marine shell	3989 (3860) 3722	Kohin Cave, Manus (Lapita)
56	ANU-2212	2310±120	charcoal	2469 (2343) 2159	Kohin Cave, Manus (post-Lapita)
56	ANU-2089	2070±120	charcoal	2298 (2050) 1890	Kohin Cave, Manus (post-Lapita)
56	ANU-2215	1910±190	charcoal	2100 (1868) 1617	Kohin Cave, Manus (post-Lapita)
Kennedy 1981.					
57	ANU-2155	2190±100	charcoal	2339 (2297, 2265, 2156) 2059	Site 9 (4) Sasi Ash, Lou Island ('Metal Age')
57	ANU-5398	2090±100	charcoal	2298 (2059) 1940	Sasi Site, Lou Island ('Metal Age')
57	ANU-3014	2070±80	charcoal	2141 (2050) 1941	Sasi Site, Lou Island ('Metal Age')
57	ANU-5399	2480±90	marine shell	2277 (2120) 2013	Sasi Site, Lou Island ('Metal Age')
57	ANU-4981	2300±100	marine shell	2026 (1899) 1800	Sasi Site, Lou Island ('Metal Age')
Ambrose 1988.					

* 412 years added to produce conventional radiocarbon age (after Stuiver & Polach 1977).
** 500 years taken off prior to calibration, calibrated using charcoal values.

TABLE 2. *Radiocarbon dates from Island Southeast Asia.*

the bone dates from this region were processed before there was full appreciation of contamination factors and the effects of rapid weathering of bone in tropical soils. Where bone and charcoal samples from comparable contexts are available, as at Niah Cave in Sarawak (Brooks *et al.* 1977; Harrisson 1976; *Radiocarbon* 1964: 359), the bone ages are usually significantly different – too young in some cases, unacceptably old in others (cf. Bellwood 1985: 256).

A cut-off point of 1800 BP has been used; by that time metal had spread throughout the more accessible parts of the region and external influences were effecting major changes in the local cultures. This is not to deny that isolated communities may have carried on for hundreds of years afterwards with lifestyle and technology not significantly changed. Our interest, however, is on the overall regional picture.

Calibration

All accepted dates (TABLE 2, FIGURE 2) were calibrated using the CALIB computer program (version 2.0) of Stuiver & Reimer (1986). For charcoal samples the 20-year values of Stuiver & Pearson (1986) and Pearson & Stuiver (1986) have been used, presented at one standard deviation with the intercept date or dates given in brackets. Marine shell samples use the values of Stuiver, Pearson & Braziunas (1986) with $\Delta = 0$ as the oceanic reservoir correction factor. This is recommended when no local reservoir correction figure has been calculated and is based on a generalized ocean model. Where necessary, ^{13}C adjustment for marine shell ages to an estimated value of $0.0 \pm 2.0\%$ has been made to allow calibration (cf. Stuiver & Polach 1977). For ease of reference in the text, calibrated ages are given by single dates presented as their intercept values rounded off to the nearest 100 years.

Fresh- and brackish-water shell

Twelve of the rejected dates were on various species of fresh-water or fresh-water/brackish-water shells where no environmental correction has been established to take account of the tendency of such shells to take up old carbon from dissolved limestone and other sources in rivers (TABLE 3). In Sulawesi, modern fresh-water shells in limestone areas have produced apparent ages of 1200–1500 years (Burleigh 1981; Mook 1981; *Radiocarbon* 1982: 246–7). Bellwood had two modern fresh-water shells from Sabah dated which gave results equivalent to an age of 500 years (1988a: 120). In southern China comparison of charcoal and fresh-water shell dates has shown a 1500-year difference (Huang 1985: 4–5). The rejected dates (TABLE 3) consist of three samples from the Yuanshan shellmound and three from Chih Shan Yen, both key Taiwanese Neolithic sites, and six from sites in the Cagayan Valley in northern Luzon (Philippines).

The Yuanshan and Chih Shan Yen samples are on '*Corbicula*' sp. shells which are found in fresh-water and brackish situations (they are described as 'semimarine' in the Yuanshan excavator's report: Chang 1969b: 212). The two sites are in an environment, the Taipei Basin, which has suffered several episodes of marine transgression and basin flooding in the mid to late Holocene (Chang 1969b: 210). Local conditions have thus gone from fresh-water to salt to brackish and back to fresh-water at various times during Neolithic and later occupation of the area, making environmental correction for the samples particularly difficult.

These dates have been commonly quoted for the beginning, at 4500 BP, of the Yuanshan culture, the Taiwanese culture most often compared with Neolithic assemblages from further south in Island Southeast Asia, and even in Micronesia and Melanesia (Bellwood 1985: 214, 224, 246–52; Thiel 1988: 126). Its dating is critical for an understanding of interaction between different areas of the region. The Yuanshan site is very similar in material culture to deposits at Tapenkeng on the west coast of the island (Chang (1969b: 213) describes differences as 'rather negligible'), but the basal date on charcoal at that site is only 3000 BP. Chang (1969b: 213) wondered why it took the Yuanshan culture 1500 years to spread from the Taipei Basin to the coast, a distance of only 15 km. If useful broad-scale comparisons are to be made between the Yuanshan culture and other cultures, it is necessary to know when it started with an uncertainty of something less than 1500 years!

The same problem affects the three samples from the near-by site of Chih Shan Yen; it has pre-Yuanshan culture levels with rice remains and evidence for domestic dog (Huang 1984), and may be ancestral to the Yuanshan culture.

