Agriculture, Hydraulics, and Urbanism at Satingpra

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From the early 1970s through 1982, Stargardt investigated an extensive complex of hydraulic works and other sites (e.g., Stargardt 1973b, 1976, 1977) that occupy the Satingpra peninsula on the east coast of the isthmus of the Malay Peninsula (Fig. 1). This volume, the first of three, emphasizes the area’s agricultural base. *Satingpra II, The Culture and Chronology of the Satingpra Complex, South Thailand,* will describe the sites (p. 30); *Satingpra III, The Regional Context of the Satingpra Civilization* will provide a regional perspective (pp. xxiii, 24).

The current work is introduced (p. xxi) as “a first attempt, not only for Thailand, but for South East Asia as a whole, to devote a sustained study to the environment and the economy of an early historic civilization.” Stargardt claims that the Satingpra peninsula was characterized after the fifth century B.C. by “extensive ricelands” (p. 19), which, irrigated and drained by a canal and tank network, produced “considerable rice surpluses” that stimulated trade (p. 7) and, by A.D. 500, urbanism (p. 20).

**SYNOPSIS**

Part I, “Satingpra and the Isthmus of the Malay Peninsula,” discusses environmental influences on early settlement in the area (chiefly diverse resources and, it is suggested, a broad alluvial plain), surveys published evidence for early trade, and introduces a topical settlement model. “It would seem that the rising surpluses in agricultural yields as well as a heightened reliability in the harvests were the principal
features of the economic background which led to the development of urbanized settlement at Satingpra by the beginning of the 6th century” (p. 20).

The results of urban site excavations include two radiocarbon dates: A.D. 835 ± 50 (an attack on the city), and A.D. 885 ± 50 (its refoundation). Ten thermoluminescence dates (A.D. 1040 ± 80 to 1280 ± 60) were obtained from Kok Moh kiln. The excavation results emphasize dateable tradewares, which solidly dominate the evidence after c. A.D. 100. The 14C dates define the end of (“Mon-Khmer”) Urban Phase I and the beginning of (“Srivijayan”) Urban Phase II (p. 36). Urban Phase III, when trade declined, ended c. A.D. 1350. Although no agricultural areas were apparently excavated, a detailed chronology (Table 2a: Chronology and Cultural Sequence) describes agricultural and other developments at Satingpra from 4000 to 630 B.P.

Part II, “The Natural Environment and the Pattern of Ancient Settlement,” describes the area’s soils, poor surface drainage, and seasonal flood/drought regime and briefly introduces beach ridge formation, which is responsible for much of the Satingpra peninsula. Economic forest plants and indigenous and naturalized plants observed on the Satingpra peninsula are itemized.

Pollen data are summarized for coring localities in three urban canals. The earliest
samples, predating canal construction, contain salt-tolerant species including 47 percent nonpioneer mangroves. Mangroves decrease as freshwater swamp occupants appear, in very low numbers. The canal bed contains no pollens; postabandonment silts are dominated by salt-tolerant *Suaeda* (50 percent) and by Gramineae (15 percent, including rice) and *Borassus* (sugar palm, 10 percent, grown traditionally in the area). G. Thanikaimoni, the project palynologist, describes (pp. 223–224) an initial lagoon; traces in the area of lowland monsoon forest that also supported certain freshwater species; and, later, mangrove clearance. Freshwater swamps were reclaimed for rice cultivation; cleared mangrove areas degraded into *Suaeda* swamps.

Part III, “Rice and the Ancient State,” chronicles local agricultural/hydraulic developments: (a) prehistoric mangrove clearance (from c. 4000 B.P.); (b) Stage 1/nonintensive riverine agriculture (2500–2200 B.P.); (c) Stage 2/selection of adaptable grains (2200–1900 B.P.); (d) Stage 3/construction of pondfields, with bunds planted in *Borassus* and ditches for flood control (1900–1700 B.P.); (e) Stage 4/final mangrove clearance, and agricultural well and tank construction (1700–1500 B.P.); (f) Stage 5/increasing harvests (1500–750 B.P.); (g) Stage 6/return of most fields to rainfed cultivation, with decreasing *Borassus* cultivation (700–400 B.P.); and (h) Stage 7/maintenance of some “archaic” fields to the present. Traditional fields are described.

Increased harvests supposedly stimulated settlements at the citadel, Wat Sri Yang, and Wat Chedi Ngam (p. 252 n.15). During Stage 5 (Urban Phases I and II), “all the great canals were built over a period of some seven hundred years and well maintained up to the mid-13th century.... The area under cultivation expanded dramatically... to cover all of the arable lands on the Satingpra Peninsula” (p. 82).

Thirty-four traditional rice strains are compared (pp. 88–107) with possible ancestral rices, and closest relationships with *indica* rices are suggested. Nine subsidiary cultivars are analyzed, and an excellent summary of the uses and cultivation of the sugar palm provided.

Very large population sizes are suggested (pp. 121–123): the pre-urban figure is 59,988, more than twice as large as that indicated for fifteenth-century Melaka, at the height of its prosperity (e.g., Anderson and Vorster 1976); a Phase II population of three-quarters of a million is suggested.

Part IV, “Man, Land and Water: The Ancient Hydraulic System,” reviews tank and canal construction, types and numbers, use and maintenance techniques, and claimed dates. Water volumes are discussed and rice hectarage projected. Of 362 tanks defined on aerial photographs (p. 134), 200 medium and large tanks were surface-surveyed, and 20 cored; apparently no small tanks were surface-surveyed. All sizes occur in settlement clusters, but the author admits that tanks “are very unevenly distributed over the ancient cultivated area” (p. 145). Coring results are discussed for Phang Sai Man, a large urban tank; the stratigraphic record here is said to agree with that for “tanks in the more remote parts of the hydraulic system” (p. 139). Schematic core profiles are presented and stratigraphy discussed for three main canals.

Part V, “Ancient Water Technology and Society in Regional Perspectives,” synthesizes information concerning early hydraulic networks in south India, Sri Lanka, Burma, Kampuchea, Viet Nam, Bali, and Java, emphasizing areas that are, like Satingpra, subject to droughts but also correlating Satingpra’s canals with the
canals that cross the Trans-Bassac lowlands, between the Mekong Delta and the Gulf of Siam. Features ancestral to Satingpra's are apparently sought.

**REVIEW**

Stargardt's ideas are, as always, interesting. She writes enthusiastically, synthesizes certain art historical information, uses a wide range of botanical information, and promotes the application at historic-era sites of stratigraphic excavation and botanical studies. But serious errors weaken her main thesis.

Perhaps because few or no data are as yet available for the agricultural contexts that are central to the thesis, theoretical chronological models are presented as facts. These models are repeated and used to reinforce other models, making it imperative that every word be read carefully, every conclusion reevaluated repeatedly.

Compelling evidence for dramatic coastal change over the period discussed is missed. And abundant evidence for the prominence of exchange is underrated in the local economic scheme.

This review introduces geoarchaeological evidence that suggests that floodplain agriculture is unlikely to have brought about Satingpra's urbanization because this type of agriculture was not possible in the area until after Satingpra was urbanized. Based on Stargardt's evidence, exchange, not floodplain agriculture, stimulated urbanism at Satingpra.

Several of the most serious problems are discussed below in terms of five areas of concern: (a) production, (b) use of appropriate literature, (c) environmental research, (d) interpretation of evidence, and (e) explanation of culture process.

**Production**

Organizational and cartographic errors make the volume difficult to read and use: e.g., numerous unnecessary repetitions; mathematical errors; unwieldy and redundant notes; lack of a reference list; and figures that obscure the author's thesis. Figural errors include missing scales (Figs. 10, 12, 21, 22); inconsistent scales (compare Figs. 6 and 8, 16 and 18, 27 and 33); missing north arrow (frequent); confusing information (e.g., arrows in Fig. 3); meaningless or missing legends (Figs. 2, 15, 17, 23, 26b, 29–31, 55–57, 63–65); and incomplete coverage (e.g., missing settlement pattern information in Figs. 10, 14, 16, 18, unprofiled and unmapped core localities). Figure 8, cited on pp. 3–4 and 6, actually challenges the position stated in the text.

Tables 12 and 13, which compare rice strains metrically, incorporate 12 entirely incorrect mathematical calculations out of 45; minor errors affect many others. Pollen time depths (p. 54) are miscalculated, even if constant sedimentation rates (9.4 cm per century and 7 cm per century) to 4000 B.P. are accepted: e.g., 400 cm deposited at 9.4 cm per century represents 4255 (not 5047) years before the sixth century A.D. (not B.P.).

**Use of Appropriate Literature**

Although non-English-language sources are extensively cited, available English-language publications concerned with the local environment and with Southeast Asian archaeology, agriculture, and history are underused. I have annotated in the
References sources of special relevance that were available before 1983 but are not cited. Serious omissions include the works by Boserup, Dudal and Moormann, Hill, Kawaguchi and Kyuma, Lamb, van Lier, Nossin, Scholten and Siriphant, Williams-Hunt, and Young.

Environmental Research

Revealing misstatements concerning local environmental characteristics include a claim that “excursions to the Satingpra Peninsula [from nearby hills] no doubt took place, to exploit its . . . timber resources” from 4000 B.P. on (p. 19). The hills themselves surely possessed varied and valuable timbers, and pollen analysis (pp. 52–53) suggests that mangroves dominated the Satingpra peninsula until canal construction began. Stargardt assumes that slow, constant sedimentation has characterized the coast since the prehistoric period. Cultural use of sand beach ridges for the construction of brick buildings is described as “astonishing” and “remarkable” (pp. 25, 30); in fact, beach ridges are the main type of landform used for traditional settlement in coastal lowland areas around the Malay Peninsula (e.g., Zaharah 1970; Quaritch Wales 1940). Stargardt (1973a) excavated one such area in Kedah.

Rock types, unconsolidated sediments, and soils—a data base of central importance—are confused throughout the volume (e.g., pp. 3, 162; Figs. 4–6). Although heterogeneous rock types are emphasized (p. 3) as a major influence on early settlement patterns, the “geological” illustrations map only soils and alluvium; except for limestone, no rock types are mapped in the volume. Ratburi limestone outcrops (p. 4) “are recorded near every known location of prehistoric and early historic settlement (Fig. 8).” Figure 8 locates only 1 of 5 prehistoric sites and 12 of 19 historic-era sites within 40 km of a limestone outcrop.

Figure 14, the “soil and drainage” map, plots landforms and sediments but no soils. Soil descriptions are not standard: structure is “powdery” (p. 25), and colors apparently based on Munsell (1975) often do not exist in that system (e.g., 7.5YR and 5YR 3/6 on p. 140) or are described oddly (e.g., 10YR 3/2, very dark grayish brown, described on p. 26 as “lt. grey/yellow,” or 7.5YR 3/4, dark reddish brown, described as “grey” on p. 162).

Terrigenous clays are “of marine origin” (p. 139). At Phang Sai Man tank, a 1.14 m thick, “compact, homogeneous layer of coarse brown sand” indicates “regular maintenance works for a long period” (p. 140); mixed Satingpra Canal deposits 1.09 m thick reflect “sustained efforts of maintenance over a very long period” (pp. 162–163); in the south longitudinal canal, “maintenance was very effective for only 0.69 m of sediments accumulated during Layer II” (p. 165). Although the descriptions are difficult to interpret, two of these data sets appear to argue against regular maintenance. Infilling—not clearing—is reflected by the thick, homogeneous sediments or possible Regosol profile in the tank and the thick, mixed sediments (called “soils”) in the Satingpra Canal. The thinness of the south canal sediments may reflect either clearing or the fact that north-south drainages receive relatively few sediments.

The Pattalung–Nakorn Sri Thammarat–Satingpra triangle is described as “a homogeneous soil area” (p. 45), a fertile “alluvial plain measuring 160 km from North to South and an average of 34 km from East to West” (p. 7; Fig. 6). Based on the constant sedimentation rate that is extrapolated from the historic period to 4000 B.P. (e.g., p. 54), this plain is said to have supported “extensive ricelands” by the
fifth century B.C. (p. 19) on "the greatest continuous deposit of alluvium... on the isthmus... [which] ranks as one of the major alluvial plains in Thailand as a whole during the latter half of the last millennium BC and the first millennium AD" (p. 6).

