

Patterns of Exchange and the Social Production of Pigs in Highland New Guinea: Their Relevance to Questions About the Origins and Evolution of Agriculture

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In recent years, cultural anthropologists have made notable progress in understanding the bewildering variety of material exchange transactions found among the aboriginal populations of highland New Guinea. One of the major findings of this work is that competitive exchange behavior may bring in its wake alterations in agronomic practices involving an intensification of production. That intensification is primarily a product of social behavior, rather than an adaptation to climate change or population pressure, is a significant conclusion that should influence the thinking of archaeologists as they investigate past episodes of agronomic change, including the origins of agriculture.

KEY WORDS: highland New Guinea; economic anthropology; social exchange theory; neolithic agriculture; pig husbandry.

. . . The political life is a stimulus to production.
Sahlins (1972, p. 135)

The exchange of weapons, ornaments, and livestock . . . form one system of circulation which is directly politico-ritual in function and operates as a kind of pump to stimulate the production of food and other forms of surplus.
Rowlands (1980, p. 46)

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INTRODUCTION

This research summary departs slightly from the usual format of the *Journal of Archaeological Research*, and we thank the editors for allowing us an opportunity to do things a little differently in order to achieve what we think will be a beneficial outcome. In the following, we review a rapidly growing and exciting body of ethnographic literature on highland New Guinea exchange behavior. Our aim is to illustrate the potential utility of these studies for addressing questions of central importance to archaeological inquiry, particularly related to the explanation of agricultural change. In fact, we feel strongly that recent highland New Guinea ethnographic research, when coupled with related comparative work on exchange behavior, discussed below, makes up one of the most interesting and relevant bodies of literature archaeologists working in various world areas might draw from as they devise more robust behavioral theories of social and technological change. However, highland New Guinea researchers have not adequately addressed the question of how their results might inform archaeologists working in other world areas. Here we attempt partially to overcome this deficiency, by borrowing selectively from this literature, in a way we hope will be of direct benefit to archaeologists. While this paper constitutes only a small step toward elucidating the theoretical value of the highland New Guinea findings for archaeology, given the abundance and complexity of the ethnographic materials in question, we hope our approach will point the way toward what we think could be a productive avenue of comparative inquiry.

We contend in this paper that processual archaeologists will benefit from an expanded knowledge of social exchange behavior as they work toward a more sophisticated understanding of technological change and production intensification, including the origins of agriculture. This can be accomplished by placing agricultural decision-making more firmly in the context of systems of social interaction, rather than seeing it only in terms of material advantage as is assumed in cultural materialist theory (e.g., Harris, 1979). We argue that a social behavioral approach is important to address, because change in production systems may result from the striving for social status and power, in some cases in a manner counter to considerations of energy efficiency or successful environmental adaptation (see below). We can illustrate the difference between a materialist and social behavioral approach by reference to a recent comment in *Science* (Holden, 1994). Here, archaeologist Michael Rosenberg is quoted regarding a find of early domesticated pigs, dating to 10,000 B.P., near Hallan Ceni in eastern Turkey. He explains this finding of early pig domestication by reference to the fact that pigs "domesticate easily and don't require much work"

(many highland New Guinea women responsible for pig-keeping would find the second part of his statement unbelievable, we are sure). He also mentions Richard Redding's finding that pigs convert 35% of their food calories into meat, compared with a 13% conversion rate for sheep. Nowhere is it mentioned that in many parts of Asia where pigs were domesticated, they had important roles in social exchange systems and in other aspects of culture and society, including ritual sacrifice (Kim, 1994). Given the potential importance of such social and cultural factors, we believe it unacceptable to draw a simple and unquestioned cost-benefit explanation of agricultural change as Rosenberg did without also considering other possible causal factors. And one possible factor to consider is exchange; as Modjeska (1977, p. 74) points out for highland New Guinea, ". . . pigs are good for exchanging as well as for eating." In this paper, we draw on the ethnographic literature from one world area to show how systems of social exchange could impinge on decisions about agricultural production involving pigs and other domesticates.

BACKGROUND TO SOCIAL EXCHANGE THEORY

The exchange of goods and services, i.e., the giving, receiving, and returning of goods and services, between persons and groups, is a central element of the social and cultural behavior of people in all societies (Befu, 1977). During this century, especially, a number of authors have contributed to the development of social exchange theory by improving our understanding of the nature of exchange, its social and cultural consequences, and its cross-cultural and temporal variability (summarized by Befu, 1977; cf., Pryor, 1977). A variety of exchange behaviors can be identified, ranging from "transfers" (altruistic giving) where a good or service moves from one person or group to another, with no obligatory reciprocal exchange of any kind (e.g., Gregory, 1980; Parry, 1986; Pryor, 1977, Chap. 4), to various forms of reciprocal exchange, where a return of some kind is expected. The latter exchanges vary greatly in form and social consequences. Reciprocal gift exchange refers to a wide range of situations in which exchange is deeply imbedded in social relationships. In this form, exchange serves to create and reproduce those relationships. In contrast, in commercial exchange, including both barter and market exchange, the emphasis is on the movement of the good or service itself (as a commodity), rather than on the social relationship between the exchanging parties (e.g., Gregory, 1980, 1982; Humphrey and Hugh-Jones, 1992). Although reciprocal gift exchange is imbedded in enduring social relationships, it cannot be understood only as a mechanism promoting social solidarity. In some of its forms, for ex-

ample, where it involves competitive distributions of food or other goods, gift exchange is bound up in the striving for status and power, and may stimulate increased production, as is proposed in the quotation above (e.g., Gregory, 1980).

The volume and sophistication of writing on social exchange in sociocultural anthropology and related disciplines are growing rapidly, but archaeologists, in our opinion, have not tapped the potential of this creative and stimulating literature. We do not mean to imply that it would be easy to extract from current discussions of exchange a unified view of this domain of behavior, packaged for convenient archaeological consumption. Many problems remain to be resolved, one of which is a substantially confused and sometimes contradictory terminology (e.g., the discussions in Humphrey and Hugh-Jones, eds., 1992). Further, it is rarely the case that exchange theory directly or convincingly addresses issues of concern to cultural evolutionary inquiry. In particular, we note few attempts to connect analytical gift exchange to production strategies and technological change. A number of authors have asserted that just such a connection exists, as we point out below, but little has been done to test hypotheses of this type. In this paper we attempt a partial corrective to the latter shortcoming by relating exchange patterns and production intensity in a small-scale comparative study of 12 highland New Guinea societies, but this is only one step in a direction that will require much more analytical effort if exchange theory is to bear explanatory fruit for archaeology.

In two very stimulating presentations, Brian Hayden (1990, 1992) argues that socioeconomic competition among socially striving individuals provided the initial impetus to the domestication of those plants and animals used in competitive feasting ritual [cf., Bender (1978) for a comparable, although less specific theory relating social behavior to domestication]. Several ethnographically well-known examples of culturally instituted competitive exchange rituals can serve as ethnographic analogs for the kind of exchange behavior discussed by Hayden. We include here the potlatch of the Northwest coast, the Kula, and the Moka, Tee, and related exchange systems of highland New Guinea (the latter discussed below). Appadurai (1986, p. 21) uses the phrase "tournaments of value" to refer to this category of gift exchange ritual and describes them as follows: "Tournaments of value are complex periodic events that are removed in some culturally well-defined way from the routines of economic life. Participation in them is likely to be both a privilege of those in power and an instrument of status contests between them. The currency of such tournaments is also likely to be set apart through well understood cultural diacritics Finally, though such tournaments of value occur in special times and places, their forms and outcomes are always consequential for

the more mundane realities of power and value in everyday life." Tournaments of value are regarded as a class of reciprocal gift exchange behavior for two reasons: (1) While some proportion of the goods distributed ritually is produced by the distributor's household or faction, much of what is distributed is obtained through reciprocal gift exchanges with exchange partners ("trade partners"); and (2) the act of distributing goods in ritual events aims in part at creating new exchange obligations among those receiving goods, assuring a continued cycle of exchange and distribution. Tournaments of value thus simultaneously manifest enduring social relations through reciprocal exchange (i.e., they are "socially reproductive"), while at the same time their competitive dimension defines and reaffirms status and power differentials among participating individuals and groups (e.g., Gregory, 1980; Humphrey and Hugh-Jones, 1992).