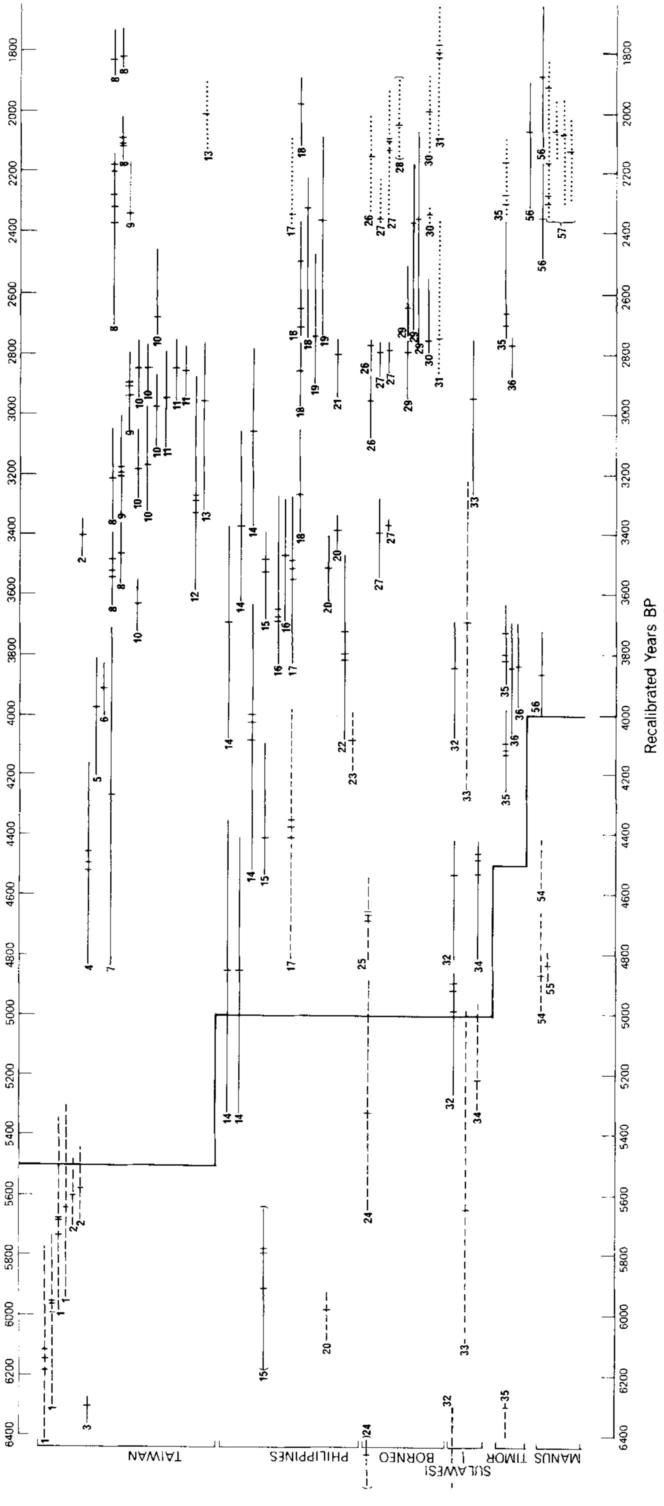

FIGURE 2. Island Southeast Asian calibrated radiocarbon dates in years BP.
Dashed lines indicate aceramic assemblages.
Solid lines indicate Neolithic assemblages.
Dotted lines indicate Metal Age assemblages.
Brackets indicate rejected dates.
Vertical solid line indicates suggested dates for the start of the Neolithic in particular areas.

lab. no.	raw date b.p.	species	site & context
Taiwan			
Y-1547	3860±80	'*Corbicula maxima* or *Corbicula subsulcata*'	Yuanshan Shellmound, 200 cm depth (Yuanshan culture)
Y-1548	3540±80	'*Corbicula maxima* or *Corbicula subsulcata*'	Yuanshan Shellmound, 120 cm depth (Yuanshan culture)
Y-1549	3190±80	'*Corbicula maxima* or *Corbicula subsulcata*'	Yuanshan Shellmound, 40 cm depth (Yuanshan culture)
Chang 1969b: 265; *Radiocarbon* 11(2) [1969]: 639–41.			
KSU-423	3640±100*	'Corbicula sp.'	Chih Shan Yen
Gak-10557	3145±110*	'Corbicula sp.'	Chih Shan Yen
Gak-10558	3080±110*	'Corbicula sp.'	Chih Shan Yen
Huang 1984: 81–2; Li 1983: 56.			
Philippines			
Gak-7048	3680±110	'Anadara sp.'	Lal-lo Shell Midden, Luzon (Neolithic)
Thiel 1989.			
?	3790±100	'Dallela sp.'	Lal-lo Shell Midden, Luzon (Neolithic)
?	3680±100	'Dallela sp.'	Lal-lo Shell Midden, Luzon (Neolithic)
Aoyagi 1983: 75–6; Aoyagi *et al.* 1986.			
Gif-1272	3550±110	'Cardium'	Magapit Bridge (Lal-lo vicinity), Luzon (Neolithic)
Radiocarbon 14(2) [1972]: 300.			
Gak-7044	4980±150	*Thiara scabra*	Musang Cave, Luzon (Neolithic)
Gak-7043	4110±130	*Thiara scabra*	Musang Cave, Luzon (Metal age)
Thiel 1980: 89.			

* Adjusted from 5730 year half-life given by excavator.

TABLE 3. *Rejected dates from fresh-water/brackish-water shell samples.*
Corbicula subsulcata *is more properly* Cyrenobatissa subsulcata *(Morton 1979; & pers. comm.).*

The Luzon fresh-water shell dates, even more critical, include:

1 One of the earliest claimed Neolithic dates from Island Southeast Asia, at Musang Cave (Thiel 1980; 1981: 133).
2 The earliest claimed metal in Island Southeast Asia, again from Musang Cave (Thiel 1980; 1981: 94).
3 All four early dates from the Lal-lo/Magapit shellmound and adjacent sites; they contain dentate-stamped pottery with the closest parallels to Lapita pottery designs yet found in Island Southeast Asia, which is claimed to be earlier than Lapita (Thiel 1988: 127).