The "alluvium" mapped glosses inland stream valleys and fluvial terraces, alternating sand beach ridges and dunes and mud swales, tidal flats, lacustrine wetlands, and the alluvial plain (e.g., Moormann and Rojanasoonthon 1972; Scholten and Siriphant 1973). Of five distinct soil series described for the Satingpra peninsula today, three form on sand beach ridges or recent tidal flats (pp. 46-47; Scholten and Siriphant 1973: 6). Beach ridge Regosols are not used for irrigated rice cultivation. One-third of the "alluvium" mapped in Figure 6 is characterized by acid sulfate soils (Moormann and Rojanasoonthon 1972)—very acidic, often saline, commonly associated with salt-tolerant swamp vegetation, toxic to most cultigens, and seriously to very seriously limited for agricultural uses (Dent 1980; Ives 1967; Kawaguchi and Kyuma 1969a, 1969b; Leamy and Panton 1966: 191-192; Paramananthan 1978; Young 1976: 225-226). Once acid sulfate soils and Regosols are eliminated, no broad plain exists even now.

The author explains a documented increase in coastal infilling (p. 42) as the result of recent logging activities in the hills but does not consider the possibility, discussed below, that coastal accretion may have accelerated before the advent of modern logging.

As mentioned, the 4000 B.P. date for mangrove "clearance" and initial floodplain agriculture is calculated incorrectly. The date is presumably incorrect in any case, since it is inferred using a post-sixth-century sedimentation rate that the author assumes can be extrapolated backward over several millennia. The historic-era rate itself is very low because it reflects sedimentation in canals that received "regular maintenance and clearing" throughout 7 of the 14 centuries involved (p. 52).

Although recent research at well-dated sites (see H. R. Allen 1987) suggests that mangrove communities did in fact decline in certain coastal areas of Southeast Asia and Australia between 5500 and 3000 B.P., the reasons (e.g., sea level changes, sedimentation and coastal progradation, changing climatic regime, cultural clearing) are still under investigation. At Satingpra, there appears to be no reason to accept either the 4000 B.P. date or the cultural clearing it is said to reflect. The pollen, urban, and agricultural sequences, which are based on this spurious 4000 B.P. base date (e.g., p. 19), are invalid. Satingpra's early development as a center for floodplain rice agriculture is difficult to accept.

As described by several uncited sources, beach ridges in areas including the east coast of the Malay Peninsula hasten infilling by trapping terrigenous silts and clays eroded from inland sources (e.g., Curray 1969; Davies 1968; Ives 1967; Nossin 1961, 1964a, 1964b, 1965; Smart 1976; Teh 1976; also, for Satingpra, Trebuil et al. 1983: 15). At Satingpra both beach sands and terrigenous muds were stabilized formerly by mangroves (pp. 54, 223), which enhance stabilization and rapid accumulation seaward.

According to historic maps, legends, and sedimentary data from Satingpra and other archaeological areas on the Malay Peninsula, formation of the coastal plain sped up dramatically during the historic period (e.g., pp. 140, 162; Batchelor 1977; Lamb 1961; Malaysia 1973; Mills Collection 1936a, 1936b; Quaritch Wales 1940; Stauffer 1973). Progradation has advanced at rates up to 1.6 km per century in more
rapidly building west coast localities (e.g., Beruas, a historic-period site: Koopmans 1964). Early settlements, which are said to have “occurred only on the alluvia” (p. 6), were probably coastal and indirectly created the alluvium that occurs beside them today.

Trebuil et al. (1983), citing historical and geomorphological sources, indicate that most of the Satingpra peninsula constituted open water (with islands) until the early nineteenth century. “We think that, given the historical and geomorphological data presented in the previous chapter, of which [Stargardt] is apparently unaware, that the hypotheses relating to the existence of “intensive” agriculture based on a sophisticated hydraulic system are incompatible with the existence of an island” (Trebuil et al. 1983:21; also, p. 17).

Based on ceramic dates, Stargardt’s own evidence shows that clays entered the Phang Sai Man tank primarily after the thirteenth and fourteenth centuries (p. 140) and that the thickest clay deposit in the Satingpra Canal (p. 162) postdates the late thirteenth century.

The evidence further suggests that this change in sedimentation rate and pattern during the early historic period at Satingpra reflects increasing erosion in the hills due to overexploitation for rainfed rice cultivation. Accumulating data from other Southeast Asian site areas (e.g., Hill 1977; Wheatley 1961; Zaharah 1969, 1970; S. J. Allen 1988) suggest strongly that dryland cultivation, especially short-fallow and permanent types, played a much more important role as a support base for early states than was once realized and that increased erosion of sediments during the early historic period followed overuse of dryland fields.

Funan, a successful trade-based state with a large planned town, centers of learning, and an extensive canal network, probably relied on dryland agriculture (Hill 1977:17). Sixth-century Kampuchea, “already a significant power,” may have grown rice by “shifting cultivation, by entrapped rainfall and natural rise of the water-table or by controlled irrigation or, as is more likely, by all or at least the two former methods” (Hill 1977:18; my emphasis).


Although Stargardt suggests (p. 184) that rainfed hill rice “extended the cultivable ricelands by a further 90,000 ha,” she virtually disregards the hills and their potential for agriculture, omitting from consideration high alluvial terraces and fans, low terraces, and hillslopes characterized by agricultural soils (see Gobbett and Hutchison 1973; Moormann and Rojanasoonthon 1972; Scholten and Siriphant 1973). Alluvial Entisols in the young fan region that borders Satingpra produce more irrigated rice than the coastal zone; rainfed rice and other crops grow on low humic gleys and gray podzols (Dudal and Moorman 1966:17, 20; Moorman and Rojanasoonthon 1972; Takaya 1972; U.S.D.A. Soil Conservation Service 1960, 1975). A less fertile, old fan-terrace region extends 10–20 km inland, with soils of
low to moderate fertility that support many rainfed rice plots, as well as extensive rubber areas that were probably once dryland cereal (e.g., rice, millet) fields (see Fig. 1).

The possibility that Satingpra's coastal plain formed during the historic era due to overuse of inland fields must be considered an alternative environmental and subsistence model that warrants investigation.

**Interpretation of Evidence**

As indicated, sequences based on very few facts are used throughout the volume to generate other sequences. A 4000-year urbanization sequence is based on two ninth- to tenth-century A.D. radiocarbon dates, ten eleventh- to thirteenth-century thermoluminescence dates, the sedimentation rate discussed, and historic-era trade-wares. That sequence is used to validate the agricultural chronology, for which no empirical evidence is presented. Only a few, brief core descriptions are presented for the agricultural fields or hydraulic works. No data suggest that large rice surpluses either were or could have been produced on Satingpra's soils until relatively late in the historic period; no data support the association of the agricultural stages with either the Urban Phases or calendar dates. The author's study of aerial photographs, while an important contribution, cannot establish prehistoric or early historic dates for either the fields or the hydraulic works; nor can it clarify any chronological relationships that may have existed among the agricultural fields, the hydraulic features, and the urban evidence.

The available evidence suggests nonagricultural and even noncultural roles for many tanks and canals at Satingpra. Figures 16, 18, and 35 plot no tanks at all throughout most of the agricultural area during the postulated peak period. At least some canals are interpreted by Trebuil et al. (1983:18) as natural drainages in a diminishing perpendicular network that utilizes topographic depressions. Many were probably navigational, as appears to be the case in several other early historic-era states (Hill 1977:17-22). Villages were apparently located every 2.5-5 km along the canals (p. 138), many or most of which could accommodate seafaring ships (p. 157). Every main east-west canal is associated with a trade site or a brick monument (e.g., Fig. 59); canal construction "resulted from a great increase in maritime traffic" (p. 168).

If many of the hydraulic features were not agricultural, the calculations of water volumetrics and irrigated hectarage lose their meaning, and the claim that irrigated floodplain rice supported Satingpra early on is further weakened.

When agricultural contexts are dated at Satingpra, I believe the vast majority of the old fields will be found to postdate the tenth century, by which time urban subsistence needs may have outstripped the ability of inland dry land fields to supply the city.

Only three reported findings from the excavations at the citadel, Wat Sri Yang, Wat Chedi Ngam, Ban Pah O, Kok Tong, and Kok Moh kiln suggest cultivation during the period reported: (a) in-washed silts and sands, which may reflect erosion from inland fields; (b) rice pollens in the most recent level in the canal cores; and (c) rice temper in Layer III bricks, which may reflect dryland or wetland cultivation, the gathering of wild rice, or the importation of foodstuffs. Other isthmian trade states
imported rice; if the suggested identification (p. 11) of Satingpra with Tan-Ma-Ling is correct, Satingpra imported rice until the fourteenth century (Hill 1977:23–24; Wheatley 1961:67, 77).

The citadel excavations produced evidence for extraregional exchange c. A.D. 100 (Layer II), five centuries before Satingpra’s posited sixth-century urbanization (e.g., p. 32). Layers II through V (pre-urban through Urban Phase III) produced Chinese tradewares manufactured from c. A.D. 100 to 1350; Layer IV (Urban Phase II) produced approximately 40,000 Chinese sherds. Kendi manufactured at Kok Moh kiln were reportedly shipped to areas including West Malaysia, Sumatra, Java, and Sri Lanka (p. 24).

The author blames agricultural declines (p. 130) for the decline of the city in the early fourteenth century. But by that time Nakorn Sri Thammarat had assumed regional control of external trade (pp. 36–37). Imports of Chinese ceramics to Satingpra apparently ceased before A.D. 1368. The evidence suggests that the loss of trade and the decline of the city were responsible for the abandonment of the agricultural fields, rather than the reverse.

Based on the available data, it seems beyond question that it was primarily involvement in internal and external exchange that stimulated Satingpra’s “urbanism,” which was, in any case, probably not the inland, agriculturally based type (e.g., Angkor, central Java) but rather that of the exchange gateways that typified coastal trade states including Aceh, Banten, Funan, Kedah, and Melaka.

In Melaka, the best documented of these, an elaborate hierarchy of appointed officials supervised all extraregional exchange and all local and foreign trader communities. The mechanisms utilized for the control of trade at Melaka underlay the city’s political structure, as well as its great prosperity. Those same mechanisms could have facilitated the “qualitative changes in the social structure” (p. 118) that accompanied urbanism at Satingpra (see Andaya and Andaya 1982; Anderson and Vorster 1983; Birch 1880; Bronson 1977; Dunn 1975; van Leur 1967; Miksic 1979).

Satingpra does not appear to have functioned at any point in its urban sequence as a chiefly agrarian state. It was coastal and participated regularly in external exchange with China and the Malay world, at a minimum. As Stargardt suggests, internal exchange with hill-dwellers and others had undoubtedly been conducted for many centuries before the historic era began. Trade must therefore be considered an integral part of Satingpra’s economic base and its urbanization. Even if we accept the possibility that irrigated cultivation was practiced, trade seems best to explain the described urban and industrial site locations, the construction of monuments, and the coordination of regional waterways. With a focus on trade, we may eventually understand the particular type of urbanism that characterized Satingpra, as well as how it came about.

Without trade, given the available evidence, we are left with an oversimplified version of Boserup’s (1965) model for agricultural intensification—one that lacks the explanatory power of that model and omits other influential components in the process, such as internal and external exchange and a prosperous economy, political structure, effects on the regional environment, and the ethnicity and social roles of both the local inhabitants and the visiting traders. Agrarian/hydraulic intensification as it is discussed for Satingpra served to produce a dense population whose sole purpose was apparently to grow more rice.
Explanation of Culture Process

Either direct foreign control (e.g., p. 106) or "diffusion," first from an uncertain Mon-Khmer source and later from Srivijaya, is credited for both agricultural development and "civilization" at Satingpra, in spite of the facts that Mon-Khmer traits are not yet well understood, and it is not even known where Srivijaya was located.

Mon/"Angkorian" origins are suggested for Satingpra's tanks, canals, and small, bundled fields (p. 35); transplanting; and sugar palm cultivation (pp. 103–104). Use of the plow at Satingpra is claimed for Stage 5 (p. 85); the plow, however, may not have been used by the Mon people (Hill 1977:20) or by the Malays of the isthmus, who are not considered by Stargardt. Certain Angkorian traits (e.g., transplanting and sugar palm) seem to be used to establish Mon precedents.

Although Mon and Khmer traits are rarely differentiated here, the two areas involved show distinct agricultural patterns; their archaeological sequences appear to have begun separately, as well. Most Mon sites (e.g., Pong Tuk, Khorat, Si Thep) predate A.D. 550; most Khmer sites are considerably later, postdating Satingpra's urbanization (Quaritch Wales 1936:75, 89–91; also, Hall 1968:36, 94–139).

