

## Popper, Karl R.

- 1959 *The Logic of Scientific Discovery*. New York: Basic Books.  
 1962 *The Open Society and Its Enemies*. London: Routledge and Kegan Paul.  
 1963 *Conjectures and Refutations*. London: Routledge and Kegan Paul.  
 1970 *Comments*. In *Physics, Logic and History*. W. Yourgrau and A. D. Breck, Eds. New York: Plenum.

## Ryle, Gilbert

- 1971 *Collected Papers, Vol. I*. London: Hutchinson.

## Schutz, Alfred

- 1964 *Collected Papers, Vols. I and II*. The Hague: Martinus Nijhoff.

## Watkins, J. W. N.

- 1958 *Confirmable and Influential Metaphysics*. *Mind* 67:344-365.

## White, Leslie A.

- 1966 *The Social Organisation of Ethnological Theory*. *Rice University Studies* 52:1-66.

## Wisdom, J. O.

- 1972 *Scientific Theory: Empirical Content, Embedded Ontology and Weltanschauung*. *Philosophy and Phenomenological Research* 33:162-177.

## Population, Exchange, and Early State Formation in Southwestern Iran

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*Several widely discussed single variable explanations of the origin of the state are tested using data from Southwestern Iran. These data demonstrate that increasing population or increasing inter-regional trade alone cannot explain the appearance of specialized governments during the fourth millennium B.C. More complex types of explanation are suggested, and methods for testing them are outlined.*

THE PROBLEM OF STATE ORIGINS has long challenged social scientists. Innumerable competing explanations for the rise of centralized governmental institutions have been suggested (e.g., Engels 1910; Adams 1966; Carneiro 1970). In this paper we summarize efforts to test some of these proposed explanations and to develop a new type of explanation of state origin based upon four years of multi-disciplinary research in Southwest Iran.<sup>1</sup>

Some of the difficulties in the study of state origins have been definitional. Many definitions of states focus on particular features usually associated with state organization, such as private landholding, formal law, or governmental monopoly of force. We believe it is more reasonable to focus on the total organization of decision-making activities rather than on any list of features. A state is defined as a society with specialized administrative activities. By "administrative" we mean "control," thus including what is commonly termed "politics" under administration. In states as defined for purposes of this study, decision-making activities are differentiated or specialized in two ways. First, there is a hierarchy of control in which the highest level involves making decisions about other, lower-order decisions rather than about any particular condition or movement of material goods or people. Any society with three or more levels of decision-making hierarchy will be directly involved in productive and transfer activities and second-order decision-making will be coordinating these and correcting their material errors. However, third-order decision-making will be concerned with coordinating and correcting these corrections. Second, the effectiveness of such a hierarchy of control is facilitated by the complementary specialization of information processing activities into observing, summarizing, message-carrying, data-storing, and actual decision-making. This both enables the efficient handling of the masses of information and decisions moving through a control hierarchy with three or more levels, and undercuts the independence of subordinates.<sup>2</sup>

Having defined a state, one could attempt to construct an explanation covering every case of state development. However, there are many types of states, including those which develop on the margins of extant states, those which form from the agglomeration of extant states, and those which arise from the fragmentation of larger states. It seems more practical to focus on only one type: those which we term "primary states" which developed within a

context of interacting pre-state societies.<sup>3</sup> However, there were few centers of such state development, and all arose before written history in their respective areas. Thus hypotheses about primary state development can be tested only by means of archaeological evidence. In this paper we limit ourselves to the testing of hypotheses involving population growth, inter-regional exchange or "long-range" trade, and local craft production and exchange as single variable causes or prime movers. We then consider them together as interacting variables in a system.

#### STATE ORIGINS IN SOUTHWEST IRAN

Exactly when did primary states first appear in Southwest Iran, and in Mesopotamia in general? To answer this question, we must consider the available evidence of administrative hierarchy and differentiation. Fortunately, through much of Mesopotamian history clay was used as a medium for record-keeping. We recover not only seals of authority, but also tags, messages, and summary records with seal impressions and other symbols. By studying both the hierarchy of settlement dominance and the association of different types of administrative artifacts with different levels in this hierarchy, we can define the changes which constitute state emergence.

Greater Mesopotamia includes the watersheds of the Euphrates, Tigris, and Karun Rivers. It is now divided between Iran, Iraq, Syria, and Turkey. The thrusting of the Arabian Shield against the Eurasian land mass has created both the subsiding basin of alluvial Mesopotamia and the intensely folded Zagros-Taurus mountain arc. In the central Zagros, erosion has uncovered massive limestone anticlinal folds which enclose extensive and relatively level upland valleys (Oberlander 1965). In the outer or southwestern portions of the arc, the folded ridges are of soft sandstone and gypsum eroded into a wasteland of spurs and canyons or into rolling foothills and lowland plains. Rain is brought to the area by winter storms from the Mediterranean. While favored upland valleys receive more than 600 millimeters of precipitation, the lowland plains average between 200 and 300 millimeters per year. These differences in rainfall and topography interact to divide Greater Mesopotamia into four environmental zones. These are: (1) the marshy areas and desert of alluvial Mesopotamia; (2) the grassy steppe of the foothills and plains up to 900 meters in elevation; (3) the predominantly oak woodlands which once covered the Zagros above that elevation; and (4) the more arid grasslands of the Iranian Plateau. However, after the establishment of settled agricultural communities (Braidwood 1960; Flannery 1965), these zones were not the environmental units critical to the communities of the area. It is the larger valleys and plains, particularly those with reliable rainfall or with good opportunities for irrigation, which formed the centers of the culturally defined environmental units. Around these were smaller agricultural enclaves and interstitial and marginal areas of broken topography and/or limited water resources. Such units or aggregates composed of a number of plains and valleys, in some cases cross-cutting biotic zones, are termed "regions" in this paper. Southwest Iran is one such component region of Greater Mesopotamia (Figure 1).