Among the consequences of tournaments of value for mundane life may be a necessity to increase production intensity to fund the exchange events; a result could be pressure on production systems, leading to the domestication of plants and animals among other possible changes in production strategies. In Hayden's (1990, 1992) conceptualization of this process, biotechnological change would occur primarily in those food items involved directly in competitive feasting. In our conceptualization of this process, production intensification could involve more than just those exotic food items directly consumed as feasting items or distributed to gift recipients. Instead, there may develop a more generalized demand for increased production to fund such events, including staple foods, as in the case of highland New Guinea, where sweet potato production is intensified both to fatten the pigs that are central to the distributional events and to meet other production demands associated with the competitive distributional events, discussed below.

Currently, we lack a sufficient understanding of the natural history of tournaments of value. Where have such ritual exchange systems developed in the past, and when? We also lack a theory that would allow us to understand the circumstances bringing about their differential distribution in space and time, and their dynamics of growth and decline. Hayden (1990, 1992) proposes their development primarily in areas of rich resources, where increases in production intensity will not easily lead to environmental overexploitation. Cross-cultural and archaeological research will be required to evaluate this proposal; we make several suggestions along this line below. In this paper, we hope to contribute to an understanding of the nature and consequences of tournaments of value by looking in detail at one world area, highland New Guinea, where competitive exchange has been identified as a factor bringing about food production intensification. While we are unable to explain the differential development of tourna-

ments of value in this area, an examination of the nature of competitive exchange here leads us to several analytical conclusions regarding the relationships among exchange systems and production strategies.

EXCHANGE AND PIG HUSBANDRY IN HIGHLAND NEW GUINEA

In the following discussion of agricultural change, we do not make a hard and fast distinction between plant and animal domestication and agricultural intensification, although these are obviously not always identical processes. New agricultural strategies aimed at intensification could involve such factors as water control, terracing, etc., that do not specifically involve change in the gene frequencies of plants and animals. But intensification resulting from exchange activity could also result in an alteration of gene frequencies of plants and animals that we would recognize as domestication, for example, when sows are not allowed to mate at random with feral boars in order to regulate the age distribution of pig populations being prepared for distribution (Hide, 1981, Chap. 8) or when special varieties are bred that are considered desirable in gift distributions. Such strategies involve a process of agricultural intensification because in order to achieve a greater degree of control over the animal population, more labor input to animal keeping is required, but as a result, gene frequencies may be altered.

Anthropological thought about Melanesian pig-keeping has progressed through several distinct analytical phases. Because Melanesian pigs are raised primarily for purposes of ritual distributions of various kinds, pig-rearing was initially regarded by anthropologists as economically irrational. Linton (1969, pp. 98–99), for example, describes it as a “luxury occupation”; as he put it, the peoples of the New Hebrides, in particular, “seem to have gone hog wild” (cf., Vayda *et al.*, 1961, p. 69). Beginning in the 1960s, ecological anthropologists challenged these ideas, and saw Melanesian pig-keeping, instead, as an aspect of human adaptive systems, providing both a source of dietary protein and a buffer from food shortages in agriculturally poor years (Morren, 1977; Vayda *et al.*, 1961). Cycles of ritual slaughters of pigs were regarded as adaptive mechanisms regulating pig populations (Rappaport, 1967; Vayda *et al.*, 1961, p. 71). However, evidence for protein malnutrition among highland New Guinea groups, even among those who maintain the largest pig populations, offers a severe challenge to any theory of dietary advantage (e.g., Allen, 1984; Bourke, 1988; Brookfield and Brown, 1963, pp. 61, 74; Brown, 1978, pp. 51–60; Heider, 1970, p. 220; McArthur, 1977; Pospisil, 1963, pp. 375, 378; Rappaport, 1984,

Appendix II; Sinnett, 1977; Waddell, 1972, p. 128). Pig-keeping and the associated cultivation of sweet potatoes (the major pig food in most highland New Guinea societies) may actually exacerbate agricultural risk (Morren, 1986, p. 88; Newman, 1965, p. 75; Strathern, 1984a, p. 75; Watson, 1983, p. 58). And functionalist theories of ritual regulation have been questioned as well, a point we return to below (Bergman, 1975; Brookfield, 1973; Lederman, 1986, p. 176, *passim*; cf. Kelly and Rappaport, 1975; Rappaport, 1984, Epilog).

Watson (1977) offered an alternative view that emphasized a social-behavioral dimension of pig husbandry and intensified garden production, namely, "conscious intergroup competition" (p. 57), a process he termed the "Jones Effect" [Panoff (1970) had earlier suggested that exchange systems might influence production strategies in highland New Guinea]. Subsequent research addressing this contested issue strongly supports the causal priority of the Jones Effect. Many Melanesian researchers now see the elaborate complex of behaviors surrounding pig keeping primarily as an outcome of gift exchange (e.g., Rubel and Rosman, 1978), although there are complex mutual causal interactions also among population density and intensity of agricultural practices that are not as yet fully understood (Boyd, 1985, pp. 120-121; Brokfield, 1972; Brookfield and Hart, 1971, p. 120; Brown and Podolefsky, 1976; Waddell, 1972, pp. 217-220). The exchange perspective points to the fact that social solidarity as well as social status are bound up in material exchanges, often involving pigs (e.g., Glasse and Meggitt, 1969), and gift exchange behavior is seen strongly to influence agricultural production strategies (Modjeska, 1977). Brookfield (1972, pp. 37-39) argues that we distinguish conceptually between production for subsistence and "social production" that is bound up in exchange behaviors. According to Lederman (1986, p. 17), for example, social exchange creates "a high demand for pigs." Thus the elaboration of a pig husbandry and the attendant increased intensity of garden production required to feed pigs (and other pressures to increase garden production, described below) are now widely regarded in part as manifestations of social production and, thus, are outcomes of social factors placing pressure on subsistence systems (e.g., Strathern, 1984a, p. 19).

VARIATION IN HIGHLAND NEW GUINEA PIG HUSBANDRY

Highland New Guinea provides a useful ethnographic setting for the evaluation of theories relevant to Neolithic social and biotechnological change. This region was comparatively isolated from direct Western influ-

ence until the 1930s and was only gradually drawn into a state administrative apparatus between the 1930s and the 1950s. Many societies were studied using modern ethnographic techniques before substantial social and technological change took place, although the degree of indirect contact with outside groups over time is not always well-known (Paynter and Cole, 1980). Throughout this area, small, autonomous social groups are found in villages or dispersed household clusters rarely exceeding several hundred persons, although larger territorial entities described variously as clans, phratries, tribes, and tribal alliances are found (Forge, 1972). Direct archaeological evidence relating to the evolution of highland New Guinea agriculture is only just beginning to be collected, although it is likely that pig husbandry and soil tillage can be traced back roughly 2500 years (Golson, 1982; Golson and Gardner, 1990). Several hundred years ago, sweet potatoes, originally from Peru, were introduced from the Spanish Philippines to this area; now it is the main staple crop for most highland societies, used for both human and pig consumption (e.g., Sorenson, 1972). Even before this "Ipomoean revolution" (Watson, 1977), however, evidence for intensification of garden production involving swamp reclamation and water control has been found archaeologically (Golson, 1982; Golson and Gardner, 1990), indicating that pressure to intensify production systems predates the sweet potato (e.g., Bayliss-Smith, 1985).