The problem at Lal-lo of an unknown environmental correction (500 years? 1500 years?) is exacerbated by lack of agreement on the genus of shell actually being dated. The midden apparently consists of a single species (Aoyagi *et al.* 1986: plate 5d). One identification of dated shell was *Cardium*, a marine shell (*Radiocarbon* 1972: 300), while another was 'freshwater *Anadara* sp.' (Thiel 1989). All *Anadara* species are marine, however. The third identification of the shell was '*Dallela* sp.' I have not come across such a species, but there is a *Daliella*, a synonym of *Simpsonella* (Phil Colman pers. comm.). *Simpsonella* does not resemble the specimens illustrated by Aoyagi *et al.* (1986: plate 5d).

Much of the pottery at Lal-lo and Musang Cave is similar to red-slipped pottery from other Luzon sites. It is dated at Andarayan starting at 3700–3500 BP, at Arku Cave at 3300–2000 BP, and, less certainly, at Dimolit at either 4400 BP or 3500 BP. But the distinctive dentate-stamped pottery at Lal-lo, of interest for its Lapita resemblance, does not occur at these other sites. The date supposedly associated with the brass needle at Musang Cave is at least 1500 years too early in comparison with other Metal Age deposits.

Associations and disturbed deposits

This last, anomalous find raises a more general question: how reliable is the association between any particular radiocarbon sample and the cultural remains it is supposed to date? Thiel (1980: 48; in press) notes that the brass needle, of a small size, could have worked downwards from nearer the surface, and also that it was separated horizontally from the dated shell sample by over 2 m. In many other excavation reports not enough detail is provided to allow any judgement on the claimed associations, partly because only rarely is anything other than a preliminary report available for sites in the region. There are a range of questions here to do with how old the dated material was when it was deposited, what post-depositional disturbances have occurred, and what excavation standards prevailed.

It is always possible that charcoal in a site, or wooden artefacts such as coffins which were dated at Niah Cave, may be from trees which were some hundreds of years old when burned or brought into association with the cultural deposit. At Niah this possibility was appreciated by the excavator (Harrisson 1970: 40–1). This 'old wood' effect might be revealed as a date outside the general pattern, if sufficiently large numbers of dates have been processed. Generally not enough dates are available, but the early Javanese date of 2700 BP from Pejaten stands out from the Metal Age series and might be explained in this way.

Post-depositional disturbances are at least as common in tropical sites as elsewhere – unrecognized pits, grave fill incorporating earlier material from deposits into which the grave was dug, crab or rodent holes, and so on. Charcoal, bones and small sherds can easily filter down in loose sediments, producing spuriously old dates for particular cultural associations.

Claims of strikingly early dates for the first appearance of pottery in Island Southeast Asia need to be examined particularly critically with such processes in mind.

Early dates for pottery and the '"Nusantao" Neolithic'

Laurente Cave on Luzon has a claimed association of pottery with a date of 8600 BP (reported earlier by Meacham (1988: 102) as 8170–6390 BP), 3600 years earlier than any reliable pottery dates from that island. There is as yet no published report on the site, but the date sticks out like the proverbial sore thumb.

Much quoted is another supposedly early pottery association from Balobok shelter on Sanga Sanga Island in the Sulu Archipelago with a date of 7500 BP (Spoehr 1973: 111).

The excavator was cautious about accepting the validity of the association (Spoehr 1973: 190), suggesting the possibility that the sherds were deposited in a 'depression' unnoticed in excavation. He further noted that in subsequent (and still unpublished) excavations at the site pottery was confined to the top natural stratum (Layer I) with the exception of one square, and was encountered nowhere below 55 cm from the surface.

The site was dug in horizontal 20-cm levels; only when excavation was completed were the sloping natural strata recognized (Spoehr 1973: 109, 190). The excavator noted four sherds from the same or a lower depth than the dated sample in the adjacent square A^1. (Spoehr 1973: 191). No sherds at all were found in the 60 cm (three levels) above these, with 9 sherds coming from the top 10 cm of the deposit in the same square. This pattern, replicated in square B^1, suggests that pottery, originally deposited near the top of Layer I, has filtered down animal burrows or equivalent disturbances to concentrate at their base well into Layer II, hence the lack of sherds in the levels in between.

From some of Solheim's writings (1976: 37, Solheim *et al.* 1979: 117) it is possible to get the impression that *Tridacna* adzes and other shell tools were found in association with the early ceramic and pre-ceramic levels at Balobok. This is not the case: Spoehr (1973: 261) reports that several *Tridacna* adzes were found on or near the surface at various times and that in his excavation a polished *Tridacna* gouge was found near the base of Layer I. He also noted but did not illustrate three 'split sections of *Tridacna*, probably intended as tool blanks' in

Layer I and near the base of Layer II. There is no hint here of formal tools in early levels but at best one or two flaked pieces.

Solheim has used the Balobok shell, along with material from Duyong Cave on Palawan, and his own test excavation on Talikod Island near Davao in the Philippines to hypothesize a shell-tool-using aceramic 'Nusantao' people in Island Southeast Asia who received pottery from the north (maybe), but already had built up an early fully Neolithic culture (1976; 1988; Solheim *et al.* 1979: 116–17).

The part of Kamuanan Cave on Talikod excavated by Solheim yielded a date of 4100 BP, contemporary with pottery elsewhere in the Philippines. In the report Solheim *et al.* illustrate a few possibly flaked pieces of Tridacna, but there are none of the formal shell-artefact types which one might expect given the claims for a 'shell tradition' (Solheim *et al.* 1979: 111, 116–17, plates 28, 29).

Formal tool types were recovered at Duyong Cave on Palawan (Fox 1970: 53–66). Pottery was limited to the surface and the uppermost stratum, but a burial including 3 shell disc ornaments, four *Tridacna* adzes, a polished stone adze and shell lime containers was excavated beneath this stratum, producing a date of 5300 BP. A supposedly associated layer (Layer 3) yielded other shell artefacts and hearths, one of which was dated to 6500 BP. The suggestion was that important elements of Neolithic culture were present by 6500 BP, representing a pre-ceramic Neolithic.