Southwest Iran covers about 210,000 square kilometers including parts of the oak woodland of the Central Zagros, the foothills and valleys, and the alluvial marshes and desert to the south. It is centered on the fertile Susiana Plain, watered by the Karun, Dez, and Karkheh Rivers. This large plain receives rainfall usually adequate for cultivation and is also crossed by rivers well-suited for irrigation; hence it is not surprising that it was a center of early village development, of state origin, and of massive and apparently very productive agricultural investments by successive empires (Adams 1961). To the northwest along the Zagros foothills are the smaller Deh Luran and Mehran Plains, while to the southeast are the smaller Ram Hormuz, Behbahan, and Zureh Plains (Figure 2). There are yet smaller valleys in the front ranges of the mountains on various routes allowing access to the upland valleys and the plateau. Most of these valleys and plains have been the objects of one or more

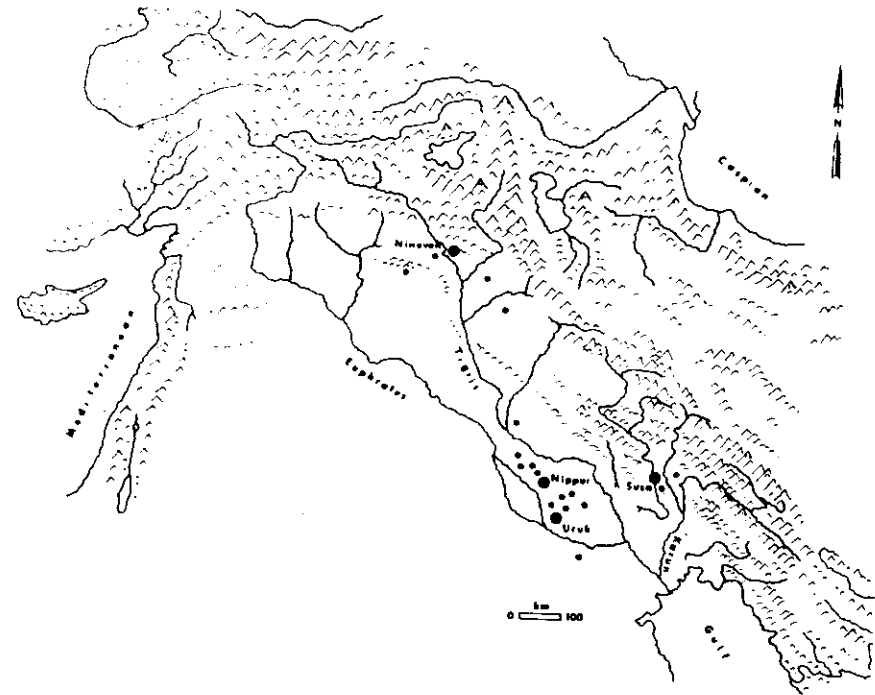


Figure 1. Greater Mesopotamia during the Uruk Period. Dots represent known centers.

TABLE 1. ARCHAEOLOGICAL CHRONOLOGY IN LOWLAND GREATER MESOPOTAMIA ABOUT THE FOURTH MILLENNIUM B.C.

	Southwestern Iran	Southern Iraq
3000	Proto-Elamite	Jemdet Nasr
	Late Uruk	Late Uruk
3500	Middle Uruk	Middle Uruk
	Early Uruk	Early Uruk
4000	Terminal Susa A	Terminal 'Ubaid
	Susa A	
	Susiana D	