Highland New Guinea societies provide the researcher with a valuable context for understanding connections among social behavior and agricultural change in small-scale social systems with a Neolithic technological base. While archaeological data will eventually have the ability to evaluate directly explanations for change, hypotheses explaining agricultural evolution can be formulated and preliminarily evaluated using a method of cross-sectional analysis of ethnographic sources (e.g., Kelly, 1988; cf. Peoples, 1993). In spite of a broad similarity in crops and techniques, there exists a variety of agricultural practices in highland New Guinea, ranging from situations probably better described as near-foraging, with only semidomestication of pigs [e.g., the Etoro (Kelly, 1988), Miyanmin (Morren, 1977, 1986, pp. 88–89), and preintensification Irakia Awa (Boyd, 1985)], to situations of extreme intensity of production and domestication of plants and animals in cases such as the Chimbu, Enga, and Dani, described below (e.g., Brookfield and Hart, 1971, Table 4.1; Brown, 1978, Table 6).

Pig husbandry, which we emphasize in this paper, can be described in terms of the amount of human effort expended and the degree of domestication of the animals (Kelly, 1988; Morren, 1977; Watson, 1977, p. 61) (see below). Numbers of pigs per person is often used as an indicator of the degree of involvement of a group with pig husbandry (Feil, 1985, 1987, Table 3; Kelly, 1988). These variables show considerable variation

between (and even within) language groups. In the cases we coded for comparative analysis, the most intense involvement in pig husbandry involves the following features [other aspects theoretically could be added to this list (e.g., Hide, 1981, pp. 563–565) but were not regularly reported in our sample's ethnographic reports].

(1) Pigs do some ranging in forest or old gardens, but their main food source consists of sweet potatoes and other garden produce harvested and fed to them in their enclosures. An extreme example is the Raiapu Enga, where roughly two-thirds of the total sweet potato harvest is fed to pigs (Waddell, 1972, p. 62; cf. Bourke, 1988, Table 2.4).

(2) Some boars are not castrated, in order to use them to impregnate sows, in spite of the time and energy costs entailed in managing the non-castrated males, and in spite of the fact that the noncastrated males gain weight more slowly (e.g., Feil, 1985, pp. 94–95; Hide, 1981, p. 451; Strathern, 1978, p. 93, 1988, p. 199). This is done in cases where pigs are carefully herded from their enclosures to feeding sites selected by their keepers, providing sows with fewer opportunities to mate with feral boars (Kelly, 1988, p. 155), or where there have been local extinctions of feral boars (Feil, 1985, p. 94). This practice appears to permit close management of pig herd growth (Feil, 1985, p. 94), and, perhaps, maintaining lines of particular desired varieties of pigs, a factor not discussed in any of the coded sources.

(3) Particular varieties of pigs are recognized as having enhanced prestige value—Lederman (1986, p. 7), for example, mentions the “renowned” Kandep pigs among the Mendi. In some cases, these prized pig varieties have interbred with European varieties, but it is still important to note that some groups have bred the introduced types, while other groups have not done so (cf., Strathern, 1978, p. 93, 1988, p. 199).

Less involvement of pig-keeping and domestication is seen in the following practices.

(1) Most of a pig's daily food supply comes from free ranging in forest and old gardens, although in all the cases coded, at least some food is supplied by human keepers.

(2) Sows are impregnated at random by feral boars—kept boars are castrated to facilitate managing them and because they fatten faster (among the Baktaman, described below, there is even less concern with pig-keeping and breeding, as evidenced by the fact that sows give birth unattended in the forest, and most piglets kept by families were originally captured wild).

(3) No special pig varieties are recognized.

A wider range of pig husbandry practices would have to be considered if our sample were to extend to other New Guinea regions (e.g., Kelly, 1988), but these variables could be coded for each of the societies in our sample and, thus, allow us to illustrate some of the important connections

among pig husbandry, garden production, and systems of exchange, using a method we describe below. It is our contention that understanding the social contexts of variation in these agronomic practices may provide clues about the causal factors involved in the domestication of pigs in New Guinea, as well as providing insights into the process of domestication in a general sense, and relevant to that process in other world areas.

FINANCE AND HOME PRODUCTION IN HIGHLAND NEW GUINEA SOCIETIES

In what follows, variation in pig-keeping practices is contextualized by reference to social relations and related cultural practices, based on an analysis of a sample of societies we discuss below. Many possible features of social behavior and culture could be included in such a comparative study. Identifying the most salient social and cultural elements for codification presented many difficult issues, and once we had established a coding scheme, we found comparison methodologically challenging because each ethnographic case study takes a different theoretical and methodological perspective (cf., Strathern, 1978, p. 74). In what follows, we attempt to identify variables that could contribute to understanding variation in pig-keeping, following the findings of a growing body of ethnographic and comparative literature on highland New Guinea, although additional work will no doubt uncover additional factors worthy of analytical consideration. Comparative research has taken several directions in highland New Guinea, involving a variety of social-behavioral and cultural variables, including patterns of leadership and sources of power (Godelier, 1982; Godelier and Strathern, 1991; Harrison, 1989; Lindstrom, 1984; Modjeska, 1982; Sahlins, 1963, 1972, pp. 135-137), intensity of production (Brookfield and Hart, 1971, Chap. 4; Brown, 1978; Feil, 1985, 1987; Modjeska, 1977, 1982), presence or absence of pigs (Modjeska, 1982, p. 86), pigs per capita (summarized by Kelly, 1988), and types of exchange (Rubel and Rosman, 1978; Strathern, 1978), elaboration of ritual (Feil, 1984, Chap. 8), among others. Feil (1987) contrasts many aspects of societies of the eastern and western Papua New Guinea Highlands and interprets these differences in terms of a scheme of stages of sociocultural evolution. We return to address this and similar evolutionary interpretations below.

Strathern's (1969, 1978, 1985) distinction between "finance" and "home production" seemed to us an especially useful social typology because it considers a prevailing pattern of exchange in relation to aspects of production. In both types of systems, big-men who strive for preeminence engage in material displays and distributional events, and create and main-

tain social relations based on gift exchanges (although, variably, other sources of prestige will be found, such as success in war, ritual knowledge, etc.). In both finance and home production, socially striving individuals "must raise the goods required for their prestige-building transactions" (Strathern, 1978, p. 74), and to some degree this implies in both cases that they will work to stimulate intensified production among their local faction (wives and other kin and followers). But in systems characterized by finance, a big-man arranging an important prestation "does not exclusively call on the assistance of his group-mates, but juggles also with a multiplicity of extra-clan connections" (Strathern, 1978, p. 75).

As Strathern (1978) points out in his comparative discussion of Melpa and Wiru, home production and finance reflect underlying differences in the pattern of material exchanges. Finance-based exchange, particularly as it is found in the elaborate tournaments of value like the Enga Tee (Feil, 1984; Meggit, 1974) takes place within multistranded, individual-centered networks involving exchanges between affines and other exchange partners over considerable distances. Maximum acclaim ("renown") results from a calculated manipulation of factional and exchange partner obligations that permit a big-man to accumulate the goods needed to stage large public prestational events that are largely secular rituals (e.g., Sillitoe, 1979, p. 97). A considerable element of competition for geographically broad renown is seen among big-men of differing clan affiliations and between status-striving individuals within clans (e.g., Lederman, 1986, pp. 4, 15), often leading to conflict and reduced cooperation within local groups (e.g., Strathern, 1969, p. 47; Waddell, 1972, pp. 111, 211). A "principle of increment" in the Tee (Strathern, 1978, p. 75) implies that givers expect larger return gifts, resulting in pressure on participants to increase production and/or manage more and more finance-based exchanges to meet obligations and to outdo others.