The burial was dug into a layer (Layer V) which contained a small flake and blade industry and dated to 7800 BP. The burial date came from 'charcoal found in the grave fill' (Fox 1970: 60), the kind of context which Higham (1983: 231) in a consideration of Mainland Southeast Asian burial sites has judged 'valueless' because of the strong possibility of charcoal relocation from the earlier sediments into which the grave is dug. When the Duyong Cave burial fill sample was originally submitted for dating, Fox noted the possibility that the charcoal was intrusive from the *upper* layer of the site, the opposite kind of problem to that noted by Higham (*Radiocarbon* 1964: 336–7)! It was the radiocarbon age itself rather than any direct association with the burial which persuaded him the sample was *in situ*.

The burial pit also cut through a stratum (Layer III) less than 20 cm thick which was assigned to the 'early Neolithic' as well on the basis of its artefactual content: a *Tridacna* adze or gouge, a broken piece of a similar artefact and a number of shell ear ornaments. Supposedly associated with this layer were 'hearth-like areas of dense charcoal' (Fox 1970: 62) and it was one of these that produced the 6500 BP date. There appears, however, to have been no direct spatial association of the hearths with the artefact-bearing Layer III, and the excavator admitted difficulties of stratigraphic interpretation. Until the early radiocarbon age was produced, it was thought that the hearths were associated with the Metal Age assemblage of Layer I (*Radiocarbon* 1966: 478–9). Once again the date itself rather than clear stratigraphic association formed the basis for interpretation.

No other site in Island Southeast Asia has produced such early dates associated with shell adzes, ornaments and fully-polished stone adzes. Given the stratigraphic problems recognized only in part by the excavator it is necessary to reject the claimed association. Each of the three main sites on which the idea is based of a regional Neolithic culture, shell-tool-using and aceramic, presents significant problems of interpretation. At Balobok and Kamuanan there is no association between the dates and formal shell tools, only an association with *Tridacna* pieces which may have been worked. At Duyong the association between dating samples and artefacts has not been established, and the source of charcoal appears to be the older underlying deposits which are clearly not Neolithic. The lack of pottery in association with the single burial at Duyong Cave suggests only that pottery was not used there as a grave good, rather than that it was necessarily absent from contemporary cultural assemblages. The tragedy of Duyong Cave, but why we know there was only one early burial at the site, is that Fox excavated the entire cave deposit (1970: 54), as was common practice at the time, and so his work cannot be checked.

The Harrisson sites

Another largely self-taught archaeologist in charge of several of the most extensive excavations in Island Southeast Asia (notably Niah Cave) was the larger-than-life Tom Harrisson.

Like Fox he pioneered archaeology in a previously scarcely-known area and he was a brilliant publicist for the subject in raising government and private support for archaeological work. He should be remembered for this contribution, but to an even greater extent than was the case with Fox, there was a cost. He excavated a large part of the main deposit at Niah Cave and completely excavated several other sites. As Solheim (1977; 1983), Bellwood (1985: 257) and others point out, however, the claimed associations between radiocarbon dates and classes of artefacts or individual artefacts are often very difficult to substantiate at Niah.

Harrisson dug in arbitrary levels (generally 12 ins or 24 ins), while apparently taking no account of stratigraphy. His 1958 paper claimed there were no distinct strata at Niah (1958: 591) although these are clearly visible on photographs of the site (Solheim 1983: 42), and a major layer he does mention – a sterile pink-and-white band in the Pleistocene levels – seems never to have been used as a chronological marker. The same paper states that stratigraphic details were recorded, but there is no indication that they were ever used in interpreting the site's history, and all radiocarbon dates are only referenced to absolute depth.

Since Harrisson's death in 1975 the task of excavating his voluminous fieldnotes has barely begun, although Majid (1982) has attempted to unravel the pre-Neolithic parts of the Niah sequence, in part by small-scale excavations of her own at the site.

Another problem was Harrisson's increasing reliance on bone dates as excavation progressed. Radiocarbon ages for the site were rarely properly reported: laboratory number and even the material being dated were not always given. It has thus not yet proved possible to determine either the laboratory or the dated material for the earliest date from the burial cave of Lobang Jeragan near Niah which contained only Neolithic deposits (Harrisson 1971a: 69). If the date, of 4300±160 b.p., was on charcoal, it would calibrate to about 5000 BP, comparable with the earliest attested Neolithic dates from Luzon and Sulawesi. It is as likely, however, that the material dated was human bone, so it has been excluded from this study. Leaving aside this Jeragan date, the earliest clearly-associated date for the Neolithic of the Niah area is 3400 BP.

Those with some knowledge of the archaeology of the area might point to the 4040±70 b.p. date for a level supposedly sealing in the Neolithic deposits at Niah Cave, first reported by Harrisson in 1959 and quoted by every commentator on the site since that time. There is in fact no such date from Niah.

In 1959 Harrisson published a short paper reporting radiocarbon dates from Niah Cave including one from '12 ins.', one 'subsurface' and one 'surface', said to bracket the Neolithic occupation of the cave (1959: 136–8). These dates did not actually come from the main deposit but from 'related subsites' never discussed further by Harrisson. When they were published by the Groningen Laboratory in 1964 (*Radiocarbon* 1964: 367–8), 240 years had been added to each date as a correction (see De Vries & Waterbolk 1958 for the rationale). It was also clear that Harrisson had mixed up the laboratory numbers of two of the samples in his 1959 paper. These are minor points, because the 1964 Groningen date-list reports them as coming not from Niah Cave but from a peat swamp on the Baram River at Marudi near the Brunei border! The lowest sample was from 12 metres not 12 inches, 'subsurface' was instead 8 m, and 'surface' was 5 m. Harrisson clearly never noticed this discrepancy and continued to publish the dates (without the 240-year correction) as coming from his own site, as has every subsequent writer on Niah. Enquiries in 1989 with the Groningen Laboratory have confirmed that the dates were from the peat swamp, and the laboratory kindly forwarded a copy of the transmittal letter from G.E. Wilford, the geologist who submitted the samples.