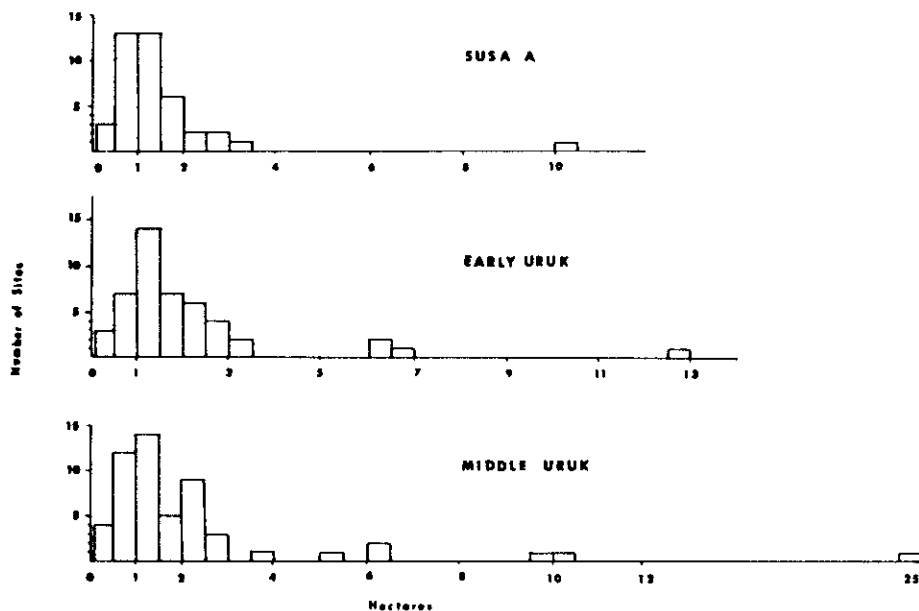


Figure 2. Histograms of site sizes during three periods on the Susiana Plain.

archaeological surveys. There have also been excavations on various sites from a wide range of periods. A chronological scheme based upon this work is presented in Table I. During the latest period on this chart (Proto-Elamite), there were large towns with extensive areas of elaborate buildings near which are found quantities of inscribed tablets. Though only the numbers, and not the Proto-Elamite signs themselves, are readable, there is little reason to doubt that these texts are the records of a state administration. In contrast, during the earliest period on this chart (Susiana d), there were no large towns, only small settlements seldom exceeding a population of 1000. The only known administrative artifacts are rare button seals with simple geometric designs. The transformation to state organization must have occurred sometime between these two periods.

While knowledge of administrative organization in the Middle and Late Uruk Periods is by no means comprehensive, it is sufficient for our present purposes. Our largest settlement group, the 54 Middle Uruk settlements of the Susiana Plain, show at least four discrete size categories (Figure 2). These were small villages with a mean size of 0.9 hectares, large villages with a mean size of 2.3 hectares, small centers with a mean size of 5.3 hectares, and large centers with a mean size of 14.8 hectares (Johnson 1973:101-103). Such a settlement hierarchy alone implies little about administrative organization. Some evidence that larger sites could control smaller sites by virtue of their location must be adduced. We take as evidence for this the condition in which a smaller settlement can most easily gain access to a larger site by going through an intermediate-sized or otherwise differentiated center. This intermediate-sized center has what we term "spatial dominance" over the small center. The paramount center in an area has dominance over all others. Seen from this perspective, the twenty-five hectare center of Susa dominates the whole plain and, in particular, the nearby center of Abu Fanduweh. This site and the similar center of Chogha Mish (site 1 on Figure 5) dominate the access of many small centers and villages to Susa. Finally, there are cases of

villages, and in particular villages with elaborate buildings whose walls were decorated with ceramic wall cones, which control the access of other villages to Chogha Mish (e.g., site 108 in Figure 5), Abu Fanduweh (e.g., site 54) and Susa itself (e.g., site 22). Thus, there seem to have been four levels of settlement hierarchy from the perspective of site size and number, and from the more crucial perspective in which some settlements dominate the access of others.

The technology of administration can provide evidence of a hierarchy of information processing which supports and enhances that of settlement pattern. Several related classes of artifacts are reported from Southwest Iran. Seals are symbols of authorization. These artifacts, usually cut from stone, are in the form of stamps or of cylinders which could be rolled. They vary in quality of stone, in size, and theme and number of elements in the design. The clay items into which these seals are impressed can be divided into two classes. Those termed "commodity sealings" prevent the opening of a container such as a vessel, basket, bale, or room. The clay is usually placed over a knot which must be untied to gain access. Discarded sealings indicate the receipt of stored or redistributed goods whose packing was authorized by the seal impressed in them. Those items termed "message sealings" convey or store facts about goods or people. There are plain counters whose shape indicates a numerical unit, small sealed forms perhaps for comparison with incoming sealed packages for authentication, sealed spheroidal jackets or "bullae" once wrapped around sets of counters, and flat rectangular tablets. The last two often bear numerical signs as well as seal impressions. Written symbols do not appear until the very end of the Uruk Period and are thus not of concern here. In later periods, spherical bullae served as bills of lading for goods and animals sent to centers in the charge of illiterate transporters. In contrast, tablets served to summarize receipts and expenditures in centers. Table II presents some data on the administrative technology of Susa, the dominant center, and Sharafabad, a small settlement with an elaborate building.

TABLE II. ADMINISTRATIVE ARTIFACTS FROM SUSA AND SHARAFABAD

	Sharafabad Uruk Pit (U.M.M.A. Collections)	Susa: Acropole Cote 17.5 m (Amiet 1972)	Susa: Sud Niv. 17 (Le Brun 1973, Fig. 44)
Commodity Seals			
Bales	13	0	0
Room Locks	18		
Jars	3	5*	8*
Bottles	2	2	4
Message Seals			
Cups†	11	—	4
Counters	6	—	1
Spherical Bullae	0	11	0
Tablets	0	6	11‡
Total	53	24	24

\*The terms "sealing" and "sealing of jar" could refer to either locks or jars. Illustrated examples and measurements show that "sealings in the mouths of jars" are for bottles.