A Dvaravati source is suggested for pre-ninth-century rice-tempered bricks at Satingpra; the bricks, it is implied, reflect irrigated rice cultivation. Hill (1977:19–20), van Liere (1980), and others agree that the Mon probably irrigated and possibly terraced their fields; Dvaravati sites, however, show no signs of irrigation or terracing until the eleventh century (Hill 1977:19). In any case, as Stargardt mentions (p. 99), rice was used as a temper in Thailand long before the historic era began; Non Nok Tha provides an example.

Van Liere's research concerning water management and agriculture in the Mekong basin around Angkor and in the Chi-Mun basin on the northeast Thai plain, suggests two different patterns. In the northeast, where Khorat and Si Thep are located, flood-grown rice was broadcast until the tenth century; fields were not banded; and early urbanization is represented by village sites surrounded by canals and large moats used not primarily for irrigation, drainage, or even defense but rather for domestic water, transportation, and fishing. After the eighth century (postdating similar developments claimed for Satingpra), "banded-field farmers" at Angkor and in the Mun-Chi basin grew transplanted rice in small, banded, leveled fields (van Liere's Pl. 3, Stargardt's Fig. 52) with irrigation canals, ditches, and cross-bund dams. Settlements occupied pond banks (van Liere 1980:271).

Hill (1977:18) considers the piedmont zone, "from the Burma-Assam border through Thailand and Laos into south China, a region once partly inhabited by Mon peoples," and an area where "abundant wild rices" grow today, to be very important in the study of the spread of rice. The Khorat Plateau is covered with prehistoric or early historic-period tanks, canals, and moated sites and shows every sign of having been an important agricultural area for the past 2000 years at a minimum (Higham and Amphan 1982; Welch 1985; Williams-Hunt 1948, 1950). Since Mon areas in Burma and Thailand experience alternating flood and drought conditions similar to Satingpra's regime, it is surprising that northeast Thailand, including the Khorat Plateau, is not discussed by Stargardt beyond brief reference to site clusters in "the Kulen uplands along the course of the Se Mun river and its tributaries from the Khorat Plateau . . . to the Mekong" (p. 200).
The Khmer field area emphasized by the author as a probable source for many of Satingpra's agricultural traits, on the other hand, occupies lowlying land in the Mekong basin—an area climatically and edaphically distinct from the Satingpra peninsula. Stargardt recognizes the dominance of acid sulfate soils in the Mekong lowlands but suggests (p. 199) that prehistoric mangrove forests were cleared and the soils drained, permitting broad-based floodplain cultivation in Funan (an area still mapped as marsh/swamp and almost certainly wetter formerly). As mentioned, Hill believes that Funan supported itself with dryland cultivation; early Chinese sources suggest that Funan's canal network was navigational.

As mentioned, Satingpra's urban period is said to be Srivijayan, although the nature of Srivijaya's relationships with Malay Peninsular states remains unclear. The name probably describes a loose confederation of relatively autonomous coastal centers (Bronson 1979; Meilink-Roelofsz 1962; Quaritch Wales 1970; Wolters 1979).

Stargardt claims that the occurrence of "Srivijayan" statuary or inscriptions in areas including Kedah defines Satingpra's "close relations with Java, Sumatra, Kedah and other sites on the isthmus" (p. 33). No such find exists in Kedah, to my knowledge (see Kedah sources cited above, plus Leong 1973; Sullivan 1958). Lamb (1961:79) used the term "Srivijayan phase" for the isthmus including Kedah "more in a chronological than in a cultural context to cover. . . the period of the T’ang Dynasty in China.” Lamb concludes that "there is no great archaeological evidence for interpreting Kedah as an outpost of an empire based on Palembang.” In any case, the occurrence of "Srivijayan" objects in an area would not establish Srivijaya's relationship with Satingpra.

Certain stylistic similarities do exist between pillar bases in Kedah and Sumatra and possibly south Thailand, and an inscription in Kedah (Site 2) resembles certain inscriptions in Java (Lamb 1961:38, 46); stylistic connections between Kedah and other areas including Champa are also suggested by certain architectural features. Overland contacts existed formerly between Kedah and Patani (Hamilton 1922); it is reasonable to assume a relationship between Satingpra and Kedah.

The growing evidence for systematic contacts among sites in various areas of Southeast Asia is encouraging. Old claims that virtually every Southeast Asian state and "civilization" reflected direct intervention by Indians (with, presumably, passive acceptance on the part of the natives) are weakening. We must guard against replacing the old Indian scheme with a Srivijayan scheme that is equally poorly understood and perhaps even less well based in fact.

Satingpra's people undoubtedly had access, through trade and other interactions, to ideas from many areas. A simple diffusionist approach cannot explain the local evolution of either introduced or indigenous traits. Stargardt realizes that these local developments are important but devotes her attention to perceived external sources for the traits. Her work differs in this regard from that of many recent researchers interested in cultural developments in Thailand and other areas (e.g., Bayard 1970, 1971; Gorman 1977; Hutterer 1976; Kennedy 1977a, 1977b; van Liere 1980; Solheim 1972a, 1972b; Welch 1985). These researchers explain the evolution of agricultural and other traits in terms of internal process and emphasize that even introduced traits must be adapted locally if they are to work.

Stargardt's work has provided stimulating ideas, a good general botanical background, pollen analysis, excellent photogrammetric coverage for portions of the study area, certain trade evidence, and a model for agricultural development. What
is needed is solid evidence—evidence relating to four facets of cultural and environmental change at Satingpra.

The city’s hinterlands need exploration, especially in terms of past dryland agricultural use. Coastal progradation and the formation of the alluvial plain need better definition, in terms of both dating and sedimentary origins. And the agricultural fields and hydraulic features need stratigraphic excavation, thorough in-field soil and sedimentary analyses, and dating analysis. Fields in different sections of the peninsula need to be explored and compared, so that we may gain some understanding as to which came first and how placement of the fields relates to coastal accretion.

Finally, urban, agricultural, and hydraulic trenches must be correlated as closely as possible, so that Satingpra may be better understood, both in its internal economic and political evolution and in its external relationships with other states.

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Paradise Gained and Paradise Lost: Intensification, Specialization, Complexity, Collapse

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INTRODUCTION

Human history as a whole has been characterized by a seemingly inexorable trend toward higher levels of complexity, specialization, and socio-political control, processing of greater quantities of energy and information, formation of ever larger settlements, and development of more complex and capable technologies. . . . Perhaps because of this, the development of political complexity has attracted more scholarly attention than collapse, its antithesis (Tainter 1988:3).

Explanations for the rise or collapse of social complexity revolve around a legion of multifaceted elements and interrelated processes: economic factors of subsistence, production, exchange, and consumption; sociopolitical factors of organization, power and prestige, wealth and status, rank and stratification; spatio-ecological factors related to environment, resources, location, and population. Archaeologists have been urged to "break down" compound concepts such as complexity into their constituent variables, and to examine the interrelationship among those variables (McGuire 1983).

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Asian Perspectives, Vol. 28, No. 2. © 1990 by University of Hawaii Press. All rights reserved.
Three recent studies on cultural complexity and collapse provide the framework for reassessing those factors commonly cited in the definition and interpretation of cultural similarities and differences, cultural continuity and change. Intensification, specialization, complexity, and collapse are defined explicitly (in their own terms and as they relate to one another), in close accord with Cowgill’s dictum that “it seems necessary to begin any investigation of social phenomena by taking for granted a number of terms that are, one hopes, peripheral or background concepts, and to concentrate on developing clear and nontrivial meanings for some limited number of key concepts” (1988: 246). In order to expand these definitions, and to clarify the value of such concepts for the study of prehistory, their application to Melanesian archaeological and ethnographic case studies is here discussed in detail. Social complexity and collapse are further evaluated through case studies taken from the volumes under review or in the context of the Bronze Age Mediterranean.

The editors of a series of papers that dealt with the theme “Trends toward Social Complexity in Australia and Papua New Guinea” state that the studies overall “raise a number of definitional and methodological questions which need to be addressed before comparative studies within a broader world framework can be undertaken” (Murray and White 1985). In an overview of the same studies, Yoffee observed that social change in Sahul never led to socially heterogeneous, economically stratified, or politically centralized complex societies, and that Sahulian societies must not be envisaged as earlier “stages” in the evolution of social complexity (Yoffee 1985:41).


Allen has suggested that cross-cultural comparison between complex and “simpler” (or “less complex”) societies has the “advantage of focussing on the variability of cultural processes and change while attempting to explain them” (1985:49). Hodder, moreover, argues that material-culture meanings are transferred from one context to another “on the basis of observed similarities and differences” (1988:67). This review assumes a similar, “universalist” stance and maintains that the archaeological correlates of certain elements intrinsic to complex societies have equivalent forms (although smaller in size and scale) in the material record of less complex societies. Questions relating to socioeconomic organization (production, exchange, subsistence, wealth, and status) in complex societies, or to constraints that may have operated to limit organizational change in ranked or emergent complex societies (“chiefdoms”), may be examined comparatively and contrastively in the archaeological record of less complex societies.

The identification of material indicators of social change or other aspects of complexity poses a challenge to prehistorians who study less complex societies (e.g., Bradley and Chapman 1986:136; Braun 1986:125–126; Cohen 1985; Keeley 1988; Muller 1987:20–21; Price and Brown 1985). While it is necessary to acknowledge the difficulties of comparison and the importance of differences among diverse social
systems, "human groups of any size possess culture, organisation, and needs which motivate their behaviour, and these behavioural responses are often more similar in form than we have so far realised from the essentially materialistic perspective of archaeology" (Allen 1985:56).

Adopting theoretical principles from political anthropology, archaeologists seek to analyze the rise or collapse of complex sociopolitical systems through qualitative and quantitative assessment of interlinked factors such as center-periphery strife, coercive power, interregional exchange, intensification of (agricultural or industrial) production, productivity, and socioenvironmental stress (Brumfiel and Earle 1987; Claessen and van de Velde 1987; Claessen et al. 1985; Cohen and Service 1978; Earle 1984; Flannery and Marcus 1983; Gledhill et al. 1988; Patterson and Gailey 1987; Trigger 1985; van der Leeuw 1981; Wright 1986; Yoffee and Cowgill 1988). Taking a cue from economists or economic anthropologists, archaeologists attempt to explain change by evaluating functions of production, exchange, and consumption in pre- or protohistoric societies (Adams 1984:97-109; Blanton 1983; Earle 1985; Hirth 1984; Knapp and Stech 1985; Renfrew and Cherry 1986; Renfrew and Shennan 1982; Sheridan and Bailey 1981; Smith 1983; van der Leeuw and Pritchard 1984). It is argued that increased demand from local or regional markets may stimulate (re)organization and expansion of production: capital outlay is increased, production is intensified, and innovation occurs. In prehistoric societies, the shift to external markets may have resulted from the chance appearance of innovations in a regional exchange network: a new raw material, new commodities, new forms of demand, or an improved means of transport (Runnels 1985). Transportation provides the nexus between production and exchange, the means by which factors are assembled for production and finished products distributed.

The development of social complexity fostered new modes of group interaction and cultural transaction, and new methods of social control and information exchange or processing that cannot be explained solely by environmental or technological variables (van der Leeuw 1986:38; Wenke 1981:79-80). All development towards social complexity involves some measure of "intensification"—be it social, ceremonial, demographic, or agricultural (Feil 1985:88; Renfrew 1982:265). Because "intensification" forms an important—and disputed—issue in Sahul's prehistory, and at the same time constitutes a key link between less complex and complex societies, it provides an appropriate point of embarkation.

INTENSIFICATION

The ways in which past human groups organised themselves is a question which underwrites almost all archaeological research, but is one which is rarely addressed by archaeologists dealing with "simple" as opposed to "complex" societies (Allen 1985:49).

What sort of socioeconomic factors or symbolic devices spur intensified production and support associated status-seeking or power strategies? Is there a "threshold" of intensification, beyond which production increases are no longer feasible?

The concept of intensification centers on factors of labor/resources, land/environment, and demography, and their impact on various socioeconomic features. For Brookfield, whose emphasis is on less complex societies (1972:31), inten-
sification of production means the addition of inputs—capital, labor, and "skills"—per constant land within a particular technological and socioeconomic system, a position maintained upon considerable reflection (Brookfield 1984:16). Renfrew, whose focus is on more complex polities, argues that increased output, often the result of technological innovations ("skills"), may occur even with reduced input of capital or labor (1982:266). Brookfield is describing increased production, Renfrew increased productivity (Bender 1978:204–206): "indeed, intensification is most conveniently envisaged as increase in output against constant land" (Renfrew 1982:266; original emphasis).