How did this mix-up occur? Harrisson had submitted the samples through Sarawak Oilfields, a division of Shell. Wilford's work was being conducted in association with a palynological study by Brunei Shell Petroleum Company (Wilford, letter to De Vries, 21 January 1959). Perhaps three of Harrisson's samples were mislaid (B. Harrisson [1967: 147] even pinpointed where one supposedly came from in the Niah Cave site), and when he was sent the datelist by Shell, who had presumably commissioned all of the samples from the Groningen Laboratory, he assumed they must have all been his dates: 12 metres became 12 inches, and so on. We will probably never unravel the full story; once again critical dates for the Island Southeast Asian Neolithic have to be rejected, those which have been used to bracket the age of the Cemetery levels at Niah as well as the main West Mouth Neolithic deposits.

Other dating difficulties

Radiocarbon technology has advanced considerably since its first applications in the early 1950s, with new measurement techniques, better understanding of possible sources of contamination and more inter-laboratory checks for comparability (Polach 1987). It is clear that 1950s and even 1960s dates must always be treated with considerable caution.

There are also particular laboratories whose results appear anomalous compared to other laboratories during particular periods of their operation. In the Pacific and Southeast Asian area the Gakushuin laboratory in Japan stands out. Early-series Gakushuin dates wherever they occur seem odd – some appear to be too young, some too old. Others are probably correct, but which ones? Pull out the Gakushuin dates from the controversial Non Nok Tha Bronze Age site in Thailand and the sequence makes sense (Spriggs, in press a); pull out the Gakushuin dates for Eastern Polynesia and the sequence there falls into place (Kirch 1984: 73). There is no reason to believe that more recent Gakushuin dates in the Gak-7000 and later series are incorrect, but earlier-run dates such as those from Dimolit and Pintu in Luzon must be questioned. Dimolit, a key site for the early red-slipped pottery tradition of Luzon, is one of very few Neolithic sites in the region to have produced structural remains of houses (Peterson 1974). Three samples from the same house floor were dated by Gakushuin. One would expect fairly consistent ages. Yet the dates spanned the range 5900–3500 BP: an earthen house floor in use for some 2400 years? If we reject the earliest of the dates as being earlier than any well-attested Neolithic samples from the area, that still leaves a lengthy period of perhaps 900 years between the other two dates, although they do overlap at two standard deviations. The Pintu site (Peterson 1974) with its equivalent pottery would appear to confirm the later of the two Dimolit dates, and its own Metal Age date agrees closely with those from comparable contexts dated by other laboratories.

Very large standard deviations usually result from sample size being too small for a particular laboratory's equipment to measure properly and such samples must also be treated with great caution. Standard deviations of 1000 years or more for Neolithic and Metal Age sites render the results meaningless, as in the case of the earliest Arku Cave date from Luzon (Thiel 1980: 68) and the earliest Metal Age date from Leuwiliang on Java (Sutayasa 1979: 68–9).

Other dating problems in the region are generally those of inadequate reporting. For marine-shell dates it is often not reported whether they have been ^{13}C-adjusted, which makes a difference of over 400 radiocarbon years. It is sometimes unclear if samples are presented using the 5568- or the 5730-year half-life. Some shell samples have been given oceanic reservoir corrections which can themselves vary according to laboratory. On occasion the material being dated is not stated and/or the dating laboratory is not identified. Commentators use various kinds of calibration to calendar years (all now superseded by those reported in the 1986 issue of *Radiocarbon*), and often do not reveal which calibration has been used, nor even that they have calibrated the original radiocarbon age. One finds also that the calibration tables have sometimes been misread. Dates are wrongly quoted from the original source, or the claimed artefactual association with the date misrepresents the original excavation report. Commentator then quotes commentator rather than referring to the original sources, and the errors are compounded. It would be invidious to name names at this juncture, but all of the above problems can be encountered in the archaeological literature of the region.

Attempts to compile date-lists, such as those of Smith (1979), Bronson (1984), Bronson & Glover (1984), and the one presented here, are almost a thankless task given these problems, and errors are inevitable. One can write to the dating laboratory in question for clarification, but some have gone out of business, such as the Michigan laboratory which dated the Bato Caves, or they fail to reply to enquiring letters even when one offers to pay for the data retrieval required.

Stricter criteria for accepting individual dates, such as those used by Williams (above, pp. 510–21) in her study of the Mesolithic–Neolithic transition in the British Isles would exclude probably the vast majority of the dates reported in TABLE 2: a cure to problems of chronometric hygiene certainly worse than the disease at this stage of our knowledge of Island Southeast Asian prehistory.

Dating the spread of the Island Southeast Asian Neolithic

The positive result of this study is its clear indications of a spread of Neolithic culture from the north (Taiwan) to the south and east (Timor) over a period of about 1000 years (FIGURE 2). Leaving aside Taiwan for the moment, the earliest Neolithic sites in the region date to about 5000 BP and they occur thinly-spread throughout the region perhaps as early as 4500 BP and certainly by 4100 BP. Further east, the earliest Lapita-associated Neolithic sites in the Bismarck Archipelago are dated to 3900–3500 BP (Gosden *et al.*, above, pp. 561–86; Spriggs in press b).

Ellen & Glover foreshadowed such a result in 1974, but at the time their Island Southeast Asian sample consisted of only eight dates (Ellen & Glover 1974: 376). It is pertinent to note that five of their original dates have had to be rejected here for various reasons, and the other three are also somewhat questionable, as discussed in the text!

Taiwan

The Taiwan situation requires some comment. The earliest Neolithic sites on the island are assigned to the Corded Ware or Tapenkeng Culture (Chang 1969b). There is, however, only a single date for an early Corded Ware site, Pa-chia-ts'un at 6300 BP (Chang 1973: 525). The next-earliest pottery-associated date is 4500/4400 BP, later than Neolithic dates for Luzon, Talaud and Sulawesi. Other developed Corded Ware sites date to the period 4000–3500 BP. Can we accept the single early date? There is certainly considerable Neolithic 'action' prior to 4500 BP, but how long a period does it represent?