†These are probably unfinished bullae which dried. De Merquenem would not have retained them or the counters, but Le Brun certainly would have.

‡The numbers on the 17.5 meter sample seem to be larger and simpler than those on the Niv. 17 sample. We suggest the former may be slightly earlier Late Uruk and the latter may be terminal Late Uruk.

During the Middle Uruk, Susa came to be differentiated into a newer lower town about which little is known and an older upper town which had a variety of special buildings including scribal areas (Le Brun 1973, Fig. 33) and storage areas (De Mecquenem 1943:20-24). Both stamp seals with simple dot motifs and stamp and cylinder seals with more complex representational motifs occur at Susa (Amiet 1972:33-108, Pl. 54-99; Le Brun 1973, Fig. 44). The better samples of administrative artifacts other than seals, all of the Late Uruk, include a minority of commodity sealings and a majority of message sealings. The latter include spherical bullae, usually with two or more impressions: one large and complex from a cylinder seal, and one smaller impression with a few elements sometimes from a stamp seal. In some cases the counters were still inside the jacket and could be compared with the exterior numbers (Amiet 1972: #460 bis, Pl. 61; #539, Pl. 68; #555). Less common are tablets usually with a number and one impression of a small cylinder seal. Most of the numbers range from 3 to 60, but a few larger tablets bear numbers in the hundreds (Amiet 1972: #545, Pl. 68; #559, Pl. 69; #641, Pl. 79). These could be summaries of smaller texts. In summary, the administrative artifacts from Susa indicate that commodities were authorized by seals of disparate complexity and shipped to Susa where their quantities were checked against bullae. Both minor and occasional major summaries of such transactions were kept on numbered tablets authorized by a simple seal.

In contrast to Susa, the settlement at Tepe Sharafabad, twelve kilometers northeast of Susa (Site 36 in Figure 5), covered no more than one hectare.<sup>4</sup> The few Uruk buildings on the site were badly damaged by later occupants, but a large pit filled with artifacts and sealings of the end of the Middle Uruk and a dump containing artifacts of the beginning of the same period were well-preserved. Only stamp seals with simple dot motifs were found here. The pit contained a majority of commodity sealings including those for storerooms, jars, bottles, large baskets, small mat-covered bales, and very small cloth-covered bales. These were impressed with both stamp and cylinder seals with complex representational motifs. There was a minority of items related to messages, including some counters like those representing numbers in Susa bullae and possible unused jackets for spherical bullae in the form of rough cups. No tablets or finished bullae occurred. Thus, goods were probably sent with bills of lading from Sharafabad to other places, while small containers of commodities were received, opened, and consumed. Certainly different, but complementary, administrative activities were going on at these two settlements. First, shipments had to be assembled and inventoried at a small community in order to prepare a bulla. When received, various shipments had to be checked. Then, summary records had to be made from these receipts. These may have been further summarized. A complete explication of administrative organization must await further investigation of small sites as well as publication of the administrative technology at Abu Fanduweh and Chogha Mish. However, there is direct evidence to show that information-processing was both hierarchically and functionally differentiated in Middle and Late Uruk times, probably with more than three levels of administrative task organization. This was undeniably a state as we have defined it.

For the preceding period we face several problems. There are no extensive samples of administrative artifacts from the Early Uruk Period. Bullae, numerical tablets, and cylinder seals are not attested, but this could be due solely to limited excavation. Therefore, settlement size and location provide the major evidences of administrative organization. There were fifty settlements divisible into three discrete size categories. These were villages with a mean area of 1.4 hectares, small centers with a mean area of 6.4 hectares, and one large center, Susa, with an area of 12 hectares. Small and large villages have not yet differentiated (Figure 2; Johnson 1973:90). Susa spatially dominates all of the western Susiana, including Abu Fanduweh. The latter dominates a number of small villages. While we do not yet recognize an artifact analogous to the later wall cones which would distinguish small sites with special architecture, it is the case that some villages have access to Abu Fanduweh or

Susa only by way of other villages. Thus, although there were slightly fewer settlements and these were in general smaller, Early Uruk administrators probably handled problems of coordination both qualitatively and quantitatively similar to those of the Middle and Late Uruk. Since the settlement patterns are very similar, we can assume three or more levels of administrative task organization indicating a state organization in our terms.

There are almost no excavated samples of the Terminal Susa A Period. It was a period of very limited settlement with only 22 sites forming three or four disjointed clusters (Johnson 1973, Fig. 15). These settlements are divisible into villages averaging 1.2 hectares and small centers of about 5 hectares (Johnson 1973:87). In a few cases these centers dominate villages, but that is all. There is probably no state organization in this period; however, this could represent a temporary collapse. Let us therefore turn to the yet earlier Susa A Period proper.