For Renfrew, "intensification" involves increases in (1) population density, (2) per capita labor input, and (3) efficiency through technological innovation (1982:271). Yet intensification may also be concerned with greater control over the environment, improved accessibility, or making returns more predictable (Bender 1978) and thus reducing risk (Halstead 1989:79). Even if intensification of labor or other inputs results from innovation, Brookfield carefully distinguishes the two processes: "Intensification is always burdensome, and is adopted from necessity. Innovation, on the other hand, offers the hope of advantage" (1984:35). For Brookfield the limits of intensification are determined by coercive relations between social classes: the adoption and extension of innovations that require higher labor inputs result from changes in the social organization of production (1984:20; similarly Bender 1978:213–214). Brookfield’s social theory posits that innovation is an investment in increasing security and reducing risk, particularly but not exclusively in marginal environmental situations (1984:38–39; similarly Halstead 1989:80).

Increased population density, the need to exploit dcbased or deteriorating environments, reciprocal exchange demands within kin-based social systems, the maintenance of social and ceremonial networks, and competition for status are all factors that may lead to elaboration in the management of labor or "storage" of resources and to organizational changes in society geared to minimize risk or gain advantage. Production for and beyond subsistence (Halstead 1989:70), once defined by Brookfield as "social production" (1972:37–39), is often determined by sociocultural values (prestation, ritual) and by conscious human intervention (increased or unequal allotments of labor) in the face of environmental or demographic change (Feil 1985:99; Modjeska 1977:73).

For Renfrew, intensification associated with state formation on the Bronze Age Aegean island of Melos resulted from organizational changes related to increased labor input and thence increased output (1982:275). For Brookfield, elaborations on innovations (which make possible a quantum leap to sustained production) eventually lead to diminishing (marginal) returns, a proposition that forms the core of Tainter’s model of collapse (Brookfield 1986:179; Tainter 1988:118–123). Yet innovations do not always bring immediate benefits, nor are they always adopted immediately. Intensification, furthermore, does not always result in more complex social or politicoeconomic systems.

For example, given the level of productive specialization and the extent of the coastal maritime exchange systems evident in archaeological data from Mailu, Motupore, and the Papuan Gulf (Allen 1984a; Allen and Rye 1982; Frankel et al. n.d.; Irwin 1985; Rhoads 1982); given indicators of population increase and centralization, constant demand and middleman benefits; given even the probability that Melanesian traders as a group stood in a qualitatively distinct relationship to other trading
network groups (Allen 1984a:439-442)—the potential existed for system expansion, for diversification in goods manufactured and traded, and for intensification of organizational activity. Yet neither archaeological nor ethnographic records indicate any significant degree of diversification or expansion in precontact situations. Whereas possible indicators of site hierarchy are apparent, "surpluses" probably remained small and irregular, and the degree of social differentiation limited. Any further spatial or productive expansion in the system would have necessitated an increase in centralized organizational complexity. Here lies the crux (Allen 1985:50-51) as well as the paradox.

Centralization of authority requires not only social support but also capital wealth accumulation. Ethnographically attested Melanesian social systems, however, generally disdain such accumulation and instead pump surpluses back into the system through sponsorship of public feasts, dances, or other prestations, pageantries, and divisions of wealth. Support within the village or clan is maintained by the flow of goods along kinship lines. And profits—sago palm, starch, pots, pigs, or pearlshells—are not reinvested in commercial enterprise or in the organizational requirements of a centralizing authority: they tend to be consumed in conspicuous displays of wealth that establish relationships, obligations, and prestige, and so have small-scale political significance. There is, thus, another way to "spend" profits: "reinvestment" to produce more "energy," namely, the support necessary for subsequent trading ventures.

Although comparative evidence might dictate that the socioeconomic system should foster growth for its own survival, Melanesian society limits intensification and constrains diversification. Failure to allocate "financial" support to organizational change suggests that economic as well as social constraints are at work in Melanesian society (Allen 1984a:442). Although competition among clans may be encouraged, social and economic levelers (e.g., public or ceremonial distributions) discourage wealth accumulation at the commercial level and equalize the distribution of resources or goods in demand (Brookfield 1984:34-35; Rathje 1978:167). Most exchanges are reciprocal and governed by kinship relations or responsibilities.

Even when high status members of Melanesian society are able to manipulate domestic production or enhance capital and labor investments, increased output may lead only to more elaborate prestations. Whereas innovation or technological intensification that requires specialists may result in such a situation of "social production" (e.g., an increase of complexity within the trading system, or "primitive commercial agriculture"; Godelier 1977:142-143), the adoption of innovation does not automatically lead to permanent social change (Brookfield 1984:34). While certain new inputs related to production, population, status, and exchange were instrumental in socioeconomic "intensification" among various south coastal Papuan groups, structural change in society seldom resulted. The lack of a strong agricultural base to support a new order of prosperity may have imposed environmental limits (Allen 1984a:447), and may have helped to set organizational ceilings on sociopolitical intensification.

SPECIALIZATION

Specialization is a continuum along which any economy can be gauged. At one end of this continuum is the ideal Domestic Mode of Production... in which the division of
labor (specialization) is limited to age and sex differences within the family. At the other end of the continuum is the modern industrial economy in which the division of labor is enormously complex... and outside specialists produce most of the goods and services used by domestic units (Brumfiel and Earle 1987:5).

Although a key issue in evaluation of less complex Melanesian social systems (e.g., Allen 1984a:442-448), and central to any theoretical discussion of social complexity, the concept of specialization is seldom defined adequately (cf. Muller 1984). The subject therefore assumes an important transitional place in this discussion.

At a more basic level of definition, and to distinguish clearly between notions such as “site specialization” and “craft specialization,” the term is here restricted to mean production of goods and services for a broad consumer population, on a (usually) full-time basis, in order to earn a livelihood (Muller 1987:15; Brumfiel and Earle 1987:3). No complex society can function unless subsistence production is geared to feed a range of specialists, including food producers (Renfrew 1982:265).

For Brumfiel and Earle (1987:5-9), specialization is a many-faceted concept that involves interdependence, economic differentiation, and five dimensions of variability: (a) affiliation; (b) nature of goods produced (subsistence, services, wealth); (c) intensity of effort (part- or full-time); (d) scale (individual, domestic, workshop, village, industrial); and (e) volume of output. Central to their presentation is the notion of specialist affiliation, i.e., independent or attached specialists (1987:5): “Independent specialists produce goods or services for an unspecified demand crowd that varies according to economic, social, and political conditions. In contrast, attached specialists produce goods or provide services to a patron, typically either a social elite or a governing institution.” Different principles govern the type of product, intensity, organization, and productivity associated with these two specialist affliations. Whereas attached specialists (e.g., in Bronze Age eastern Mediterranean palace workshops) develop in close association with ruling elites and institutions in order to establish, strengthen, and maintain the latter’s control, independent specialists (e.g., in the Aztec state’s utilitarian craft production) develop in response to resource diversity, increased population density, stabilized levels of supply and demand, or market demand or urbanization (Brumfiel and Earle 1987:5-6,8).

The Melanesian archaeological record (Fig. 1), especially that from the Port Moresby region (Allen 1977a, 1984a; Bulmer 1979, 1982), from Mailu (Irwin 1978a, 1978b, 1985), and from the Papuan Gulf (Frankel et al. n.d.; Rhoads 1982, 1984) suggests that groups of traders established cooperative specialization in pottery production and/or distribution. Wherever possible, these traders controlled access to resources (clay, obsidian, shell) and to the specialized manufacture of utilitarian or status items (pottery, stone axes, shell ornaments). Access to the associated technology (especially with clays) must also have been critical. A “monopoly” on trading—facilitated by skills in voyaging—may also have made possible the occupation of agriculturally marginal areas where the economy, as a result of a presumed population and/or wealth influx, diversified further (Allen 1984a:437-442).

Based on excavations at the offshore island of Mailu in southeast Papua, Irwin argued the reverse: location—marginal or not—promotes specialized trade (Irwin 1978a, 1985:242-243). Through sourcing work (pottery, clays, and obsidian) and locational analyses, Irwin demonstrated how Mailu over the past 800 years developed into a communication center, exercised regional control over ceramic pro-
duction, and at least limited the distribution of obsidian imported from Fergusson Island to amounts that served local needs (Irwin 1978a:414, 1985; see also Ambrose 1976).

Allen's excavations at Motupore, an offshore island about 35 km southeast of Port Moresby, also provide evidence of specialized production in pottery and shell ornaments (Allen 1977a:391–395, 1977b, 1978, 1984a). Sourcing work (PIXE analysis) suggests that Motupore-manufactured wares reached as far northwest as the Papuan Gulf (Allen and Duerden 1982; Allen and Rye 1982: 101), although this conclusion is not as straightforward as Allen has claimed (Frankel et al. n.d.).

Toward the end of Motupore's 500 years of occupation (about 300 B.P.), at least 12 new sites appeared in the Bootless Bay area; if contemporary, these are suggestive of population increase if not centralization (Allen 1984a:431–432; Allen and Rye 1982: 106). Although the volume of Motupore's remains prompted Allen to classify it as a large site (Allen and Rye 1982:106), Bulmer pointed out that Motupore, at 2 ha, is not uncommonly large among Port Moresby sites (Bulmer 1982:118). Irwin also argued for a rise in population in the Mailu region after about 350 B.P. on the basis of increased site numbers, a shift to defensible site locations, and outward migration to more marginal ecological situations. The settlement on Mailu Island itself had become "abnormally large" just before European contact (Irwin 1978a:410).

In ecological and locational terms, Mailu and Motupore were small in size, impoverished in resources, but centrally situated within their own interaction spheres. Thus they had the capacity to function as intermediaries and to supply goods in demand to regional trading partners. Within Island Melanesia, similar developments may have occurred in the Amphletts—a pottery distribution sphere that included the Trobriands and parts of the D'Entrecasteaux Islands, especially Dobu (Irwin 1983:70–71; Lauer 1970, 1971)—in the southernmost Massim on Tubetube Island.
Asian Perspectives, xxvii(2), 1988–1989

On the basis of archaeological evidence, therefore, it may be argued that sometime in the course of the last 600 years, specialized trading activity developed on offshore islands like Mailu or Motupore, or on islands centrally located in a regional cultural system (the Amphletts, Siassi Island, Tubetube). The economy of these settlements slowly came to be based on the specialized manufacture of pottery and shell objects, on limited control over maritime movements of imports like obsidian or shell, and on participation in a regional exchange system that moved their own products as well as imports over the extent of the south-central and southeast Papuan coast, and into and through the islands of the southern Massim.

Looking diachronically at the south coastal Papuan system, both Allen and Rhoads maintain that “specialization” and “trade complexity” have increased gradually over the past 2000 years (Allen 1984a:442–448; Rhoads 1982:141–142, 148). Allen’s accelerating climb-and-collapse trading model (1984a:444, Fig. 2) implies differential increases in various aspects of “complexity” (albeit without transformation from an egalitarian to a hierarchical social order) and acknowledges an ambiguity between the overall Papuan south coastal trading network and the more localized, spatially reduced subsets within it (p. 455). The resurgence of “complexity” in these trading systems (about 400–500 years ago) has important implications for assessment of the “finality” of collapse (discussed below).

To what extent these systems were interconnected, how they might be related to the kula and kune “rings,” and how far back in prehistory they or their similarly patterned forerunners extend, are issues for further empirical research by Melanesianists. With regard to the “Lapita cultural complex” (flourished about 3600–2500 B.P.), suggestions—if not material reflections—of such phenomena as “multimodal” exchange networks, exchange valuables, specialized pottery production, and social stratification imply that intensification, diversification, and specialization typify, somewhat erratically, early prehistoric Melanesian socioeconomic systems (Allen 1985; Ambrose 1978; Anson 1986; Green 1986, 1987; Kirch 1987; Lilley 1988; Specht et al. 1988; for discussion of the Lapita Homeland Project, see Allen 1984b; Allen and White 1989; Spriggs 1984; White, Allen, and Specht 1988).

Melanesia’s rich ethnographic record also documents intensive trading networks throughout coastal Papua and Island Melanesia. While these areas characteristically exhibit diverse ecological conditions, the societies that occupy them show considerable similarity in specialized production and/or maritime trade. Besides pottery, Melanesian middlemen-traders trafficked in the production and/or distribution of shell valuables, boar’s tusks, stone axes, obsidian, large trees for canoe construction, hardwood bowls, and woven baskets.