In groups dominated by home production, on the other hand, competition is less apparent and exchanges, to a greater degree, manifest the creation and affirmation of social relationships within and between clans or village groupings. Gift exchanges occur more frequently than do finance transactions in the context of religious ritual and life-cycle events such as initiation, bridewealth payments, and death payments. Pigs more often are sacrificed and consumed by ritual participants rather than being distributed and carried away by receivers for future distributions. Prestige may be gained by individuals better able to contribute pigs or other items for consumption in such ritual events, but to a greater degree, prestige in these cases is counted more in corporate terms, in the sense that the quality of the material display or prestation reflects group prestige more than individual or household prestige. Both patterns of exchange, individual-centered and corporate, will be found in both home production and finance societies, but

Strathern's dichotomy points to the fact that they will coexist with varying degrees of comparative importance across cases. Among the Mendi, the two patterns are termed "sem" exchange (based in ceremonial events) and "twem" exchange (involving exchange partners) (Lederman, 1986). A contradiction between sem and twem exchange is found, owing to the conflicting goals of maintaining acceptable clan relations, while at the same time status-striving individuals find it desirable to direct wealth items toward competitive, ego-centered partnership exchanges (Lederman, 1986, Chap. 3, *passim*; cf. Sahlins, 1963, pp. 289-90; Sillitoe, 1979; Strathern, 1971a, p. 2, 1985), reflecting the distinction Feil (1988, p. 101) refers to as "individual strategy versus social appropriateness." In purer cases of home production, such as the Northern Tairora and others discussed below, this contradiction is less salient because finance-based partnership exchange is virtually nonexistent, and most exchange is analogous to the Mendi sem exchange.

Because the home production and finance categorization seemed to embody a crucial social behavioral distinction among highland New Guinea societies, we chose it as the beginning point of a strategy for socially contextualizing the variability in pig keeping and other agricultural practices. In order to do this, however, we use an approach and a terminology somewhat different from Strathern's that is more appropriate in light of our analytical goals. The home production/finance dichotomization entangles a set of production variables (home production) with a set of exchange variables (finance). In the following, we disentangle these because we are interested in elucidating the causal relationships among exchange and production. To do this, we dichotomized a sample of New Guinea societies based on the predominant pattern of exchange, naming the patterns "corporate" and "network." Corporate cases have a predominance of exchanges analogous to the Mendi sem exchanges, while the network cases add to this a strong element of individual-centered network exchange (like the Mendi twem). We reiterate that the two exchange patterns always coexist with varying degrees of dominance and antagonistic interaction. To manage this complex situation, our dichotomization arbitrarily divides cases exhibiting a subtle range of variation in patterns of exchange into two broad categories suitable for comparative analysis [we have been influenced in this dichotomization by Mead (1937)].

A SAMPLE OF SOCIETIES CODED FOR CORPORATE AND NETWORK EXCHANGE

Our cross-sectional analysis of variability in pig-keeping is based on a sample of 12 highland New Guinea societies. The cases selected are all coded from published, well-described, lengthy ethnographic studies that

contain information we required on patterns of exchange in relation to agricultural practices, although there are a few missing data points (other suitable cases could have been added, but given limitations of time and resources we restricted ourselves to a sample of 12 well-described cases). The selection of cases was made in order to maximize variation in the corporate and network categorization. All are situated within roughly similar environmental circumstances, near to or above 1500 m in elevation, with intermediate to heavy rainfall, and with little seasonal variation in precipitation. Substantial agricultural risk due to seasonal or year-to-year variation in precipitation is not mentioned in any of the ethnographic sources, although frost damage to crops can occur in some of the higher fields. The major environmental distinction that can be made within the sample pertains to topography. A number are located in high valleys that include some level to rolling terrain in addition to adjacent sloping terrain [including Raiapu Enga, Chimbu, Siane, Dugum Dani, Melpa (Mt. Hagen), Kapauku, Mendi], while others are located on more sloping terrain or along high ridgelines (Gururumba, Baktaman, Tsembaga Maring, Wola); one was indeterminate (Northern Tairora). Table I contains the coded data, and references for coding sources are given in Table II.

The sample includes seven cases coded as illustrating a comparatively greater importance of network exchange, while five cases showed a predominance of corporate exchange. It is of interest to note that this exchange dichotomy replicated another variable we termed "degree of group boundary permeability." To get at this variable, we assessed the degree to which there is regular movement involving material gift exchanges or trade across tribal boundaries (for example where major long-distance "trade" routes are identified within a group's territory), as opposed to situations where the presence of well-defined social boundaries is associated with only limited traveling through a strongly socially segmented landscape. In the preceding sentence, we enclose trade in quotation marks because most of the transactions taking place along what are called "trade" routes involve reciprocal gift exchange, or some combination of reciprocal gift exchange, and trade (barter), although terminological difficulties in the ethnographic sources often make it difficult to distinguish between the two types of transactions. It is important to distinguish definitionally trade from reciprocal gift exchange. Reciprocal gift exchange creates obligations and manifests enduring social relations between exchange partners, while in highland New Guinea trade refers to the more impersonal transactions based on barter (cf., Gell, 1992; Godelier, 1977, pp. 127-151; Gregory, 1982; Healey, 1985, 1990; Hughes, 1977, Table 17; Humphrey and Hugh-Jones, 1992; Modjeska, 1985; M. Strathern, 1992). Barter is found as a minor transactional pattern in several of the coded cases (e.g., Rappaport, 1984, p. 189; cf. Healey,

Table I. Coded Data for 12 Highland New Guinea Societies

	Population density ^a	Pigs/person ^b	Pig domestication ^c	Corporate/network ^d	Settlement pattern ^e	Garden intensity ^f	Total intensity ^g
Enga	140	1.7	3	1	2	7	9
Chimbu	100	1.5	2	1	1	8	10
Gururumba	15	ND	0	0	1	6	6
Siane	28	.6	0	0	1	3	3
Dani	160	3.0	4	1	2	8	12
Melpa	58	2.1	4	1	2	6	10
Kapauku	40	ND	3	1	2	7	10
Tairora	15	1.5	0	0	1	4	4
Baktaman	ND	.3	0	0	1	2	2
Mendi	52	1.0	3	1	1	7	10
Tsembaga	24	.6	0	0	1	2	2
Wola	26	ND	2	1	2	2	4

^aAs persons per square kilometer, based on the ethnographic sources and Brown and Podolefsky (1976, Table 1) and Feil (1987, Table 2). See also Sillitoe (1977).

^bBased on the ethnographic sources and Feil (1987, Table 3). Where a range of values was given in the source, the coded value is the middle of the range.

^cDegree of pig domestication, a sum of values where pigs primarily range for food = 0, pigs obtain food supply roughly equally from feeding and ranging = 1, primarily by feeding = 2; sows impregnated by feral boars = 0, sows impregnated by boars kept for breeding = 1; no pig varieties recognized = 0, pig varieties recognized = 1.

^dCorporate orientation = 0, network orientation = 1.

^eNucleated or pulsating villages = 1, dispersed = 2.

^fIntensity of garden production, based in part on Brookfield and Hart (1971, Tables 4.1 and 4.11) and the ethnographic sources, using the system developed by Brown (1978, Table 6).

^gTotal agricultural intensity, which sums degree of pig domestication and intensity of garden production.

Table II. Ethnographic Sources Used for Coding

Enga	Waddell (1972); see also Meggitt (1965); Feil (1984)
Chimbu	Brookfield and Brown (1963); Brown and Brookfield (1967); Brown (1972)
Gururumba	Newman (1965)
Siane	Salisbury (1962)
Dugum Dani	Heider (1970)
Melpa (Mt. Hagen)	Strathern (1971); see also Strathern (1978, 1984)
Kapauku	Pospisil (1963)
Northern Tairora	Watson (1983)
Baktaman	Barth (1975)
Mendi	Lederman (1986)
Tsembaga Maring	Rappaport (1984)
Wola	Sillitoe (1979)

1990) but is of little relevance for the present discussion (the unfortunate oxymoron “trade partner” is avoided in the subsequent discussion).

Boundedness of social systems is not discussed in detail in any of the coded cases or analyzed in the comparative literature on highland New Guinea, so coding of our group boundary permeability variable was problematic, while feasible. As expected, the two variables, corporate/network exchange and closed/open boundedness, coded simply different aspects of the same process and thus dichotomized the sample identically. Network exchange implies open boundaries of local groups, across which exchange-partnership transactions, and trade, in some cases, occur over long distances. A predominance of corporate exchange implies more territorial localization and relatively closed social boundaries. The following briefly relates examples of the kinds of ethnographic statements that influenced our coding according to the degree of network/corporate exchange and boundedness. Enga, Chimbu, Dugum Dani, Melpa, Kapauku, Mendi, and Wola illustrate features of weak boundedness:

Enga. The Tee exchange systems links 70,000 people in this region (Waddell, 1972, p. 108; cf. Feil, 1984; Meggitt, 1974).