During this latest phase of the greater "Ubaid tradition" in southwest Iran, there were at least forty-one sites on the Susiana Plain.<sup>5</sup> All but one of these are small settlements of less than 3.5 hectares, averaging 1.2 hectares. The exception is Susa itself, which was at this time a newly founded center of 10 hectares (replacing a similar, earlier, large center near the middle of the plain). While many of the smaller settlements could have restricted the access of others to Susa itself, there were no intermediate subsidiary centers which could mediate relations between Susa and the smaller settlements. Thus there were two levels of settlement hierarchy by the criteria of size and spatial dominance.

Fortunately, there is a diversity of evidence of Susa A administrative activities in the form of seals and sealings. There is some material from Susa which at this time had a large central platform of mud brick supporting a number of elaborate buildings and store rooms (Steve and Gasche 1973, Figs. 14, 15). Around this platform were similar large buildings and smaller buildings about which little is known (Le Brun 1973:169-170, Pl. 31; Dyson 1966:273). A wide range of stamp seals in the form of round buttons and hemispheres were found in various excavations of Susa A layers. A majority have simple linear geometric designs and a minority have simple representational designs, frequently one or two caprids (Amiet 1972:5-46). A few examples have an abstract cruciform or a human figure with a reptilian head (Amiet 1972:35-38). A limited number of impressions on jar and bale sealings and small pierced lenticular bullae, perhaps tags (Amiet 1972:24), bear the impressions of all these types of seals. Thus, all types of seals were used at Susa and all known types of impressions are attested on seals. In summary, at Susa itself there is at present evidence only of the sealing and unsealing of commodities. There is no evidence of a higher level recording or summarizing of such activities.

A small series of administrative artifacts is available seven miles north of Susa from Djaffarabad, one of the smallest known Susa A settlements. Both a linear geometric seal and a representational seal with a goat have been illustrated (Dollfus 1973, Fig. 23:3,5).<sup>6</sup> No impressions have been reported. Stamp seals similar to these from Djaffarabad have been found on the surfaces of other small sites. Thus, there are indications that goods were sealed on smaller sites, but there is no evidence of receiving. Even if some goods were shipped to Susa, with only two levels of administrative task organization, we would have evidence of only minimal administrative complexity.

Even with presently available evidence, the broad outline of the development of administrative organization on the Susiana Plain is clear. The Susa A Period had two classes of settlements coordinated by organizations with no more than two levels of administrative hierarchy. During the Terminal Susa A Period, the settlement distribution suggests that there was a simplification of this earlier arrangement. In the Early Uruk Period there was a marked increase in settlement complexity which, the evidence of the Middle and Late Uruk indicates, must have been coordinated by organizations with three or more levels of adminis-

trative hierarchy. The origin of the state on the Susiana Plain thus probably occurred during a brief time at the beginning of the Early Uruk period.

This pattern of developing settlement arrangements correlated with changes in the technology of administration is apparently not unique to southwestern Iran. The transition seems to occur in several adjacent regions in Iraq between the beginning of the Early Uruk and the end of the Middle Uruk Periods around the ancient centers of Nippur, Nineveh, and Uruk (see Figure 1). Thus rather than one case of state emergence, there was a series of emergences of individual states in a network of polities. Now let us consider some possible causes of this transformation.

#### PATTERNS IN POPULATION CHANGE

Population growth is frequently cited as the determinant of cultural change (Binford 1968:313-341; Sanders and Price 1968). Stephenson has demonstrated a close association between states and high population densities in Sub-saharan Africa (Stephenson 1968). Carneiro has argued that population growth in areas of circumscribed agricultural resources results in warfare and the conquest of militarily weaker social units. The state emerges as specialized organizations are developed to administer conquered societies and to allocate tribute extracted from them (Carneiro 1970). The plains of Southwestern Iran are certainly circumscribed agricultural areas. If such an argument were an adequate explanation of state development, then we would expect an unprecedented increase of population to a certain point, after which there would be state development in this region. Let us consider the available evidence.

With increasing improvement in the techniques of monitoring population trends by means of archaeological data, the testing of such propositions is possible. Several anthropologists have noted correlations between living areas and population (Naroll 1962; Cook and Heizer 1968). Tobler, a geographer, has argued that such a relationship is true of all human communities (1969). Several Near Eastern archaeologists have assumed such a general correlation and have further assumed a standard density of between 100 and 200 people per hectare of settlement (Adams 1965:123-124; Hole et al. 1969:349), although the relation may be non-linear (Nordbeck 1971). Here, we assume that there is a relationship between area and population. However, as there is no need to have more than a relative estimate, no constant or exponent is assumed, and only hectares of settlement area are presented in our table. The problem is the measurement of settlement area. As settlements of nomads are seldom preserved, we necessarily measure only the communities of townsmen and villagers. Such communities are made largely of sun-dried mud brick. One which has been rebuilt two or three times before abandonment is marked by a mound covered with broken ceramics. While it is possible that some mounds have been obscured by alluviation, by wind-blown sand, or by extensive later re-occupation, several areas of Southwestern Iran have been surveyed a number of times<sup>7</sup> and we are reasonably confident that such measurement errors affect sites of the cultural periods between 3000 and 4000 B.C. in the same manner. The possible movements of some communities during a given cultural period may inflate our site area estimate. The effect of such double counting should be minimal because our periods are relatively short, averaging less than 200 years; furthermore, such error should affect each period to a similar extent.<sup>8</sup>

Environmental and settlement characteristics for the Deh Luran, Susiana, and Ram Hormuz Plains (Figure 3) are presented in Table III. The distribution of land types must have changed since antiquity, but since they are to a large extent functions of total plain size and stream discharge through the plain, the proportions must be roughly the same. By Late Susiana times, the broad outline of the observed traditional agricultural pattern was certainly present on the Deh Luran and Susiana Plains, with bread wheat, six-row barley, and lentils commonly cultivated and sheep, goats, and cattle commonly herded (Hole et al.