Specialist traders mobilized demand in both local and long-distance exchange. The Motu, for example, who dominated the hiri system along the south-central Papuan coast, often provided “surplus” sago acquired in the gulf region to other trading partners inland or southeast of Port Moresby. The Motu thus bound trading partners closely to themselves and at the same time increased the flow of wealth and the number of people seeking it. In turn this facilitated economic diversity at the village level, increased the need to import sago, and so perpetuated the initial demand (Allen 1984a:432–438). By virtue of constant demand for Mailu-produced pottery and the ubiquitous presence of Mailu wares in most district villages, pottery...
assumed what was tantamount to a standardized unit of value with set equivalencies in food (Irwin 1978a:407).

At contact, the Motu occupied a 125-km stretch of south-central Papua (centered on Port Moresby) and maintained trading links west (hiri system) and east (unnamed system providing shell valuables). Population data indicate that the agriculturally marginal zone of the Western Motu held more people, supported the largest village in the area, and had a greater population density than the Eastern Motu (Allen 1984a:411–415). The Western Motu trading regime may have offered advantages that enabled population increase and consequently an adequate and extended subsistence base. The desire to share in or gain access to Motu trade profits may in fact have spurred the inland Koita people to settle in Western Motu villages, a development that would have increased village size and population level (pp. 436–437).

Within Melanesian trading villages, a close relationship existed between exchange and social ranking. Ongoing ethnographic work and recent reinterpretations of earlier ethnographic materials suggest that ranking and hereditary elements in leadership may have existed among coastal and highland groups in Papua New Guinea as well as in Island Melanesia. The elaboration of rank and leadership in the Siassi Islands (Lilley 1985, 1988:516) and in the northern Trobriands (Brunton 1975; Persson 1983:38–39), the development of rank among Melpa big men (Feil 1982), and the existence of chieftainship and ranked clans among the Roro and the Mekeo, two tribes occupying the coastal area just west of the Motu (Davis n.d.; Hau’ofa 1971, 1981), have been interpreted as the ability of local leaders to control the means of production, or at least to limit widespread access to prestige goods passing through regional exchange systems (Brunton 1975; Feil 1982; Friedman 1982:183–186).

Melanesian trade was not geared to surplus production for profit, but rather served as “a basic subsistence mode as well as a central factor in their social lives” (Allen 1984a:409). The Motu, for example, produced pots and exchanged prestige goods for subsistence and social status, but not for wealth accumulation. Even if such “wealth” existed, it was not reinvested in a spiral of commercial growth, or in the long-term entrenchment of elite authority, but instead was consumed in a culturally sanctioned process of status acquisition, or was “spent” to provide support for future enterprise.

In the case studies of the Brumfiel and Earle volume, specialization in subsistence goods likewise proved to be insignificant in the development of sociopolitical complexity (1987:6–7). Such specialization was either absent entirely (Mississippian chiefdoms [Muller]), or else had little relationship to political elites (Hawaiian chiefdoms or Inka empire [Earle], Late Classic Maya [Rice]).

Political competition in marginal subsistence areas, such as Mailu, Motupore, or the Papuan Gulf, often revolves around the accumulation and circulation of foodstuffs, that is, the intensification of the subsistence economy. What emerges in these Melanesian examples is a positive correlation among strategic location, specialist production, and developed systems of exchange. In diachronic perspective, configurations of south coastal Papuan trade changed continually, as did the type of goods exchanged and the actual centers of trade (Allen 1985:51). Traders responded to (or in some cases created) demand for items produced in specialized centers or for goods moving through those centers. The net result was the satisfaction of social needs—consumption or competition for status, the pursuit of prestige rather than profits. The circulation and exchange of comestibles, raw materials, and various
exotica thus promoted prestige and provided social support for the traders, which in turn served to intensity specialist production and exchange.

In prehistoric coastal and island Melanesia, specialist traders and craftspeople, living in marginal but strategic sites, effectively transported an ever-changing array of imported goods and their own handiwork in dugout canoes (another specialist product) within a regional exchange system whose configuration was also constantly changing (Allen 1985:51). Yet the complexity of Melanesian exchange systems did not depend upon a complex social system. Even if the hiri system, for example, involved social ranking based on differential access to resources, production continued at the household level with no overarching or coercive control, and social stratification never developed.

In premonetary economies, such as those of prehistoric Melanesia, demand for goods produced beyond subsistence needs was neither constant nor uniform over time and space. Shell, obsidian, even utilitarian objects (stone axes) functioned as valuables and traveled in all directions. The basic ability to transport and exchange such goods in demand is a necessary but insufficient condition to trigger all the organizational changes leading to urbanization, internationalization, or social complexity (Allen 1984a:453-454; Portugali and Knapp 1985:66; Wright 1984; Yoffee 1985:45).

SOCIAL COMPLEXITY

Complex societies are problem-solving organizations, in which more parts, different kinds of parts, more social differentiation, more inequality, and more kinds of centralization and control emerge as circumstances require. Growth of complexity has involved a change from small, internally homogeneous, minimally differentiated groups characterized by equal access to resources, shifting, ephemeral leadership, and unstable political formations, to large, heterogeneous, internally differentiated, class structured, controlled societies in which the resources that sustain life are not equally available to all. This latter kind of society requires constant legitimization and reinforcement (Tainter 1988:37–38).

The preceding section highlighted intensified production and increased population, competition for resources, strategic location and demographic centralization, and specialized exchange systems as important components in systemic change and the overall growth of complexity. Equally significant is the capacity to direct organizational change in society. Yet the “adaptationist” model—which posits that leadership develops in environmental or demographic contexts where effective economic management is either necessary or beneficial—is contradicted by the Melanesian situation, wherein egalitarian socioeconomic institutions persisted and hierarchical leadership regularly failed to develop. Other shortcomings of this model—and of an economic growth model in which specialization and exchange are viewed as autonomous processes dictated by economic efficiency and the pursuit of individual power—are emphasized by Brumfiel and Earle (1987:1–3).

Yoffee argued that mid–late Holocene changes apparent in Sahul’s archaeological and ethnographic records ought to be analyzed within theoretical frameworks different from those commonly used to understand social transformation in more complex societies (1985:47). It must be reiterated, however, that theories adopted to explain the development of social complexity may profitably be examined cross-
culturally in the simpler archaeology of less complex societies (Allen 1985: 49; Gam­ble 1986a; Knapp 1984). "There is no true understanding without a certain range of comparison; provided, of course, that comparison is based upon differing and, at the same time, related realities" (Bloch 1954: 42). In contradistinction to the Annales historian Bloch, Lévi-Strauss questioned the appropriateness of the comparative method (1963:21). Nonetheless political anthropologists and historical sociologists have argued that "single society" (i.e., relativist) paradigms—whether analysis is aimed at modern national states, tribal communities, or archaeological cultures—provide only partial understanding of relevant social or politicoeconomic phe­nomena (Persson 1983:32; Ekholm and Friedman 1979; Kohl 1987; Wallerstein 1974, 1980; see also Radcliffe-Brown 1950:2). Whereas it is essential to stress disparities in size, scale, and level between complex and less complex societies, inter­cultural comparison of differences (in a context of similarity) and similarities (in a context of difference) may help us to contrast, and thus to understand, cultural variability.

Table 1, for example, lists some aspects of complexity and proposes certain archaeological correlates from a complex, east Mediterranean (Cyprus) social sys­tem, and from less complex Melanesian (Mailu and Motupore) social systems. Prima facie similarity between the two distinct data sets should be perceived in contrast as much as in comparison. Even if, for example, the "Lapita Cultural Complex" were to be regarded as an extensive, interregional exchange system rather than an areal colonization (White and Allen 1980), the major part of the Lapita area, plus the Papuan Gulf and south coastal Papuan region, is no more extensive than the major Mediterranean part of the Old World system (Kohl 1979, 1982) (Fig. 2). Compari­son of Melanesian subsystem size to that of the eastern Mediterranean (Fig. 3), or even to the Aegean and Cypriot subsystems (Fig. 4), suggests that Melanesian ex­change networks were local trade entities, parts of a Melanesian regional system. More important, these figures demonstrate that, in a comparative exercise, one must bear in mind differences in scale, level, intensity, and complexity.

Table 2 juxtaposes Cypriot and Melanesian archaeological indicators of factors cited by development economists as predictable responses to increased demand for resources or specialized manufacture. Such indicators are also signs of change to­ward increasing specialization and complexity. In both cases, demographic growth is apparent, as is intensification or specialization in production, participation in re­gional exchange (and the interplay of the attendant supply and demand forces), differential access to resources, and the capacity to organize production, distribution, and transport.

How do these factors relate to other studies on the long-term evolution of social complexity, or to shorter-term mechanisms of change?

Complex society’s most distinctive feature is a hierarchical, centralized form of politicoeconomic organization, as opposed to an egalitarian, more dispersed form (Allen 1985:49; Wenke 1981:79). According to Yoffee (1985:42–43, after Runci­man 1982:351), “the most important necessary and jointly sufficient condition that separates complex societies from noncomplex ones is the emergence of socioecono­mic and governmental roles that are emancipated from real or fictive kinship.”

Although development is seldom linear, patterns often inconsistent, and cause and consequence frequently intermingled, social stratification typically follows the development of stable land-use systems, where there is unequal access to and con-
### TABLE 1. ASPECTS OF COMPLEXITY/INTENSIFICATION

<table>
<thead>
<tr>
<th>ASPECTS</th>
<th>COMPLEX EASTERN MEDITERRANEAN (PRE- AND PROTOHISTORIC CYPRUS)</th>
<th>LESS COMPLEX MELANESIA (ARCH. AND ETHNOHIST. MAILU AND MOTUPORE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased/Specialized Production</td>
<td>Agriculture: cattle and plow complex</td>
<td>Ceramics</td>
</tr>
<tr>
<td></td>
<td>Copper mining/manufacture/technology</td>
<td>Shell products</td>
</tr>
<tr>
<td></td>
<td>Ceramics/shell/beads/textiles</td>
<td>Stone axes</td>
</tr>
<tr>
<td></td>
<td>Prestige goods (copper ingots, imports)</td>
<td></td>
</tr>
<tr>
<td>Competition for Control over Basic Resources and Manufactures</td>
<td>Intensified copper production</td>
<td>“Monopolies” on production/distribution (clay, shells, ceramics, comestibles)</td>
</tr>
<tr>
<td></td>
<td>Elites (political, administrative)</td>
<td>Central location between resource-rich and resource-poor areas</td>
</tr>
<tr>
<td></td>
<td>Regionalism</td>
<td>Economic specialization and competition</td>
</tr>
<tr>
<td></td>
<td>Storage facilities</td>
<td>Limited island carrying capacity</td>
</tr>
<tr>
<td></td>
<td>Prestige goods (ingots, metal figurines, “ingot-bearers,” other symbol-laden items)</td>
<td>Warfare</td>
</tr>
<tr>
<td></td>
<td>Warfare/weapons/burials</td>
<td></td>
</tr>
<tr>
<td>Demographic Change/ Centralization</td>
<td>Site hierarchy</td>
<td>Locational advantage: centrality to trade system (also Amphlett, Tubetube; Siasi [ethnographic])</td>
</tr>
<tr>
<td></td>
<td>Centrally-planned urban coastal emporia</td>
<td>Increased site numbers (Mailu); increase in population (Mailu and Motupore; western Motu village [ethnographic])</td>
</tr>
<tr>
<td></td>
<td>“Gateway” cities</td>
<td></td>
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<tr>
<td></td>
<td>Increased site size</td>
<td></td>
</tr>
<tr>
<td>Ranking/Stratification/ Specialization</td>
<td>Site hierarchy (agricultural, industrial, commercial)</td>
<td>Traders/big men in hierarchical relation to other groups in trading network</td>
</tr>
<tr>
<td></td>
<td>New social division of labor (?)</td>
<td>Social differentiation</td>
</tr>
<tr>
<td></td>
<td>Elites (administrative: writing)</td>
<td>Phratry system (Mailu [ethnographic])</td>
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<tr>
<td></td>
<td>Large-scale public/ceremonial buildings</td>
<td>Social constraints on wealth</td>
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<tr>
<td></td>
<td>Differential burial practices</td>
<td>accumulation; public display and distributions of wealth</td>
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<tr>
<td></td>
<td>Political flux/warfare</td>
<td></td>
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<tr>
<td>Regional Exchange Systems</td>
<td>Increased internal production/specialization</td>
<td>Social Relations</td>
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<tr>
<td></td>
<td>Control of metal resources; centralization</td>
<td>Economic Basis</td>
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<tr>
<td></td>
<td>External demand</td>
<td>Model</td>
</tr>
<tr>
<td></td>
<td>Intra-island and external transport</td>
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<td></td>
<td>Local and long-distance systems</td>
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<tr>
<td>External Demand</td>
<td>Internal/external transport technology</td>
<td>Trade Mechanisms*</td>
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<tr>
<td></td>
<td>Extractive/ productive metals technology</td>
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<tr>
<td></td>
<td>Elaboration of internal markets/ emporia</td>
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<tr>
<td></td>
<td>(copper refinement/export centers)</td>
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<td></td>
<td>Copper ingots, luxury imports</td>
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<tr>
<td>CONTRASTIVE ASPECTS</td>
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<td>Social Relations</td>
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<tr>
<td>Economic Basis</td>
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<tr>
<td>Model</td>
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<tr>
<td>Trade Mechanisms*</td>
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<tr>
<td>Spatial Organization</td>
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<tr>
<td>Production Level</td>
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<tr>
<td>Transport</td>
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<tr>
<td>Location</td>
<td></td>
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<tr>
<td>Types of Evidence</td>
<td></td>
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</tr>
</tbody>
</table>