Chimbu. Ties to distant kin and exchange partners involve exchanges of women, pigs, shells, feathers, and axes (Brookfield and Brown, 1963, p. 13); major routes of gift exchange and trade are mentioned (p. 65).

Dugum Dani. “Extensive trade connections” exist and trips of several days to distant “trading friends” are made (Heider, 1970, pp. 25–27).

Melpa (Mt. Hagen). The Moka exchange system is analogous to Enga Tee (Strathern, 1971).

Kapauku. Exchange partnerships, long-distance expeditions, and important “trade” routes through the Kamu valley are known (Pospisil, 1963, pp. 328–340, *passim*). The presence of foreigners at pig festivals brings prestige to sponsors (p. 330).

Mendi. Twem exchange between distant exchange partners occurs; the “Mok ink” pig festival cycle has features in common with Tee and Moka (Lederman, 1986, pp. 178–182, *passim*).

Wola. Lengthy expeditions involve exchange and trade. Renown is based on the ability to handle wealth in exchanges. Pig kill sequences like the Mendi Mok ink were spreading into the Wola area at the time of the ethnographic fieldwork (Sillitoe, 1979, pp. 20, 271, *passim*).

A greater degree of corporativity and closed boundedness is illustrated by Gururumba, Siane, Northern Tairora, Baktaman, and Tsembaga:

Gururumba. Most exchanges take place in the context of life-change ceremonies; group–group exchanges are organized at the village or phratry level rather than ego-centered exchange partnerships (Newman, 1965, Chap. 5, *passim*).

Siane. There was probably some individual exchange with partners, but exchange events are strongly corporate, taking place within and between clans (e.g., Salisbury, 1962, pp. 77, 86–87, 94–99).

Northern Tairora. Ritual events emphasize community solidarity; within-group food sharing is important. Some exchange partnerships exist, but external ties are probably more important for arranging military alliances than for material exchanges. Pigs are grown primarily to meet internal social obligations (Watson, 1983, pp. 54, 233, 267–272).

Baktaman. The “known world of the Baktaman remained very small,” and ritual distributions manifest group solidarity through food sharing and sacrifice or are done “to impress a neighboring group” (Barth, 1975, pp. 19, 35–36, 196–198).

Tsembaga. Some exchange partnership transactions and trading are found (Healey, 1990), but most pigs are grown locally and killed ceremonially (Rappaport, 1984, p. 153); pig distributions occur primarily in the context of life-cycle events and during the final phases of the Kaiko pig festival (pp. 81–84), a religious ritual which Rappaport (1967, 1984) interprets as a homeostatic mechanism regulating the pig population, among other variables.

RELATING EXCHANGE PATTERNS AND PRODUCTION

Carol Smith (1976) argues that exchange can be a powerful factor shaping society. The question of the comparative importance of exchange in social causality in highland New Guinea, as elsewhere, is a complex analytical issue. For purposes of the following regression analyses, however, we use the corporate/network dichotomy as the causal (X axis) variable and regard the agricultural variables as dependent (Y axis), while not ignoring the likelihood that causality is complex and more circular than is implied by this procedure. Our preliminary goal is to investigate how the prevailing patterns of exchange interrelate with production practices, although later we present comments from the ethnographic sources that support the contention that exchange variables strongly influence production in a cause-effect manner.

To analyze causal interrelations among exchange and production variables, we developed a 4-point scale measuring the degree of intensity of pig-keeping and pig domestication. This scale is based on the distinguishing factors mentioned earlier, namely, amount of human feeding versus foraging in pig diet, breeding using noncastrated males, and recognition of bred pig varieties (see Table I). Our other agricultural variable measures intensity of garden production and is based on a comparative scale developed

by Paula Brown [(1978); a forerunner of her scheme that influenced our thinking about production intensity was developed by Brookfield and Hart (1971, Chap. 4)]. Brown's scheme, which produced values ranging from 2 to 8 in our sample (Table II), assesses various aspects of intensity of gardening practices. The following summarizes her variables and indicates how her point system was used to arrive at a total intensity value for each coded case (higher scores indicate the presence of more intensive practices) (taken from Brown, 1978, Table 5).

Enclosure:	Features that protect field from livestock, or define garden boundaries, 0-1 point
Fallow:	Length of fallow and degree of fallow management, 0-2 points
Ground Preparation:	Degree of plowing, mounding, ridging, trenching, etc., 0-2 points
Erosion Control:	Degree of terracing, walling, etc., 0-1 point
Water Control:	Degree of irrigation or drainage, 0-1 point
Fertilization:	Degree of ash application, mulching, crop rotation, etc., 0-1 point

For cases in the sample where values are provided by Brown (1978, Table 6), we simply used her values. For cases not included in her Table 6, we replicated her method in arriving at the values given in Table I. A variable measuring total agricultural intensity for each group simply sums the value of the pig keeping variable and the agricultural intensity variable (Table I).

Agricultural intensity and pig-keeping intensity are related, as is obvious in the scatterplot of these two variables in Fig. 1 ($r^2 = .483$, $p = .01$) (in this and subsequent scatterplots, larger circles indicate overlapping points). This scatterplot also illustrates a pattern that will become more evident as the analysis proceeds, namely, that, viewed in terms of agricultural intensity, the cases coded as having a network exchange orientation and relatively open boundaries (indicated as filled circles in Fig. 1) form nearly a completely distinct population from the cases coded as having a corporate orientation (open circles).

The scatter of points in Figure 1 illustrates a problem inherent in Strathern's home production/finance dichotomy. In all but one of the network cases, goods involved in reciprocal exchange events (mostly pigs) are obtained through a combination of high levels of household production, using intensive gardening and pig-keeping practices, in addition to finance (i.e., through exchange partners), and thus combine high levels of home production with finance. In only one case (with values of pig-keeping and

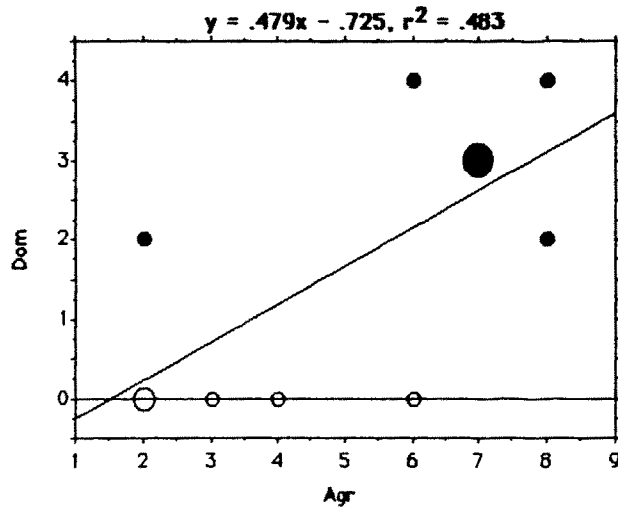


Fig. 1. Intensity of agricultural production (Agr) by degree of pig domestication (Dom). Data are given in Table I. Network cases are shown as filled circles.

agriculture of only 2), the Wola, is it true that pigs and other presentational valuables are obtained primarily through finance alone. According to the ethnographer (Sillitoe, 1979, p. 111, *passim*), renown among the Wola is based on an "ability to handle wealth in exchanges," but production is evidently of little concern: "It is not the production of valuables which engages men, but the time consuming activities of arranging, discussing, viewing, giving and receiving items in exchanges" (p. 153). The fact that pig festival sequences like the Mendi Mok ink are described as having just recently arrived in the Wola area (Sillitoe, 1979, p. 271) makes it plausible to propose that an expanding Mok-ink-like exchange sphere engages participants on its edge who initially obtain needed goods through finance strategies. Perhaps it is only later, pushed by the inherent difficulties of finance, discussed below, that exchange is supported by increased household production. Or do the Wola exemplify a distinct type of political economy in which finance alone is used to obtain goods for prestations?