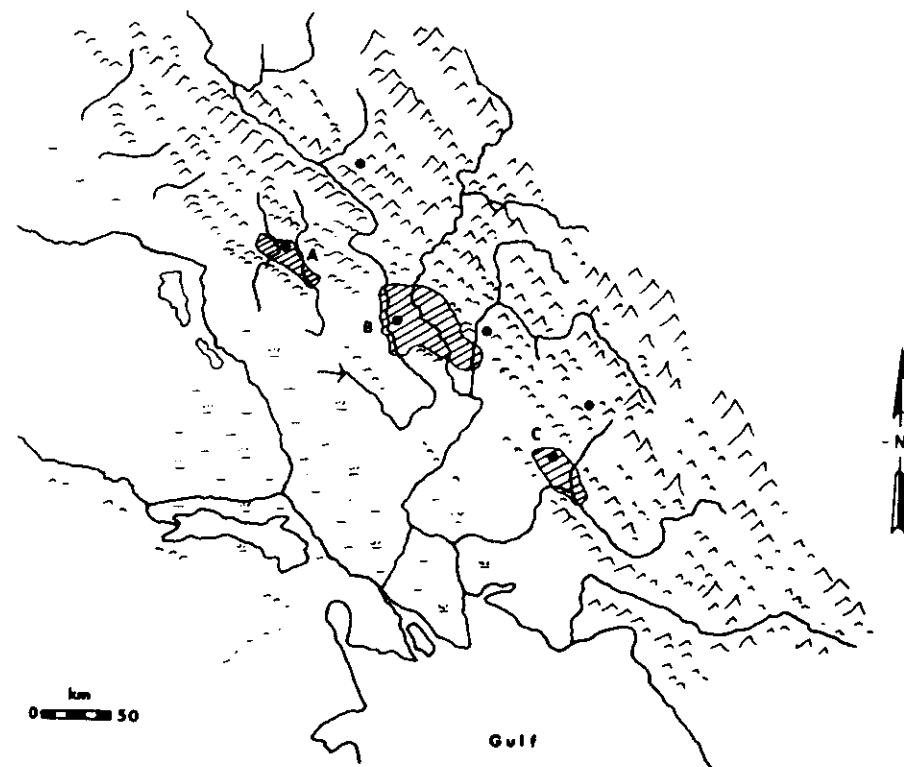


Figure 3. Southwest Iran During the Middle Uruk Period: A is the Deh Luran Plain; the dot represents Farukhabad. B is the Susiana Plain; the dot represents Susa. C is the Ram Hormuz Plain; the dot represents Tall-i Ghazir. The other dots are small centers on routes leading toward the highlands.

1969:281-330, 342-426; Redding 1974; Dollfus 1973:77). Given this, site area per 100 square kilometers of relatively level river levees and lower colluvial slopes should be a reasonable indicator of effective population density. These data show that by Susiana d times, population of the region was large, and the surveyed plains had approximately the same population density.<sup>9</sup> In the Susa A Period, a drop in population occurred on all plains. In Terminal Susa A, there was further decline resulting in virtual abandonment of the marginal plains. Some evidence elucidating this collapse is available from the Deh Luran Plain. Here the decline and eastward shift of Late Susiana settlement was followed by resettlement on the eroded northwestern piedmont of the plain around a spring-fed stream. These new settlers used ceramics of a highland affinity, and one of their two initial settlements was protected by steep slopes and rough stone walls. Thus there is evidence for locally unsettled conditions (Wright, Neely, Johnson, and Speth 1975). However, the extent and duration of actual conflict, if any, is unknown.

In the Early Uruk Period, with state emergence, settled population tripled on the Susiana Plain, increased even more on the Deh Luran Plain, and increased somewhat on the Ram Hormuz Plain. The marginal plains still had smaller populations and lower densities than during the Susiana d Period. The Susiana Plain had a density equivalent to that of the Susiana d Period. Thus, there was a greater concentration in the larger, centrally located