*Both systems trade utilitarian goods/raw materials/valuables/comestibles.
Fig. 2.  

a, generalized boundary of the *coastal* extent of the eastern half of the Mediterranean "Old World" system: from the Ionian Sea and the Syrtic Basin (Gulf of Sidra) in the west to the Levantine seaboard in the east;  
b, generalized boundary of the *areal* extent of the western half of the region in which Lapita-style pottery has been recovered; from the Bismarck Archipelago and southeastern Papua in the west to an arbitrary line in the east that runs approximately N–S, from the Santa Cruz Islands through Vanuatu to New Caledonia.
Fig. 3.  

a, E. Med. as in Fig 2a;  
b, generalized boundary of the coastal extent of eastern Papua New Guinea; from the Papuan Gulf in the west, along the southern coast, around the southeastern tip, and northwest to Collingwood Bay;  
c, generalized boundary of the widest areal extent of the kula ring; from the Trobriands in the northwest to Tubetube in the southwest, and from Laughlan in the northeast to Misima in the southeast.
Fig 4.  

a, generalized boundary of the *coastal* and *areal* extent of hypothesized Aegean Bronze Age regional exchange system, from the Ionian Sea and Strait of Otranto in the west, south to and including Crete, east to Rhodes, and northeast to the western coast of Anatolia; 

b, generalized boundary of the *coastal* and *areal* extent of the local (intra-island) Cypriot Bronze Age exchange system; 

c, Papua and Kula as in Fig. 3b, c.
TABLE 2. RESPONSES TO DEMAND (ARCHAEOLOGICAL INDICATORS OF CHANGE)

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>PREHISTORIC BRONZE AGE CYPRUS (ABOUT 2500–1700 B.C.)</th>
<th>MAILU (Ma), MOTUPORE (Mo), PAPUAN GULF (PG), PORT MORESBY (PM) (MINIMAL APPROX. DATES)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovation</td>
<td>(External?) Demand for copper</td>
<td>MaMo: Demand for obsidian, shell, ceramics, axes</td>
</tr>
<tr>
<td></td>
<td>Regional exchange system</td>
<td>Ma: Peak in obsidian imports (A.D. 1200–1600)</td>
</tr>
<tr>
<td></td>
<td>Specialized ceramic and copper exports</td>
<td>MaMo: Specialized trade in manufactures and raw materials (by A.D. 1600)</td>
</tr>
<tr>
<td></td>
<td>First attested ceramic and metal imports</td>
<td>MaMo: Specialized coastal trading centers (A.D. 1200–1600)</td>
</tr>
<tr>
<td></td>
<td>Differential burial practices; elaboration in grave goods</td>
<td>MaMo: Specialized trade in manufactures and raw materials (by A.D. 1600)</td>
</tr>
<tr>
<td></td>
<td>Mould-cast metal weapons/tools/ornaments</td>
<td>PGPM: Warfare (ethnographic: post A.D. 1850)</td>
</tr>
<tr>
<td></td>
<td>Increased site size/population*</td>
<td>MaMo: Population increase (A.D. 1600–1700)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(increased number/size of sites)*</td>
</tr>
<tr>
<td>Intensification of Production</td>
<td>Copper mining and production</td>
<td>MaMo: Specialized ceramic production (post A.D. 1200)</td>
</tr>
<tr>
<td></td>
<td>Ceramics (Red Polished and White Painted traditions)</td>
<td>Mo: Shell manufacture (post A.D. 1200)</td>
</tr>
<tr>
<td></td>
<td>Agricultural: cattle and plow complex</td>
<td>MaMo: &quot;Monopoly&quot; on ceramic manufacture and distribution (A.D. 1500–1600)</td>
</tr>
<tr>
<td></td>
<td>Specialized: antigorite, bead/shell, ground stone tools</td>
<td>Transport within regional trade systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dugout canoes</td>
</tr>
<tr>
<td>Expansion of Capital Factors</td>
<td>Intra-island transport of copper; intersite relations</td>
<td>Ma: Trade &quot;monopoly&quot; in obsidian? (A.D. 1600)</td>
</tr>
<tr>
<td></td>
<td>Oared longships (for copper export?)</td>
<td>Amph: Trade &quot;monopoly&quot; on pottery supply to Trobriands (Amphletts: A.D. 1400)</td>
</tr>
<tr>
<td></td>
<td>Extractive metallurgical technology</td>
<td>Ma: Specialized ceramic production (post A.D. 1200)</td>
</tr>
<tr>
<td></td>
<td>Centralized storage</td>
<td>MaMo: Population (labor?) increase (A.D. 1600–1700)</td>
</tr>
<tr>
<td></td>
<td>Public structure (Mosphilia)?</td>
<td>Public wealth displays (ethnographic)</td>
</tr>
<tr>
<td></td>
<td>Increased labor inputs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Extensive agriculture &amp; forest clearance</td>
<td></td>
</tr>
</tbody>
</table>

* Site sizes: CYPRUS: Kissonerga (Mosphilia), 12 ha; Alambra (Montes), 15 ha; Dhali (Kafkallia), 12 ha; Kalopsidha (Tsaoudhi Chiftlik), 20 ha. MELANESIAN SITES: Motupore, 2 ha; Taurama (PM), 3 ha; Nebira (PM), 10 ha.
sumption of basic resources, and where management or control of resources pro-

vides a direct path to sociopolitical power (Brookfield 1984:27; Halstead 1989:70–

80). Even if class-organized, complex politics occasionally developed before state

formation (Adams 1984:88; Wright 1984:69), the actual transformation to a special-

ized, decision-making, state organization was rapid (Wright 1986:358). A compara-

tive, evolutionary view of politicoeconomic organization and complexity orders

society along a continuum and seeks to measure changes in cultural complexity

through qualitative or quantitative analysis of relevant variables (Cherry 1984:23;


Although social complexity may be readily conceived along a continuous scale,

the use of discrete stages is still useful heuristically (Earle 1987a). In the Brumfiel and

Earle volume, various contributors discuss the role of specialization and exchange—

particularly but not exclusively in terms of subsistence goods and wealth, staple or

wealth finance, and independent or attached specialists—in certain complex societies

that lack highly integrated economies: chiefdoms (Mississippian, Copper Age

Iberia), complex chiefdoms (Early Bronze Age northern Europe, Hawaii, Low-

land Maya Late Classic), states/empires (Inca Empire, Yamoto state, Aztec state,

Neolithic–Bronze Age Mesopotamia). For Tainter, who divides complex societies

only into simpler polities and the state (1988:24–28), “economic specialization, ex-

change, and coordination” are features of complex chiefly societies “at higher levels

of political differentiation” (1988:25; emphasis added). Evolutionary typologies of

human society and social complexity, in other words, may facilitate scholarly com-

munication and comparison (Tainter 1988:29), but degrees of variation among

societies limit the usefulness of stages and preclude more appropriate concentration

on processes of stability, change, or discontinuity (Earle 1987a:280; McGuire


Tainter argues that certain constituent components of complexity—agriculture

and resource production, information processing, sociopolitical control and spe-

cialization, and overall economic productivity—form an interdependent system in

which each sphere represents human investments in stability and welfare (1988:94).

By contrast, contributors to Brumfiel and Earle draw important distinctions be-

tween economic and “adaptationist” models, on the one hand, and on the other a

“political” model (herein “politicoeconomic”) held to be the key for understanding

elite roles in organizing specialization and exchange within emergent and developed

complex societies:

The political approach reverses the primary direction of causality in the model. Spe-

cialization, induced by environmental and demographic conditions, is not seen as caus-

ing political complexity. Quite the opposite, political complexity causes the elabora-

tion of specialization as a means to strengthen political and economic control. (Earle

1987b:67)

Given Brumfiel and Earle’s aversion to an adaptationist model, and their unstated

but underlying predilection to understand innovation in terms of independent

invention, exogenous influence—in the form of “exotic” goods or interregional

exchange systems, for example—receives scant attention (Brumfiel and Earle 1987:

2–3). Yet the adoption of innovation, whether the result of endogenous change or

stimulus diffusion, forms part of a single process (Harris 1968:378; Kelley 1971:

61), and social evolutionary studies must consider how internal conditions facilitate
or forestall the impact of external factors on human sociocultural systems (Bargatzky 1985:290).

Because detailed arguments for such processes in the emergence of social complexity on Bronze Age Cyprus have been presented elsewhere (Knapp 1986b, 1988b, 1990), only one further point needs emphasis: emergent complex polities often show various social, politicoeconomic, or symbolic patterns convergent with those of well-established, socially complex, external elites (e.g., Renfrew and Cherry 1986). Changes in local elite material patterns towards those typical of an exogenous, complex polity eventually result in a shift from social autonomy to social interdependence; an asymmetrical relationship between two (or more) polities becomes one of mutual interdependence (Schortman and Urban 1987:74–75). As information and material flows increase and organizational structure evolves, members of an interaction sphere often coalesce into an interregional system which, even as it adds another level of complexity, heightens interdependence on economic-ideological inputs and concomitantly increases the likelihood of “coextinction” (Schortman and Urban 1987:75–77; Futuyama 1979:468).

Having called into service an important principle of evolutionary biology, it is necessary at least to make a statement on the appropriateness of biological models for the explanation of sociocultural complexity. Eloquent negative arguments (Yoffee 1979; Adams 1984:117–121; Tainter 1988:84) are offset by equally eloquent positive ones (Bray 1973; Dunnell 1980; Wenke 1981:111–119; Rindos 1985). Yoffee’s position has been restated forcefully in one of the volumes under review:

The evolution of the solar system and the evolution of biological life on earth are obviously related but also must be considered separable for purposes of scientific investigation. In judging “goodness of fit” between appropriate theory and problems needing to be solved, therefore, it is clear that biological and social evolutionary processes differ in their fundamental domains and in the paces and kinds of change that occur within them. No single theory of evolution can account for both biological and social change. (Yoffee 1988:8)

In summarizing his own counterpoint to the use of biological models, Adams (1984:117–121) cited another caveat against biological models, this one from a Nobel prizewinner in physics:

The ability to reduce everything to simple fundamental laws does not imply the ability to start from those laws and reconstruct the universe. . . . The constructionist hypothesis breaks down when confronted with the twin difficulties of scale and complexity. The behavior of large and complex aggregates of elementary particles, it turns out, is not to be understood in terms of a simple extrapolation of the properties of a few particles. Instead, at each new level of complexity entirely new properties appear, and the understanding of the new behaviors requires research which I think is as fundamental in its nature as any other. (Anderson 1972:393)

It must be pointed out, however, that evolutionary biology has addressed at least some of these antireductionist arguments (see, e.g., Grene 1988). Because biology’s subject matter is historical in nature, yet generated by evolutionary processes, it remains a “bifurcated science”: “In effect, changes within a [biological] system are subject to a set of laws, but abrupt historically specific transitions also take place between systems” (Blute 1979:54–55).