What is certain is that in southern Taiwan there is a range of sites with non-specialized flake tool assemblages, seen as 'Palaeolithic survivals' by their excavators. The sites at Ch'ang-pin (Chang 1969a) and O Luan Pi (Li 1983) give consistent dates down to 5600 BP, suggesting at least that Neolithic culture was not universal on the island by that time. One might conclude that Taiwan's Neolithic goes back to around 5500 BP and perhaps back to 6300 BP.

The earliest Neolithic sites in Luzon and Sulawesi go back to 5000–4900 BP, with other dates around 4500 BP. If we derive these Neolithic assemblages from Taiwan, then the donor culture can only be the Corded Ware culture. There were certainly later continuing contacts between Taiwan and Luzon, particularly associated with the Yuanshan culture (Aoyagi & Tanaka 1985; Bellwood 1985: 214, 224; Koomoto 1983), but the question is open as to which way cultural influences might have been going at that time – particularly if the Yuanshan culture began around 3000 BP rather than 4500 BP.

Corded Ware assemblages on Taiwan comprise: cord-marked pottery with incised, everted rims and occasional lug handles and ring feet; quadrangular polished stone adzes, some stepped; polished slate points; stone net sinkers; and one example of a stone barkcloth beater (Chang 1969b). Pollen-core evidence suggests forest clearance in the centre of the island about 4800/4700 BP (Tsukada 1966), and rice remains have been found in the late Corded Ware site of K'enting dating to 4000 BP (Li 1981).

Luzon and Selawesi

The earliest dated Neolithic sites outside Taiwan are Rabel Cave in Luzon and Ulu Leang 1 in Sulawesi. Rabel is a frequentation cave which has produced a consistent sequence of dates between 4900–3000 BP, but only the rather undistinguished flaked-stone assemblage has been reported in print (Ronquillo 1981). Pottery occurred throughout the deposit (W. Ronquillo pers. comm.). Ulu Leang 1 is one of the sites which demonstrates a pre-Neolithic to Neolithic transition, occurring about 5000 BP (Glover 1976). The earliest pottery in this frequentation shelter consisted of plain globular cooking pots with everted rims. Leang Tuwo Mane'e in the Talaud Islands between Sulawesi and the Philippines shows a sequence from a pre-Neolithic assemblage dated at 5300 BP to an assemblage of plain and red-slipped globular pots and bowls dated at 4500 BP and later (Bellwood 1976: 255–67).

East Timor

Further south, in East Timor, the earliest Neolithic assemblages (also from frequentation caves) have produced dates of 4100 BP for Uai Bobo 2, 3800/3700 BP for Uai Bobo 1 and 3800 BP for Lie Siri (Glover 1986). In all cases, pottery continued some way below the dated material. Glover compared the plain and red-slipped pottery to that from the Leang Tuwo Mane'e site. The Timorese sites also produced a range of introduced animals which *may* be associated with the introduction of pottery. The qualification is necessary because of localized stratigraphic disturbance, filtering down of small bones, and so on. The marsupial *Phalanger* was introduced from Maluku or New Guinea, possibly by about 6000 BP, but the pig, civet cat, Macaque monkey and *Rattus exulans* are all pottery-associated or occur from levels immediately pre-pottery. The dog and sheep or goat appear immediately prior to the introduction of metal (Glover 1986: 199, 204–5, 219–22). Pierced shells as ornaments occur below pottery-bearing levels, but pierced shell disks, *Trochus* shell armbands, other shell bead types, a shell fish-hook and a *Tridacna* adze all have a Neolithic association although they are not all found in the earliest Neolithic levels (Glover 1986: 117–18, 151–3, 187–90).

Other sites

Similar plain or red-slipped pottery assemblages, hand-moulded or coiled in construction and finished by paddle and anvil are common throughout Island Southeast Asia, dating to 3700 BP (with rice) at Andarayan, 3500 BP at Pintu, 3300 BP at Arku Cave and poorly-dated or undated at Dimolit, Lal-lo and Musang (also on Luzon), 3500 BP at Bagumbayan (Masbate), and 3800/3700 BP at Edjek (Negros) (for references see TABLES 2 & 3). They are associated with a range of other material culture including flaked stone assemblages, polished stone adzes and various types of shell ornaments. Comparable assemblages come from undated sites on Palawan, Borneo and Sulawesi. The latest date for a pre-Neolithic assemblage on Palawan comes from Guri Cave at 4700 BP, but the earliest pottery-associated date from the Island is 3000 BP (Fox 1970). There are typologically earlier but undated pottery assemblages from burial caves on Palawan associated with stone and shell ornaments. For Niah Cave no pottery is definitely dated prior to 3400 BP and no internal chronology is available for the Neolithic, so it is difficult to know when the burial-associated complex pottery vessels forms first appear. There is some evidence for the presence in the Neolithic of the dog and domestic pig (Medway 1973; 1977; Cranbrook 1979), and a large range of stone, bone and shell ornaments as well as polished quadrangular stone adzes certainly made their appearance in Neolithic levels (Chin 1980: 9–10). In northern Sulawesi an undated open site at Paso produced comparable pottery to Leang Tuwo Mane'e but with a wider range of vessel forms. The excavator also noted close parallels with the Dimolit and Lal-lo assemblages (Bellwood 1976: 250–3).

Pottery sequences

Where pottery sequences are available in the region, elaborate decoration by incising or stamped-impression occurs later than the appearance of plain or red-slipped wares. This is the case in the Timorese sites (Glover 1986), Bukit Tengkorak (Bellwood & Koon below, pp. 613–22) and Madai 1 in Sabah (Bellwood 1988a), and the Palawan sites excavated by Fox (1970). The most elaborate vessels tend to be from Metal Age contexts (Bellwood 1985: 304–17). There are few reliable dates associated with such assemblages. In the Uai Bobo 1 site in Timor the decorated pottery is Metal Age in date, after 2300/2200 BP, while at Lie Siri it occurs mainly in a level dated in one part of the site to 2800 BP or after (Glover 1986: 55, 67, 131).