TABLE III. ENVIRONMENT AND SETTLEMENT CHARACTERISTICS OF THREE LOWLAND PLAINS IN SOUTHWESTERN IRAN

	Deh Luran	Susiana	Ram Hormuz
Area in Square Kilometers	940	2280	445
Percent of Land Types			
Steep Dry Land			
Rocky Slopes	23%	2%	4%
Gravelly Slopes	28%	14%	2%
Sand Dunes	—	—	15%
Low Wet Land			
River Flood Plain	10%	18%	6%
Seasonal Swamps	8%	3%	—
Level Dry Land			
River Levee and Lower Slopes	31%	61%	73%
Square Kilometers of Level Dry Land	290	1495	325
Hectares of Site Area			
Susiana d	18.7	94.1	13.1
Susa A	8.0	59.3	3.2
Terminal Susa A	1.4	33.1	1.2
Early Uruk	9.0	97.0	1.8
Middle Uruk	9.6	127.6	3.8
Late Uruk	3.0	53.0	1.8
Hectares Site/100 km <sup>2</sup> Level Land			
Susiana d	6.4	6.2	4.0
Susa A	2.7	3.9	1.0
Terminal Susa A	.5	2.2	.3
Early Uruk	3.0	6.5	.5
Middle Uruk	3.2	8.5	1.0
Late Uruk	1.0	3.5	.5

area. In the succeeding Middle Uruk Period, there were slight increases in population everywhere. Even so, it is unlikely that the aggregate settled population of Southwestern Iran was much greater than that of the Late Susiana Periods, since during these periods most of the smaller valleys had considerable settlement. In Late Uruk times, there was a general decline in settled population. This corresponds to a marked increase in population in southern Iraq (Adams and Nissen 1972:4) and possibly resulted from interaction between different primary states in Greater Mesopotamia.

In summary, the available data show that there was a period of population decline prior to state formation. States emerged perhaps during a period of unsettled conditions as population climbed back toward its former level. As Carneiro suggested, warfare may have a role in state formation, but in this case, increasing population in a circumscribed area cannot be the sole or direct cause of such warfare. If the hypothesis that population increase was the primary cause of state formation were correct, the state should have emerged in Susiana d times, because population in that period seems to have been as high as population in Early Uruk times.

## INTER-REGIONAL AND INTRA-REGIONAL EXCHANGE

Trade has been cited repeatedly as a factor in primary state development (Sanders 1968:105; Polanyi et al. 1957:257-262), but a mechanism by which it contributed to the specialization of administration is seldom clearly specified. A possible chain of events might be that as demand for rare materials increased, the leaders of ranked societies were obliged, on the one hand, to reorganize local resource procurement or craft production in order to have things to export. On the other hand, they would have to organize the redistribution of the imports. These types of organizational requisites, together with those such as the defense of trading parties, could exceed the administrative capabilities of the ranking figures and force them to appoint increasing numbers of specialized assistants. If such an argument were an adequate explanation of state development, then in any given case an expansion of trade would precede the period of state emergence.

Information on local and import commodities from three centers in Southwestern Iran (see Figure 3) are presented in Tables IV-VI. Where possible, the densities of items per ten cubic meters of debris are presented, thus allowing comparability between periods and sites. We make the assumptions that the deposition of garbage and building debris (cf. Lloyd and Delougaz 1942:126-133) and the loss rates of both the waste of export production and bits of import items were essentially constant on a site during the fourth millennium B.C. in Southwestern Iran.

Farukhabad (Table IV) was a small center on the westerly Deh Luran Plain. It was roughly equidistant from the large towns of Susa on the Susiana Plain and Uruk on the Lower Euphrates in Iraq, and strategically located on a traditional route between the two areas. The excavations were designed to elucidate exchange (Wright 1969). The evidence demonstrates that bitumen was locally extracted and processed here. It was perhaps exported to riverine areas where it was used as an adhesive and for waterproofing such things as boat hulls.<sup>10</sup> It was little used by Deh Luran communities, and the density of fragments is a useful indicator of export. Among Farukhabad's imports were obsidian from eastern Anatolia, copper from unknown sources, marine shell from the nearby Gulf, vesicular basalt

TABLE IV. DENSITIES OF EXPORTED AND IMPORTED MATERIALS AT FARUKHABAD, DEH LURAN PLAIN PER TEN CUBIC METERS OF DEPOSIT

	Kgs. Bitumen	Obsidian Artifacts	Copper Pieces	Marine Shells	Basalt Artifacts	Other Artifacts
Late Jemdet Nasr (27 m <sup>3</sup> )	2.5	—	.4	3.8	3.1	1 alabaster bowl 1 lapis bead
Early Jemdet Nasr (44 m <sup>3</sup> )	.3	—	.2	1.1	.4	2 carnelian beads
Late Uruk (26 m <sup>3</sup> )	.6	.4	—	2.0	—	1 alabaster bead 1 carnelian bead
Middle Uruk (26 m <sup>3</sup> )	.1	—	.8	—	—	
Early Uruk (11 m <sup>3</sup> )	.4	1.9	—	.9	—	
Farukh (Susiana d) (62 m <sup>3</sup> )	.3	.3	—	—	—	

TABLE V. OCCURRENCES OF EXPORTED AND IMPORTED MATERIALS AT TALL-I GHAZIR, RAM HORMUZ PLAIN\*

	Alabaster Artifacts	Obsidian Artifacts	Copper Artifacts	Other Artifacts
Proto-Elamite	9	—	8	1 turquoise bead 1 lapis pendant
Late and Middle Uruk	2	—	3	—
Early Uruk	5	1	1	1 steatite
Terminal Susa A and Late Susiana	—	—	—	—