Social scientists are indebted to biology inasmuch as biological models have pointed the way to describe and theorize about a historical process (Blute 1979:58;
Bray once considered the relationship between biological and cultural change (1973) and perceived that the core issue was whether change was generated and propagated in a Lamarckian or Neo-Darwinian manner (see Leonard and Jones 1987). Whereas archaeologists often presume that innovation is intentional and adaptive, they have seldom related adaptation to the process of selection, which for biologists is the key to understanding adaptation. If it is accepted that the search for ultimate origins and the explanation of sharp disjunctions in the rate and scale of change are better realized through recourse to fundamental Darwinian concepts such as variation and selection (Cherry 1986:44), one obvious benefit of a biological model is that it makes no assumption about the direction of social change (Blute 1979:55–58; Lewthwaite 1987).

Power Relations and Complexity

Brumfiel and Earle’s basic politicoeconomic model—in which primary emphasis is given to the goals of political elites, or to the opportunities or constraints within which they operate—is elaborated, refined, and exemplified through ethnological (Rowlands), archaeological (Muller, Gilman, Kristiansen), or archaeological-documentary (Earle, Rice, Barnes, Brumfiel, Galvin) case studies. The integral roles of symbols, ideology, and wealth finance in promoting and stabilizing politicoeconomic organization are especially well illustrated in (ethnohistoric) studies by Earle and Brumfiel, and in Rowlands’ (ethnological) study. Instrumental in the development of sociopolitical complexity and change are competition, ideology, and the establishment of power relations among elites. As Earle states in his case study of Hawaii chiefdoms and the Inca (1987b:68), “institutional elaboration as related to attempts to maintain and extend economic and political control underlies the increasing scale of complex societies.” The real contribution of the volume is to evaluate how specialization and exchange are linked to the economic and ideological basis of expanding political authority.

Power may be defined as the capacity to limit behavioral alternatives through force, threat, manipulation, or persuasion (Claessen 1983:214). Power strategies may be enhanced by material objects, ideologies, and control over factors of production (Gamble 1986b:235). The accumulation of permanent, paramount, and enforceable authority results in the first place from successful competition among elite-established coalitions or alliances (Peebles 1983:194), many of which would have been mediated by elite wealth (Brumfiel and Earle 1987:8). Competition is often most intense over differential access to or control of basic resources (e.g., land, water, metal, obsidian) or “wealth” items that involve security rather than efficiency (e.g., bronze weapons and tools). The capacity to organize the production and distribution of essential resources or high-quality goods in demand was an effective political tool.

Power also derives from the segregation and manipulation of symbols, rituals, or ceremonial activities that allow emergent elites to transform their social roles. Ideology, in other words, is not simply a reflection of or accompaniment to sociopolitical change (Brumfiel and Earle 1987:9); rather it is a means to maintain, resist, or change power relations within society (Knapp 1988a:139). Ideology serves to establish and legitimate social position and political authority, and to validate the politicoeconomic basis of that authority. Even if effective political power had been limited,
ideological sanctions would have provided a way to develop and organize economic strategies, and to establish political configurations to direct those strategies.

Legitimization, in turn, requires a genuine commitment of resources to meet various demands of the supporting population. The development and legitimization of hierarchical authority structures were not carried out in a social vacuum: mixed, egalitarian social relations were replaced by more fixed, ranked, or stratified ones, and behavior was prescribed more by achieved social structures than by kinship bonds (Tainter 1988:25, 28).

Legitimization and social stratification are important components of both conflict and integration theories of state formation. Conflict theory focuses on issues associated with class struggles that emerge from differential economic success; integration theory is related to issues associated with ruling institutions that develop to manage society-wide stresses (Tainter 1988:37, 193–194). From the perspective of the ruled, the beneficent aspects of stratification (goods, services, social order, and wellbeing) must be weighed against coercive costs (Haas 1982:82–83). From the perspective of the ruler, coercion is costlier than cooperation, but legitimization also involves provision of “real outputs” (Tainter 1988:36–37). The inability of complex polities to meet such costs or to resolve perceived problems associated with such costs diminishes support for central authority and may lead to collapse.

Growth in social complexity involves the regulation of more social and economic networks through increased hierarchical controls; the organization of increased information flow; subsistence support for specialist producers; and intensified production, distribution, and transportation facilities to support the growth of economic interdependence. Such organizational factors are costly to maintain, and the ratio of benefits to investments in complexity will vary. Tainter argues that such variations on investment in complexity follow a curve of “diminishing marginal returns,” an important and recurrent aspects of sociopolitical evolution (1988:92), and one that finds alternative and perhaps more appropriate means of expression in the literature (e.g., Adams 1978; Yoffee 1988:12–14, summarizing Eisenstadt 1969).

Lewthwaite (1987) sagely reminds us that any explanation of increasing stratification might as well be understood in terms of the relaxation of one conditioning framework (egalitarian farming communities) as the imposition of another (differentiation into hierarchical production centers). Although the combined necessary and sufficient conditions that set the stage for the development of social complexity may vary according to ecological, sociopolitical, or technological opportunities or constraints peculiar to different cultures, sophisticated explanatory frameworks, such as Brumfiel and Earle’s politicoeconomic model, or Renfrew and Cherry’s “Peer Polity Interaction” (1986; Knapp 1986c), take us a long way toward sorting out the vagaries of the archaeological record.

COLLAPSE

To explain collapse is to analyze and understand what constitutes vulnerability within complex polities. The aim of Yoffee’s introductory chapter (“Orienting Collapse”), reiterated in Cowgill’s social-science dissection of the concept of collapse, is to establish a framework wherein recurrent or particular conditions of collapse—as presented in the volume’s case studies—can be examined intensively from a comparative perspective. In stark contrast, Tainter’s goal is to produce a single, all-
encompassing model of sociopolitical collapse, and to evaluate that explanatory model through detailed, qualitative investigation of the Roman, Mayan, and Chacoan collapses.

Case studies in both “collapse” volumes make it clear that those variables which contribute to complexity also contribute to collapse. Culbert, for example, suggests that the Mayan politicoeconomic system never attained equilibrium: factors that promoted constant “growth” may also have generated a trajectory toward disintegration (1988:77). Integrative mechanisms and ideological doctrines are double-edged swords: factors that help to shape complexity and serve to legitimize and vindicate power may subsequently shatter unity and limit authority (Kaufman 1988:226–227).

The failure of integrative/regulative mechanisms is inherent in any social system. The construction of social or politicoeconomic systems (as well as system boundaries) may generate variance or contradictions that result in transformation, decline, or discontinuity (Eisenstadt 1988:242); this observation directly affects Allen’s climb-and-collapse model of trade in Melanesia (1984a:442–448). Within this reflexive relationship, the process of collapse may include the social, ideological, and integrative seeds of reconstruction (Eisenstadt 1988:243). Hsu’s study of Han China, for example, reveals that the Literati who made up the bureaucracy not only contributed to the Han collapse but also facilitated the reformulation of later Chinese states (Hsu 1988:194–195; Yoffee 1988:16).

The salient point, exemplified here and emphasized in both “collapse” volumes, is that complex, state-level societies are prone to conflict, difficult to regulate, and atypical in sociocultural evolution (Cowgill 1988:254). Adams forcefully stresses the need for a disequilibrium (“conflict and variance”) model, one that concentrates on indeterminacy and discontinuity (Adams 1988:29–32).

Turning to definitions, for Yoffee (1988:13),

Collapse . . . ensues when the center is no longer able to secure resources from the periphery, usually having lost the “legitimacy” through which it could “disembd” goods and services of traditionally organized groups. The process of collapse entails the dissolution of those centralized institutions that had facilitated the transmission of resources and information, the settlement of intergroup disputes, and the legitimate expression of differentiated organizational components.

Tainter’s definition is more elliptical (1988:4; his emphasis): “Collapse . . . is a political process. It may, and often does, have consequences in such areas as economics, art, and literature, but it is fundamentally a matter of the sociopolitical sphere. A society has collapsed when it displays a rapid, significant loss of an established level of sociopolitical complexity.”

Although both volumes generally regard collapse as a process of political fragmentation, case studies in Yoffee and Cowgill deal solely with the collapse of complex polities (states, empires, or “civilizations”/“great cultural traditions” [Cowgill 1988:256]): Mesopotamia (Yoffee, Adams), Maya (Culbert), Teotihuacan (Millon), Roman (Bowersock), Han China (Hsu), South/Southeast Asia (Bronson). The editors’ chief concern is to consider the problems and failures of statecraft (Cowgill 1988:256–257); collapse, however, is never viewed as final, and close attention is given to postcollapse developments. With the possible exception of politics that
collapse as a result of natural disasters, Yoffee maintains that no "civilization" ever collapses rapidly, or equally in all its subdivisions (1988:18; Adams 1988:21).

In contrast, Tainter's model of collapse is unrestricted with respect to type of society and level of complexity, and collapse is viewed as a sudden, major, all-or-nothing proposition (pp. 4–5). Whereas Yoffee regards collapse as the restructuring and reintegration of social institutions (1988:11–14; Eisenstadt 1988:238–239), Tainter regards it as an "economizing process," a return to "the normal human condition of lower complexity" (p. 198; similarly, Cowgill 1988:267).

Allen's model of prehistoric Melanesian trade portrays a subtle variation on this theme: long-term overall growth in exchange systems was punctuated by periodic instability and collapse, and accompanied by a reduction in geographic extent (1984a:444, Fig. 2); a similar model of local discontinuity within a system of general evolution is presented by Ekholm (1980:156, Fig. 1). Initial testing of this model against the flow of Bismarck obsidian into southeast Solomon Lapita sites, and the distribution of local chert and imported obsidian in the Mailu area, substantiates many of its assumptions (Allen 1985:52–53).

Yoffee maintains that collapse results from the interplay of institutional conflicts, from contradictions between the forces and relations of production, and from divergent center-periphery goals. Loss of legitimation by a political center, together with an inability to secure resources or surpluses from the periphery, jeopardizes organizational premises related to information processing, the resolution of intersocietal conflict, and the expression of authority (1988:12–13). The flexibility (or "resilience") necessary to maintain such complex relationships breaks down, and the center's "maximizing" tendencies undermine its legitimation, erode peripheral support, and ultimately lead to socioeconomic disintegration and collapse. Eisenstadt's incisive chapter adds another important dimension (1988:236): "The . . . collapse of ancient states and civilizations is one example . . . of the larger problem of how social boundaries are restructured and reconstructed, with particular reference to the boundaries of political systems." Whereas increasing social complexity involves the construction and maintenance of various mechanisms for systemic integration and control, social collapse usually entails subsystemic change, what Eisenstadt terms the restructuring of sociopolitical system boundaries.

Tainter provides a "trait list" to identify instances of social collapse (p. 4), outlines the characteristics of postcollapse societies (pp. 19–20), and summarizes them in a doomsday narrative:

The overarching structure that provides support services to the populations loses capability or disappears entirely. No longer can the populace rely upon external defense and internal order, maintenance of public works, or delivery of food and material goods. Organization reduces to the lowest level that is economically sustainable, so that a variety of contending polities exist where there had been peace and unity. Remaining populations must become locally self-sufficient to a degree not seen for several generations. Groups that had formerly been economic and political partners now become strangers, even threatening competitors. The world as seen from any locality perceptibly shrinks, and over the horizon lies the unknown. (p. 20)

The historical overview of collapse provided in the two volumes is notably at odds: Yoffee's discussion is clear and concise, and takes note of works by Spengler, Toynbee, Rappaport, and two lesser-known Malthusian types (1988:2–6). In dis-
cussing collapse as an evolutionary product, Yoffee and Cowgill find the use of biological analogies seriously wanting, and the scope of general systems theory too vague, abstract, or presumptive of highly integrated, well-regulated, sociocultural entities (Yoffee 1988:6–11; Cowgill 1988:251–255). Yoffee prefers to explore the principles of political stability and pathology, and to analyze collapse as the restructuring of social institutions (1988:11–14), within frameworks rooted in historical sociology (Eisenstadt) and political anthropology (Kaufman).

Tainter’s meandering narrative presents 18 cultural vignettes in the introductory chapter (pp. 5–18); offers the views of historians (Spengler and Toynbee) and social scientists (Sorokin, Kroeber, Coulborn, and others) in a separate chapter (pp. 39–42); and, having discussed 11 themes around which most prior evaluations of complexity are said to have revolved, goes on to assess each theme with reference to a further series of culture-historical vignettes (pp. 42–89). Although this borders on overkill, Tainter is at pains to show that, despite a concerted effort in both the social and historical sciences to understand the process of collapse, most explanatory themes—except the economic one—have failed in their objective. Having thus set a stage replete with illogical scenarios, unexplained variability, and mystical solutions, Tainter offers his antidote: understanding collapse through the marginal productivity of sociopolitical change.