Although Fox (1970: 109–19) claimed that dates of 3000 and 2800 BP from subsurface hearths were associated with elaborate burial jars at Manunggul Cave Chamber A on Palawan, no details were presented in the publication which would allow verification of the association. Indeed, many of the burial jars were found on the cave surface (1970: plate X). Bellwood (1988a: 248) implies that these vessels are actually Metal Age by comparison with his very similar Madai material. There is a dated Metal Age assemblage from the adjacent Chamber B of Manunggul. The artefact assemblages of the two Chambers, with metal and glass only in B, do support the idea that the Chamber A burial jar assemblage is older. The closest dating possible, however, is to use the Chamber A subsurface dates as a *terminus post quem*. The decorated pottery was therefore deposited sometime between 3000 and 2100 BP.

At Bukit Tengkorak and Madai decorated vessels come in about 2300 BP. In open sites near Kalumpang in central Sulawesi large assemblages of similar pottery have been found with stone adzes, ground slate projectile points, a barkcloth beater, and stone 'reaping knives' but they have never been dated. It is likely that they are late Neolithic in date (van Heekeren 1972: 184–190; Stein Callenfels 1951).

Lapita pottery affiliations

The pottery assemblage which has always stood out by its suggested parallels with Lapita decoration is that from the Batungan Caves on Masbate (Solheim 1968). Cave 2 was dated to 2800 BP, but the excavator believed that the Cave 1 assemblage was earlier on typological grounds. The Lal-lo site, with parallels to Lapita and Batungan, has no acceptable dates (p. 600 above). Taiwanese pottery assemblages, from the early Cord Marked wares onwards, include decorated vessels of various kinds, although the Yuanshan pottery which shows most parallels to the decorated assemblages discussed above may be late, from 3000 BP onwards.

It is, therefore, significant that Lapita assemblages from the Bismarck Archipelago have the highest percentage of decorated vessels in their earliest levels, and the trend over time is for less decoration (Gosden *et al.*, pp. 561–86 above). While preserving Southeast Asian vessel forms and the presence of red-slipping, as well as other items of Neolithic culture, the florescence of Lapita decoration occurred while the Island Southeast Asian pottery assemblages were still predominantly undecorated. The suggestion has been made (Green 1979) that the Lapita design system, originally present further west on other media such as barkcloth and tattoo, was only transferred to pottery in the Bismarcks. If this is accepted then two alternative explanations can be suggested for the later appearance of related designs on Island Southeast Asian pottery: either a similar media transfer occurred independently but later in Island Southeast Asia, or there was continuing contact with and influence from the Lapita culture to the east.

Direct evidence for such contact, starting about 2800 BP, is given by the presence at Bukit Tengkorak of obsidian from Talasea in the Lapita heartland of New Britain (Bellwood & Koon, below, p. 620). The unique elaborately decorated stamped-impressed vessel from the base of that site includes a complex Lapita-related design. As well as motif similarities, a range of later Southeast Asian Neolithic sites also share with Lapita the technique of lime-infilling of the decoration, particularly of impressed circles. This technique is known from Batungan and Lal-lo as well as other undated contexts in Palawan, Samar, Sanga Sanga, Sarawak and Sulawesi (Fox 1970: 85; Gridley 1972: 65; Solheim 1968: 37; Solheim *et al.* 1959: 175; Spoehr 1973: 186–7; Stein Callenfels 1951: plate XIV; Thiel 1988: 124). Decoration parallels have also been drawn with assemblages in the Marianas Islands in Western Micronesia where earliest settlement dates to about 3400–3200 BP (Bonhomme & Craib 1987).

A final example of contacts across a wide region of Island Southeast Asia after the beginning of the Neolithic is the 'event' which actually marks its end: the spread of metal throughout the region, including into the Bismarck Archipelago (Ambrose 1988), from an external source to the north either in China or mainland Southeast Asia. There is a single early date of 2700 BP for metal in Java mentioned earlier but elsewhere in the region metal appears late and almost instantaneously: in late Yuanshan contexts in Taiwan sometime prior to 2000 BP, at 2300 BP at Pintu Shelter in Luzon (in this case glass beads rather than metal), 2100 BP in Manunggul Cave in Palawan, 2300 BP at Niah (Sarawak) and Madai 1 (Sabah), 2300/2200 BP at Uai Bobo 1 in East Timor, and 2300–2100 BP on Lou Island in Manus (for references see TABLE 2).

The overall archaeological picture

What picture emerges from this examination of dated sites? A rapid spread but spotty distribution of the Neolithic occurs, from Taiwan to Timor, before 4100 BP. Assemblages include pottery in a range of vessel shapes but, apart from Taiwan's cord-marked ware, there is little decoration other than red-slip. Other features are quadrangular polished-stone adzes, shell ornaments, some association with domestic animals and increased forest clearance; rice, in Taiwan by 4000 BP and in Luzon by 3700 BP, is not yet attested anywhere else. This crop never did reach the Bismarck Archipelago where similar Neolithic assemblages occur, the Lapita Culture.

A fairly homogeneous Neolithic culture (with some regional variation to be sure) was established in Taiwan by 5500 BP, in Luzon and Sulawesi at 5000 BP, in Timor by 4100 BP, and in the Bismarck Archipelago by 3900–3500 BP. The New Guinea mainland appears to have been avoided and has its own independent Neolithic trajectory, although links with adjacent areas will doubtless be found. The Neolithic sites of the region are either in easy reach of the coast or along major rivers. Communities from one end to the other in this network were in down-the-line contact for a further 2000 or so years, witnessed by the distribution of New Britain obsidian, changes in pottery style over wide areas, and the almost instantaneous spread of metal across the region. While there were increasing regionally-specific emphases, rice in the north for instance, material culture, economy and perhaps social organization were quite similar throughout the region. Set down in a settlement on Taiwan, Timor, Manus and perhaps even Tonga in 3000 BP one would find oneself in the same cultural milieu. All that changed after about 2000 BP. The cultures of the Island Pacific and Island Southeast Asia diverged rapidly after that time, and their later archaeologies look very different.