Boyd's (1985) discussion of agricultural change among the Irakian Awa, although occurring in a Colonial situation, may throw light on this issue. Under the influence of Colonial rule, Irakian social boundedness was reduced, and some Irakian men increasingly expressed a willingness to participate in competitive pig exchanges that would tie them into the exchange cycles of their Fore neighbors and, thus, permit the group as a whole to

elevate their social status vis-à-vis the Fore. It was recognized that this increased level of intergroup exchange would require the adoption of new, more labor-intensive strategies of pig husbandry and a corresponding increase in garden production to provide pig fodder (Boyd, 1985, pp. 123–124), in addition to more finance transactions to obtain pigs (pp. 128–131). The new practices were debated within the group and eventually implemented. The question, Why haven't the Wola similarly adopted more intensive agriculture? is of considerable theoretical interest.

Figures 2a–c illustrate agricultural differences found in the corporate and network cases. Here the exchange pattern (corporate or network, from Table I) is the X -axis variable, and intensity of garden production and total agricultural intensity are the Y -axis variables (degree of pig domestication is not shown because all of the corporate cases have values of pig domestication of 0). Figure 2c scatterplots the exchange pattern against pigs per person. Again, in all cases excepting the Wola, there is little or no overlap of agricultural values by exchange pattern for all three of these agronomic variables (all correlation values are significant at the .02 level or below). The corporately organized societies have consistently among the lower values in intensity of garden production, pig-keeping, and numbers of pigs per person. Table III indicates the probability values of the t test for difference of means for the same variables and for pig domestication.

A cross-sectional study obviously cannot elucidate the nature of past causal interactions. We have shown that the competitive exchange systems are statistically significantly associated with greater intensity of garden production and more pig domestication. But did exchange systems cause subsistence change, or did subsistence change make possible the development of elaborate tournaments of value? Below we enumerate comments by New Guinea researchers that point to the likely priority of social production in agricultural change, but the final judgment will come from archaeological investigation. There are causal interactions with environmental and population variables to account for, as well, although population pressure theories per se have not fared well in the New Guinea literature (e.g., Boyd, 1985, pp. 120–121; Brookfield, 1972; Brookfield and Hart, 1971, p. 120; Brown and Podolefsky, 1976; Waddell, 1972; pp. 217–20). In the cases coded, population density (Table I) is generally higher in the network cases ($X = 82.3$ persons km^2) than in the corporate cases ($X = 20.5$ persons/ km^2). But it cannot be said with any certainty whether these differences constitute cause or effect in terms of agricultural intensity; Brown and Podolefsky (1976) suggest a complex mutual-causal interaction between population density and agricultural intensity. Hayden's (1990, 1992) suggestion that competitive exchange and domestication will tend to occur in comparatively more productive environments receives support from these data, since most

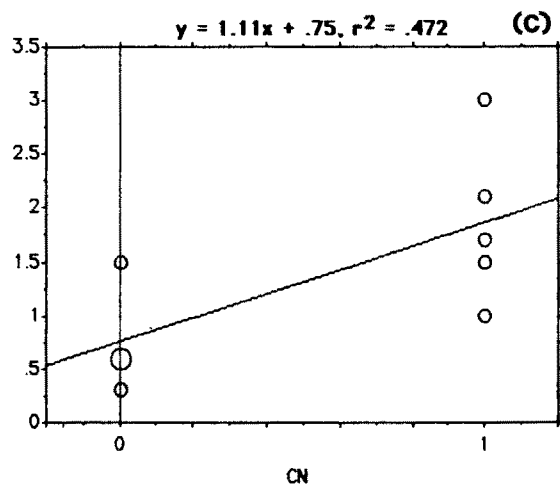
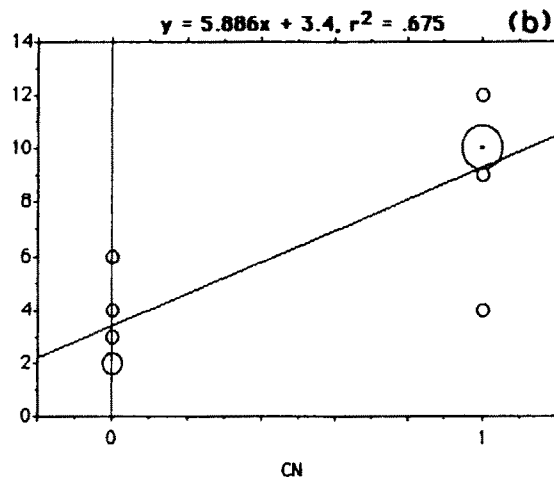
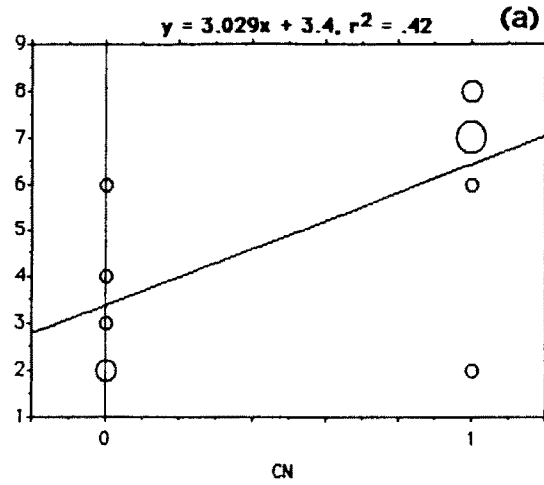


Fig. 2. Corporate (0) and network (1) cases by (a) intensity of garden production, (b) total agricultural intensity, and (c) pigs per person. Data from Table I.

Table III. Mean Values and *t* Tests of Difference of Means of Agricultural Variables by Corporate and Network Exchange Patterns

	Network	Corporate	Significance of <i>t</i> test of difference of means (2-tail)
Total agricultural intensity (Tot)	9.3	3.4	.001
Intensity of garden production (Agr)	6.4	3.4	.02
Numbers of pigs per person (Pigs)	1.9	.75	.04
Degree of pig domestication (Dom)	3.0	0.0	.0001

of the corporate cases are found in more marginal rugged terrain, whereas the network cases (except the Wola) are found in areas that include at least some gently sloping alluvium where intensified garden production can be carried out with minimal erosional damage. We return to this point below.

The availability of forested areas for hunting and pig foraging is another cultural ecological factor potentially related to the intensity of pig husbandry. As this argument goes, with population growth and expansion of gardens comes a decline of natural foraging areas and local declines of populations of feral males. These changes may necessitate more husbanding of pigs that no longer have adequate access to forest resources and, perhaps, the maintenance of domestic boars (for reproduction) (e.g., Feil, 1985, pp. 94–95; Golson, 1982, p. 133; Morren, 1977, p. 305; Sorenson, 1972, p. 361). In our coded cases [as elsewhere in highland New Guinea; cf. Feil (1987, pp. 49–50)], this problem is partially mitigated through the adoption of a settlement pattern consisting of dispersed household compounds in the high-productivity societies, as opposed to the nucleated or pulsating village pattern (i.e., where villages are dispersed during only part of the ceremonial cycle) among the more corporate, low-productivity cases [Table I; a cross-tabulation of settlement pattern by corporate/network orientation shows a high degree of association, producing a Fisher's exact test probability (two-tail) of .03]. In the dispersed, high-productivity, pattern, there is less likelihood that pigs will damage gardens of other households, and there is more access to nearby foraging areas.