The basis of Tainter’s model—the Law of Diminishing Returns (LDR)—is purely economic, and has been used extensively by development economists to analyze subsistence regimes (agricultural or horticultural) since the pioneering work of Boserup (1965), Geertz (1963), and Brookfield (1972). The hypothetical marginal and average product curves used by Boserup and Geertz (presented in Brookfield [1984:18, Fig. 1]) and the economist’s “Classic” marginal productivity curve (presented in Brookfield [1984:19, Fig. 2]) should be compared, respectively, with Tainter’s marginal–average product curve (p. 93, Fig. 1) and his “diminishing marginal productivity” curve (p. 119, Fig. 19). Renfrew’s pioneering archaeological efforts with the LDR (Renfrew 1972:36–37), and his concise discussion and portrayal of the production function in agricultural intensification (not collapse)—and its application to Neolithic–Bronze Age Melos in the Aegean—form an important archaeological forerunner to Tainter’s model (Renfrew 1982:265–275, Figs. 20.1–20.6) but receive little acknowledgment beyond a nod to the role of emigration in relieving demographic stress (Tainter 1988:123).

The crux of Tainter’s economic model, thinly veiled in sociopolitical dress, is that once the costs of complexity begin to outweigh the benefits, further investment will fail to yield proportionately increasing returns and, barring acquisition of technological innovation or new energy sources, society will become increasingly vulnerable to collapse. “Among whatever set of resources a population obtains, for whatever reasons, the law of diminishing returns is likely to apply” (Tainter 1988:111; original emphasis).

This same theme is adumbrated in many of the contributions to the Yoffee and Cowgill volume, albeit with a lighter touch (e.g., Culbert 1988:100–101; Bowersock 1988:172; Bronson 1988:215; Kaufman 1988:231–232; Cowgill 1988:239, 276), and with a more pluralistic and penetrating approach. Although societies that experience declining marginal productivity develop regulating mechanisms to cope with perturbations, any society’s net productive reserves (energy, minerals, hoarded surpluses) will be taxed and weakened by “major, unexpected stress surges” (e.g.,

Tainter assesses his model’s importance for understanding collapse through detailed consideration of three case studies which represent quite different levels of complexity, and which exemplify both historically documented and archaeologically attested instances of collapse (Tainter 1988:128–192). How does the “marginal product of increasing complexity” add to what is known of the Roman, Mayan, and Chacoan collapses? How does it compare with analyses of the Roman and Mayan collapses presented in the Yoffee and Cowgill volume? Is declining marginal productivity a basic, underlying process of collapse, or another “Grand Theory” (Skinner 1985), too vague to explain individual variation?

Tainter suggests that what affected each polity so adversely was (1) how one or several factors—environment and subsistence, external pressure or internal conflict, population growth, sociopolitical dysfunction or catastrophe—were related to the cost/benefit ratio of investment in complexity, and (2) how collapses became increasingly likely when various challenges or stresses led to excessive deterioration in this ratio. For the Romans, it was the excessive costs of maintaining an extensive empire in a hostile environment by means of a devastating tax levied on a much-reduced peasantry. Bowersock, in contrast, points out that the world of Late Roman Antiquity was in the process of “transformation, reformation, and relocation” (1988:171), and questions both population decline and the presumed falloff in productivity.

For the Mayans, the burdens of an increasingly costly society were borne by a weakened and increasingly resistant peasant population in the context of environmental deterioration or overexploitation—an evaluation that finds much in common with that of Culbert. For Culbert, however, subsistence failure is the key variable: short-term agricultural intensification was incompatible with long-term ecological stability (1988:99–100). For the inhabitants of the San Juan River Basin, the continued addition to the Chacoan network of low resource-diversity communities reduced its buffering effectiveness to the point that the costs of participation in comparison to benefits became too high, and some of the most productive communities withdrew from the system (Tainter 1988:191–192).

In these case studies, the costs of complexity increased—usually for a weakened population—while benefits decreased; population leveled or declined while well-being deteriorated (Roman and Mayan); the environment was overutilized, probably as a result of population pressure on resources (Mayan and Chacoan); peripheral peoples (“barbarians”) rose to prominence after collapse (Tainter 1988:191). Diminished services, a faltering economy, declining productivity, and increasing ideological strife may combine in a negative multiplier effect until separation or disintegration into smaller, independent polities becomes preferable and inevitable (Tainter 1988:120–123). In Tainter’s view, societies collapse not because they fail to respond to such changed circumstances but because—in the face of declining marginal productivity—collapse is the most appropriate response (Tainter 1988:198). For Tainter, therefore, collapse is adaptive, which is tantamount to saying that bankruptcy is an adaptation to wealth. Something is much amiss here.

The process of collapse occurs in each society or social interaction sphere amid at least some partially unique circumstances. Cowgill (1988:245) emphasized the need to narrow the gap between abstract Grand Theory (specious in clarity) and subtle,
meticulously detailed, particularizing case studies (sterile in generalization) (similarly, Adams 1988:37). But this is not to deny the utility of “parsimonious theory” in the analysis of individual and regional cultural histories (Cowgill 1988:245). Where the principle of diminishing marginal productivity obtains within a particular society, it must follow a unique trajectory. And, as examples in both collapse volumes demonstrate, change in declining marginal returns—and associated organizational changes—often occur as a response to external conditions (Tainter 1988:209; Kaufman 1988:224–225, 229).

In the case of interacting, potentially competitive “peer polities” (Renfrew and Cherry 1986), as opposed to more isolated, states, Tainter makes two points: (a) collapse to a lower level of complexity invites dominance by another member of the interaction sphere; (b) investment in organizational complexity must therefore be maintained at the level of one’s peers, whatever the cost (a sort of “keeping up with the Mayans” model). This leads Tainter to formulate his final—clearly faulted—principle of collapse (1988:202; original emphasis):

Collapse occurs, and can only occur, in a power vacuum. Collapse is possible only where there is no competitor strong enough to fill the political vacuum of disintegration. Where such a competitor does exist there can be no collapse, for the competitor will expand territorially to administer the population left leaderless. . . . Where peer polities interact collapse will affect all equally, if and when it occurs, provided that no outsider competitor is powerful enough to absorb all.

Tainter discusses this principle with reference to the Mayan and “Mycenaean” collapses. Mayanists will have to speak for themselves, but such an analysis presents problems in the interpretation of the widespread, intersystemic collapse at the end of the Bronze Age in the eastern Mediterranean, of which the “Mycenaean” represents only one component (Shrimpton 1987). In the last two centuries of the eastern Mediterranean Late Bronze Age (about 1400–1200 B.C.), major inland (Egyptian, Assyrian, Hittite) and maritime (Aegean [“Mycenaean”], Levantine, Cypriot) powers thrived and depended on a wide-reaching interaction network, and on Levantine, Aegean, Egyptian, and Cypriot ports where basic resources and other commodities in demand—metals, ceramics, luxury items, and comestibles—were available (Knapp 1989; Portugali and Knapp 1985:64–67; Sherratt n.d.a).

This elaborate, overspecialized, closely linked network of production, consumption, and exchange relied on dependable, cost-effective transportation and communications. As a result, it was vulnerable to a host of factors associated with competition, interregional conflict, and political disruption (Sherratt n.d.a). In light of Tainter’s proposition, it may also be assumed that some of these polities were affected by declining marginal productivity (this proposition is likely for Assyrian and Egyptian polities, possible for the Mycenaean one). Because their prosperity and wellbeing required conditions of security throughout the interaction sphere, these interregional politicoeconomic alliances were inherently unstable.

Tainter’s “last principle” holds that collapse would occur simultaneously among interacting peer polities. Unless the concept of simultaneity is stretched to cover at least a century-long horizon of collapse (about 1250–1150 B.C.) throughout the eastern Mediterranean interaction sphere (Knapp 1986b:96–111, 1988c:181–183, 211–215; Liverani 1987), this principle seems problematic, despite the vagueness of the chronological resolution. Whereas competing Mycenaean city-states may have undergone more closely contemporaneous collapse, this was clearly not the case for
the wider interaction sphere. Furthermore, none of the separate but economically interlinked "dominant powers"—which were both close enough and powerful enough to take advantage of a deteriorating situation—assumed supremacy, as Tainter argued they must (p. 202).

Tainter rightly cautioned, however, that ambiguity surrounds the issue of population loss or emigration accompanying collapse (p. 199). Because the process of collapse in the eastern Mediterranean probably lasted up to 100 years before all power centers concerned were affected, population loss in one area (Mycenaean Greece, for example, which may have been the earliest polity to collapse) may have resulted in emigration to other areas (Cyprus, Cilicia, the Levant) (see, e.g., Sherratt and Crouwel 1987). Furthermore, the negative impact that collapse exercises on political and administrative elites does not necessarily extend to the entire population (Tainter 1988:198), nor is it always felt evenly and instantaneously throughout the entire interaction sphere. In the study of collapse, it is essential to specify which kinds of social boundaries are failing, and how these affect other organizational boundaries (Eisenstadt 1988:238).

In the drawn-out process of collapse in the Bronze Age eastern Mediterranean, it seems evident that some areas (e.g., Cyprus) had the opportunity to recover and realign themselves while others (e.g., the Levant, Egypt) were still undergoing the process of collapse. Detailed discussion of the Cypriot collapse and (comparatively rapid) recovery has been presented elsewhere (e.g., Knapp 1988d:167–170). To illustrate Yoffee's dictum that collapse is seldom, if ever, final and that more attention should be given to postcollapse processes (1988:18), it may be added that what began as a collapse of the eastern Mediterranean interaction sphere led to the development and extension of new westward maritime routes in the quest for new supplies of metal and other resources in demand (Sherratt n.d.b; Liverani 1987); to the establishment of the broader, specifically Mediterranean economic and exchange systems of the first millennium B.C. (Frankenstein and Rowlands 1978; Knapp 1989); and ultimately to the far-flung politicoeconomic machine that was the Roman Empire.

**Complexity and Collapse: Past, Present, Future**

Is collapse inevitable for every complex society? From a contemporary perspective on past polities, the answer is a resounding yes, even if the process was rarely final and occasionally lasted for centuries (see Yoffee's Mesopotamian and Millon's Mesoamerican case studies). Although no modern intellectual field of enquiry can tell us whether all complex societies must collapse, contributors to Yoffee and Cowgill's volume have mustered and examined a variety of disequilibrating factors that affect complex sociopolitical systems: center-periphery strife; differential rates and effects of collapse; maximization-resilience strategies, and the like. Tainter has eloquently and not at all parsimoniously presented a commonplace: whether politico-economic regimes are repressive or benign, where declining marginal productivity takes effect without checks, balances, or new inputs of energy, societies become increasingly vulnerable to collapse. In both volumes, it is argued that where the necessary capital, technological expertise, or economic and demographic incentives exist, complex polities may develop new economic or energy subsidies to help forestall collapse (Tainter 1988:199; Culbert 1988:100–101; Kaufman 1988:231–232).
Tainter maintains that he has placed contemporary “civilization” in historical perspective, and sought to apply a universal principle that links past, present, and future. Yoffee and Cowgill argue that a focus on modern-day concerns about the limits of growth and the possible decline of western civilization would be counterproductive; they probably find Tainter’s “Grand Theory” as overdramatic and simplistic as the nineteenth-century biological, doom-and-gloom views it attempts to supersede. Tainter’s focus on collapse, however, has implications for the direction of all industrial societies (see esp. pp. 209–216). Even if twentieth-century global complex society is enjoying a respite from collapse in the context of a dubious (but essential?) power proliferation (as opposed to a power vacuum), we cannot regard ourselves as unique amid the inevitable oscillations and forceful vortices of world history. Scientific advances and material “progress,” nonetheless, have brought the modern world to an unprecedented nuclear brink (Adams 1988:20).

The Yoffee and Cowgill volume brings out clearly the variety of ways in which humanistic science formulates issues and evaluates problems related to collapse. Tainter’s model illustrates but one way and, whereas its economic basis cannot be faulted, some of its “principles” are spurious, and at best it deals with proximate—not ultimate—causality. Nonetheless, both collapse volumes provide important new impetus and deserve a readership not only in archaeology but in anthropology, history, historical sociology, economic history, and classics.

Because this study has attempted to exemplify through the generous use of quotations the thrust of each volume, as well as the important insights that all three contribute to issues of specialization, complexity, and collapse, it is appropriate to conclude in a similar vein (Tainter 1988:197): “An end to the artistic and literary features of civilization, and to the umbrella of service and protection that an administration provides, are seen as fearful events, truly paradise lost.”

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