Linguistic correlation

Languages have not yet been mentioned but if we do attempt to marry the two different databases after each has been examined independently, then their congruence becomes immediately evident for the region, as Bellwood has long pointed out (1985; 1988b). The two major linguistic entities are the Austronesian languages (AN) concentrated in Island Southeast Asia and Island Melanesia, Polynesia and Micronesia, and the Papuan or Non-Austronesian languages (NAN) concentrated on the island of New Guinea (Blust 1988; Foley 1980; 1986; Pawley & Green 1973; 1984; Tryon 1984). If a map of major AN sub-groups with an understanding of the sequence of language splits from Proto-Austronesian is put down over a map of the spread of the Neolithic in the region, it fits almost perfectly (FIGURE 1).

If we allow a link between the spread of Neolithic Culture and AN languages (and no convincing alternative explanation exists for the distribution of these languages, cf. Bellwood 1988b: 112), we can also hazard guesses for the dating of the break-up of Proto-Austronesian and subsequent stages. The basis for age estimates in Blust's recent attempt (1988) is nowhere discussed in detail; they appear to be too early. Revised estimates based on the dates presented in this paper will therefore be given.

Blust (1988: 47–54) locates Proto-Austronesian as being spoken on Taiwan. It split into a Formosan and a Malayo-Polynesian grouping with movement south to the Philippines about 5000 BP (Blust, 6500 BP). Proto-Malayo-Polynesian broke up into Western Malayo-Polynesian and Central-East-Malayo-Polynesian with the move from Sulawesi across to northern Maluku at around 4500 BP or slightly earlier (Blust, 5500 BP). Since no site has been excavated in northern Maluku, this phase cannot be directly correlated with archaeology.

The next linguistic split, the break-up of Proto-Central-East-Malayo-Polynesian into Central and East Malayo-Polynesian groups, occurred with movement to the east, probably centred on the islands in Cenderawasih Bay off West New Guinea, and a spread to the south through Maluku and the Lesser Sunda Islands including Timor. No radiocarbon dates have been produced from any archaeological site in the eastern area, but the earliest Timor dates suggest a time around 4500-4250 BP (Blust, 5000 BP).

Proto-East Malayo-Polynesian split into two groups, South Halmahera-West New Guinea and Oceanic, with a movement from Cenderawasih Bay to the Bismarck Archipelago around 4000 BP (Blust, 4500 BP). Ross (1988: 19–21, chapter 10) has argued that the Proto-Oceanic homeland was centred in an area of New Britain which includes the Talasea obsidian quarries. Rapid population spread between 5000 and 4000 BP led to high rates of linguistic change, but Blust also noted that 'Proto-Oceanic retained a large proportion of the basic vocabulary inherited from Proto-Malayo-Polynesian (perhaps 70%)' (1988: 58).

Subsequent movements led to Oceanic-group AN languages being spoken over most of Island Melanesia, Polynesia, east and central Micronesia and in some (generally coastal) areas of the eastern part of New Guinea (Ross 1988). Western Micronesia (Marianas, Belau) derived its languages from a Western Malayo-Polynesian source, presumably in the Philippines (Blust 1988: 56).

New Guinea's independent and early Neolithic development is witnessed by its distinctive Papuan or NAN languages. What languages may have been spoken in Island Southeast Asia prior to AN and Neolithic expansion are unknown. The presence of NAN outliers in Eastern Indonesia possibly represents a late expansion from New Guinea (cf. Foley 1980: 77), whereas the presence of such languages in the Bismarcks and Solomons more certainly represents a pre-AN but probably agricultural presence which is attested archaeologically (Allen *et al.* 1988; Wickler & Spriggs 1988). Beyond the Solomon Islands initial settlement was by AN-speaking populations.

Conclusions

What drove this AN and Neolithic expansion on? Bellwood (1988b) has stressed rice agriculture, but the expansion does not slow when it goes beyond the areas where rice agriculture was attested in early historic times (Spencer 1966). It was an agricultural economy rather than the specific crop which gave the population advantage, the necessary demographic muscle relative to the hunting and gathering populations of the region. One to two thousand years is certainly long enough for rapidly growing agricultural populations to have maintained an onward momentum from Taiwan to Tonga (cf. Bellwood 1988b: 114–16). They initially avoided a perhaps heavily-populated and already-Neolithic New Guinea mainland and for similar reasons never established more than a few enclaves on the mainland of Asia. The reasons why Australia formed an impenetrable barrier to the south may have been ecological and/or demographic.

This is not to say that these AN farmers blanketed Island Southeast Asia with their settlements in one go. Large inland areas not on major river corridors may have remained unutilized by them, inhabited by hunter-gatherers at low population densities for millennia after AN expansion. The interiors of islands with fully-wet tropical rainforests would have been difficult environments for early agriculturalists to pioneer. Examples would include parts of Sumatra, West Java, Central Sulawesi, parts of Luzon and much of Borneo and Mindanao (see map in Glover 1977). Similarly it has by no means been established that the whole of New Guinea and its adjacent islands were completely settled by agriculturalists soon after 9000 BP.

More than 20 years ago, Solheim (1967) likened the spread of Neolithic Culture in Island Southeast Asia and the Pacific to that of the Danubian I farmers across Europe; he suggested little competition between the assumed slash-and-burn farmers and the already-present hunting and gathering populations. Renfrew (1987) has recently argued for a strong link between the spread of Indo-European languages and the expansion of agriculture in Europe, even bringing in a few Pacific analogies. Given the various criticisms of Renfrew's ideas (for instance in *Antiquity*, September 1988), it seems that such linking models have considerably greater explanatory power for the situation in Island Southeast Asia than they do for Europe. It is to be hoped that this is not only because the prehistory of Europe is more fully researched.

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'Lapita colonists leave boats unburned!' The question of Lapita links with Island Southeast Asia

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'Not another trendy and incomprehensible title,' some will sigh. No, the title means what it states, albeit with metaphorical flourish. The Lapita cultural complex of Melanesia and western Polynesia, an entity beloved of a generation of Pacific prehistorians and ever a hot source of debate, can now be shown to have retained at least some links with contemporary populations far to the west of its known distribution. This is significant, not least because

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