It is not likely, however, that population growth and expanding garden areas will explain all the variation in the intensity of pig keeping. A recurrent theme in discussions of pig husbandry in our coded sources, and in the related literature, is that pig-keeping is understandable primarily in relation to the pressures brought about by exchange systems (e.g., Godelier, 1991; Hide, 1981; Kelly, 1988; Modjeska, 1977). While environmental fac-

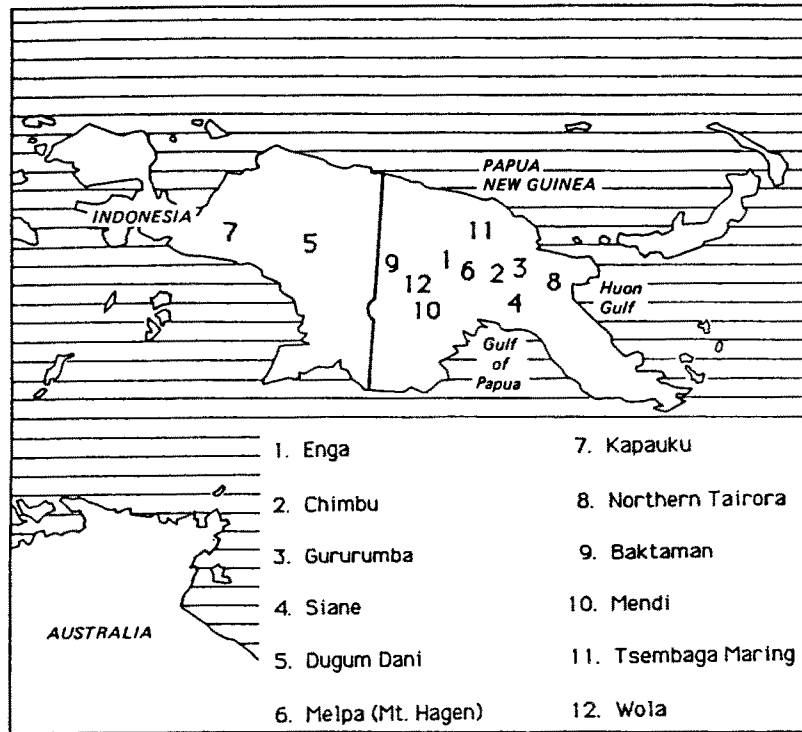


Fig. 3. Map of New Guinea showing locations of coded societies.

tors such as the declining access to foraging areas and the decline of access to wild boars surely enter into the complex of causal factors conditioning the intensity of pig husbandry, more causal factors are involved. Specifically, the enhanced role of pigs in competitive exchange itself brings change in pig husbandry. As Feil (1985, p. 94) puts it (following Hide, 1981, Chap. 8), "The fascinating and detailed material of Hide documents beyond doubt that the Chimbu of Sinasina purposefully control pig breeding to achieve the size and sex configuration of herds geared to the periodicity of their ceremonial cycles. Pig herds do not simply increase naturally, but are planned and are very definitely social products." We conclude that any theory ignoring aspects of social production, particularly competitive exchanges involving pigs, will be inadequate as a theory of agronomic variability and change.

SUMMARY AND IDEAS

Although pig husbandry is not always described in sufficient detail, in the cases discussed here increased pig productivity and degree of control over pig breeding involves increased production effort as well as new production strategies. As the amount fed to pigs is increased, garden production must increase as well, involving the employment of new techniques and more garden work. What might prompt the development of new strategies, with their heightened work demands? The ethnographic cases reviewed here strongly suggest that agronomic change and intensification are more likely to occur in the context of systems with weak boundedness in which an important strategy for gaining geographically broad renown is ego-centered finance exchange, including exchange with external partners. Several authors describe how the struggle for renown in these situations results in pressure on production systems. According to Waddell (1972, p. 109), among the Raiapu Enga, exchange rituals "result in an increase in production far beyond . . . minimum requirements—an increase which is utilized for political aggrandizement." Further, he points out (p. 192) that "the limits to individual power are essentially technological—the productive limits of the system and the capacity of a single man to manipulate them—the clearest expression of the operative considerations being provided by the Tee, where a man must assemble and distribute as quickly as possible numbers of pigs that are far in excess of his capacity to support, while making the greatest political capital out of the transactions." As Strathern (1971a, p. 2) puts it, competition for prestige "is played out against a background of certain limitations in technological, ecological and human resources which set problems for the big-men who are struggling for success" (cf. Feil, 1984, Chap. 8).

One point relative to understanding the relationship between exchange and production is made in Brookfield and Brown's (1963) discussion of the Chimbu, where many important prestige-goods used in competitive exchanges were not locally available. A "range of plumes, feathers, shells, and the ceremonial 'Hagen' axe, all used in ceremonial exchanges, were procurable only by producing a surplus of food and, especially, pigs" (p. 60). The question of why exotic good would enter into big-man transactions in the first place can probably be understood in terms of the dynamics of prestige-good systems (Friedman, 1982; Peregrine, 1992, Chap. 3; Strathern, 1979; cf. Feil, 1984, pp. 85–93), an issue not pursued here. Regardless of the causes, however, once exotics are incorporated into tournaments of value, some regional populations, like the Chimbu, may be forced to increase agricultural production to obtain prestige items not locally available (e.g., Brookfield, 1972, p. 38). This may be a source of pressure on pig

and garden production not found to this degree in other cases we investigated. Although this topic would benefit from further research using ethnographic case studies providing fuller accounts of material culture and artistic production than most of those in our sample, we noted that in the corporate cases many items consumed in ritual events were locally produced rather than obtained through long-distance transactions (cf., Gell, 1992). This included, especially, various forms of personal adornments worn in dances, such as elaborate feather headdresses and painted boards (e.g., Newman, 1965, pp. 21, 69; Salisbury, 1962, pp. 49, 52, 57).

Several comments in the coded ethnographic sources and elsewhere indicate that striving, ambitious network players face severe difficulties in attaining and reproducing desired levels of social status while at the same time maintaining acceptable social relations with kin and others in their local group (e.g., Strathern, 1984b). We suggest that it will be productive to investigate the inherent difficulty of pursuing finance strategies as we search for sources of stress that would prompt big-men and their households and factions to intensify home production and devise new production strategies that could augment finance. Of the difficulties of finance, one theme expressed in several sources relates to the time and effort involved in lengthy trips to distant exchange partners (e.g., Heider, 1970, p. 25; Waddell, 1972, pp. 86, 192, 200). Pospisil (1963, p. 383) writes that long exchange trips required "physical vigor to endure extensive traveling" (cf. Lederman, 1986, p. 80). In Strathern's (1971a, p. 222) description of the Melpa, he relates that "numerous partnerships were a strain to manage." We conclude that the potential to expand the scale of transactions through finance is clearly limited by diminishing returns, presenting increasingly severe difficulties of time allocation and energy costs.

Another difficulty of finance-based exchange is logistical. Optimal timing of receipt of return gifts from exchange partners is required if a big-man is to stage the largest possible prestational event. These events are public, and failure to assemble good in a timely fashion will mean loss of renown. The big-man must maximize the number of valuables distributed, but donors to the big-man's fund who owe him may not present pigs or other items when they are needed (Sillitoe, 1979, pp. 92-93, 94-98; Strathern, 1969, pp. 55-61, 1971a, Chap. 8). Pigs that arrive before the event have to be fed until they are distributed (e.g., Waddell, 1972, p. 192). This is done through the efforts of the big-man's faction, particularly his wife or wives, potentially exacerbating nutritional stress for the human and pig population (Allen, 1984; Brown, 1978, p. 59; Strathern, 1969, pp. 58-59). Bourke (1988, Chap. 5) summarizes those factors inherent in competitive pig distributions potentially bringing about temporary food shortages: (1) Additional food is required by visitors; (2) additional food is required for pig herds assembled just before they are distributed; (3) distributors

take extra measures to fatten pigs just before distribution; (4) there is damage to gardens by the large numbers of pigs being kept for distribution; and (5) participation in festivities results in neglect of gardens.

An additional source of stress on agricultural systems is found in cases where groups residing in marginal environmental settings choose to engage in competitive exchange systems. As related by Allen and Crittenden (1987), such groups must produce at levels similar to environmentally better-situated neighboring groups, to maintain their status in exchange relations and prestatational events, but these levels may not be locally sustainable. While pressure to increase production will be felt throughout the exchange sphere, participating groups residing in comparatively marginal settings may experience environmental feedbacks and declining returns to production earlier than better-situated groups. Rather than population pressure, Allen and Crittenden (1987, p. 155) point out that this is really "social production pressure." In such situations, we might expect a more pronounced tendency to devise innovative solutions to production problems, but failing this, marginal groups might also tend to develop and implement social movements that are reactions to social production pressure (see below). At any rate, we hypothesize that environmentally marginal localities might prove to be exceptionally dynamic in the evolution of new behavioral patterns, rather than just the more productive zones as Hayden (1990, 1992) suggested.

The many inherent limitations of finance, we suggest, could provide pressures resulting in agronomic innovation and change, leading to higher levels of factional home production. For example, higher levels of garden production would permit big-men to feed larger numbers of pigs while waiting for optimal times for distributional events. Admittedly, increased home production also poses many problems. The big-man may lose factional support if he becomes, in Sahlins's (1963) phrase "over-extractive" (cf. Strathern, 1971a, p. 223, 1984b, 1985). But as Pospisil (1963, pp. 214-215) points out for the Kapauku, while exchange partnerships bring prestige, it is crucial that a man become a successful pig breeder if he is to become important. Big-man strategies can be carried only so far without both finance and high levels of home production, and thus, we would argue, big-man strategies have important implications for agronomic change.

THE EVOLUTION OF HIGHLAND NEW GUIENEA AGRICULTURE

Viewed broadly, in highland New Guinea there has been a process of agricultural evolution in the direction of increased levels of intensity of production over a period of several thousand years (Golson, 1982; Golson

and Gardner, 1990), although there is considerable interregional variation in agronomic change that has yet to be fully documented. The analysis and review of literature presented here suggest that an important cause of agricultural intensification would have been the evolution of finance-based big-man systems, and evolutionary scenarios informed by cross-sectional data do typically see an evolution from small, closed, group-oriented societies, like our corporate-oriented societies, to more open, complex, systems with both finance and high levels of home production, like our network-oriented cases (excepting the finance-only Wola) (e.g., Godelier, 1991; Lemonnier, 1991; Rubel and Rosman, 1978; Strathern, 1985). Feil's (1987) important study contrasting societies from eastern and western Papua New Guinea, while considering a wide range of variables not discussed here, includes many features of the corporate-network dichotomization, and supports this type of general evolutionary scenario. Archaeological research will provide the final word on the nature of sociocultural evolution in this region, but it will be guided by hypotheses developed from the comparative literature. With this in mind, we suggest that archaeologists consider a more complex alternative to the simple stage theories, in which the corporate-oriented cases are not suitable proxies for evolutionarily "early" stages.

We suggest that it will be necessary to consider the possibility that social and agronomic change in highland New Guinea may not have taken the form of unidirectional evolutionary stages and, instead, may have exhibited a complex cycling between systems organized like our corporate cases and our network cases. We propose this based on several features inherent in both kinds of societies. As Rappaport (1968, 1984; cf. Vayda *et al.*, 1961) insightfully observed, the Tsembaga ritual cycle aims importantly at regulating the pig population. This not only aids in the maintenance of appropriate environmental relations, but also helps to limit the degree of intragroup conflict owing to pig depredations on gardens. The ritual cycle would also limit the degree to which ambitious big-men could accrue large herds for competitive prestational events. As Brookfield (1973, p. 155) points out, the Tsembaga situation is very much unlike the ritual cycle of the Chimbu. There, "such quasi-automatic regulatory mechanisms as Rappaport postulates would hardly be conceivable among the numerous Chimbu with their interlocking cycles . . . Ceremonies are not held primarily to dispose of pigs; they have complex objectives in the maintenance and reinforcement of the whole system of social relationships."

How could such distinct patterns of pig ritual have developed? We propose that the group-oriented social formations like the Tsembaga result from the development and implementation of specific cultural regulatory mechanisms capable of countering the high-production, competitive ex-

change systems. According to this scenario, corporate systems are a product of network-oriented systems, a reaction to them, rather than representing an early stage of cultural evolution. As we have seen, an elaboration of finance and competitive exchange is strongly associated with agricultural intensification and would, thus, bring with it increased production work loads, as well as increased long-distance traveling, increased agricultural risk, increased nutritional stress, and, as noted previously, increased potentials for intragroup conflict. In environmentally marginal localities, in particular, increased risk of environmental degradation could result from agricultural intensification, further exacerbating work requirements, agricultural risk, and nutritional stress. Under the pressure of worsening conditions, we propose that new social and cultural forms may be implemented as reactions to the big-man dynamic. Strathern (1985, p. 106) suggests that tendencies toward "exploitation" of their factions by ambitious big-men can lead to "counter-tendencies, couched often in religious terms . . ."

Feil (1983, 1984, pp. 239–240) relates a situation among the Enga during the 1940s that illustrates how this kind of reactionary process took the form of a cult with features contradictory to Tee exchange (cf., Brunton, 1971; Meggitt, 1974, p. 181). As Feil describes it (1984, pp. 239–240), during this time "many Kompiama clans participated in a cult which swept through the area from the west . . . Four men visited each clan and told its members to kill all of their pigs and destroy their pearlshells, and to forego the evil ways of their ancestors." The cult was successful for a time, but eventually there was a return to finance transactions and Tee. We suggest that this example poses a possible mechanism for the development of more corporately organized social formations. It does appear to be the case that the competitive exchange systems like Tee and Moka may be subject to breakdown and reactionary cult formation (Brunton 1971, p. 115; Feil, 1983; Meggitt, 1973; Strathern, 1971b). Modjeska (1977, p. 296) describes the spreading Kiria Pulu cult among the Duna as a "religious inversion" of Tee and Moka. On the other hand, controls on individual action inherent in the corporate systems may be subject to challenges by entrepreneurial individuals whose involvement in expanding exchange spheres opens the way to subsequent elaboration of the big-man dynamic (e.g., Feil, 1987, pp. 254–255). The result of these processes would not be a simple evolution of sociocultural stages embodied in the distinction between the two social forms, corporate (early) and network (late). Instead, we propose the possibility that highland regions have been characterized by alternating long cycles between the two social forms, bringing with them alternating episodes of intensification and disintensification of agriculture as described by Brookfield (1972) [a similar social dynamic is seen in Frankenstein and Rowlands (1978) and Friedman and Rowlands (1978, p. 213)]. Again, ar-

archaeological research will be the final arbiter of differing evolutionary scenarios. We agree with Golson and Gardner (1990, pp. 407, 412–413) that comparative studies of contemporary societies cannot present a complete picture of the causes of agricultural change. We make these suggestions in order to indicate the possibility that unilinear evolutionary schemes constructed from cross-sectional data may tend toward too-simple conclusions about the nature of long-term change in human societies in highland New Guinea (cf. Yoffee, 1985).

FINAL COMMENTS

The literature discussed here and our brief foray into cross-cultural analysis support the hypothesis that finance transactions and tournaments of value may have been important causal factors bringing about agricultural evolution in highland New Guinea. This finding is partially congruent with the main thrust of evolutionary scenarios proposed by comparativist New Guinea researchers, although we find problematic the proposal that contemporary corporate-based systems can be viewed as proxies for earlier evolutionary stages. In our opinion, the importance of ethnographic research and comparative analysis in highland New Guinea is to be found not so much in the elucidation of a specific evolutionary sequence, but in the discovery that systems of competitive reciprocal gift exchange influence many aspects of society, including agricultural production strategies. We would argue that the results of highland New Guinea research have considerable bearing on the kinds of processual issues faced by archaeologists trying to understand the origins of plant and animal domestication and other aspects of production intensification in the Neolithic of various world areas. Our purpose in this paper has been to make archaeologists more aware of the potential usefulness of this literature, and these stimulating findings, and to encourage them to incorporate exchange variables as testable hypotheses in their future research designs. We believe that we have also pointed to the potential value of further comparative research on ethnographically known instances of tournaments of value.

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