\*The cubic meterage is not known in this case.

from Syria or Central Anatolia, and lapis lazuli from Afghanistan. The table shows that there was limited export of bitumen and import of obsidian in Late Susiana times. Bitumen was processed in equal quantities near both simple and elaborate residences, indicating little specialization of production. The limited volume of exchange continues during the Uruk Periods, although there is a sporadic decline in the occurrence of obsidian artifacts and a sporadic increase in copper and marine shell. Perhaps by the end of Middle Uruk times and certainly by the beginning of Late Uruk times, the settlement had an elaborate building with an associated spherical bulla and a bale sealing indicating that it had become a local administrative center. There is substantially more bitumen near the building, indicating a reorganization of production by the new administrators. In spite of this, there is no major increase in bitumen export or in imports until the Late Jemdet Nasr Period, long after state development.

Tall-i Ghazir (Table V), a similar small center on the easterly Ram Hormuz Plain situated on a traditional route to the highlands of Southeastern Iran (Caldwell 1968), yields no evidence of export or import in the reported Late Susiana samples. The local production of alabaster is attested in the Early Uruk, but the major increase in both alabaster production and in imports seems to be in the Proto-Elamite Period, roughly equivalent to the Jemdet Nasr Period at Farukhabad.<sup>11</sup>

TABLE VI. DENSITIES OF EXPORTED AND IMPORTED ITEMS AT SUSANA PLAIN PER TEN CUBIC METERS OF DEPOSIT

	Chert Artifacts	Bitumen Artifacts	Obsidian Artifacts	Copper Pieces	Other Artifacts
Late Uruk (28 m <sup>3</sup> )	8.2	1.1	.3	.7	1 turquoise bead 1 alabaster bowl
Middle Uruk (40 m <sup>3</sup> )	16.1	.5	—	.5	—
Early Uruk (10 m <sup>3</sup> )	11.0	3.0	—	1.0	—
Terminal Susa A and Susa A (39 m <sup>3</sup> )	1.0	—	—	—	—

Susa (Table VI) was the main center for the Susiana Plain and all Southwestern Iran for much of the time between 4200 B.C. and A.D. 800.<sup>12</sup> Here, import and export prior to the Uruk Period was also minimal, there being some evidence of it from the earlier excavations at Susa. The working of locally available chert, a stone probably exported eastwards, where chert is rare, for use as sickle blades, increased in Early Uruk times in the portion of Susa from which samples are available. The import of bitumen also increased. Copper import was modest but continual throughout the Uruk Period. There are indications of an increase in the number of commodities moving to Susa in the Late Uruk Period. Unfortunately, comparable data are not available for the post-Uruk Period at Susa.

The data from these three centers must be viewed from the perspectives of both intra-regional exchange and inter-regional exchange. In the Later Susiana Period, both seem to be minimal. At the beginning of the Uruk Period, there are several changes in local production and intra-regional exchange. For instance, alabaster production increases at Ghazir and alabaster objects do appear at the other sites during the Uruk Periods. Chert production increases at Susa, while bitumen import, presumably from one of the sources closer to Susa than Farukhabad, also increases. However, the only increase in inter-regional or long-distance movement of goods is a slight but consistent rise in the import of copper. Major increases in the volume of inter-regional movement do not occur until long after state emergence. Whatever the impact of such materials procurement on later state formations, Early Uruk states cannot have been a result of increasing volume of inter-regional trade.

#### LOCAL EXCHANGE

Several observations indicated to us that local exchange within a single plain might have been important in state formation.

First, it has long been recognized that there was a sudden shift in craft production, particularly in ceramic production, in Terminal 'Ubaid or Early Uruk times from individually crafted items to mass produced items (Childe 1957:129). This involved a decrease in decoration and increase in the use of the potter's wheel and pottery mold, both previously little used. In the Susiana Plain, this shift in techniques is correlated with a shift from small scattered shops to larger centralized shops. Since the products of these central shops are found in all settlements, there must have been changes in local distribution. Second, as our first population data were assembled in the form of archaeological site survey maps, we noted that the Uruk settlements were more regularly spaced than Late Susiana centers. Given the assumptions of some locational theorists in geography (Christaller 1966; Garner 1967:304-305), such a pattern shift would be predicted if the local exchange functions of these centers increased in scale. Therefore, Johnson undertook a detailed study of local exchange and administration on the Susiana Plain (1973).

Before considering the results, we should refer briefly to the assumptions behind this kind of study of local exchange. If the products of various shops could be differentiated, one could map their locations and test for patterned distributions. How do we distinguish the products of different shops? If there were constant interchanges of craftsmen between shops, variation in artifacts of a form used for one activity would be random and measurements of any single attribute should show a normal frequency distribution. If, on the other hand, there were barriers to the movement of craftsmen, masters and apprentices would tend to stay in the same community, and in a few generations differentiation in ceramics should occur. Vessels of a form used for one purpose would have a certain number of measurable attributes that show multimodal distributions, each mode representing a shop or group of shops in one community.<sup>13</sup>

The Middle Uruk Period is the best known on the Susiana Plain. Large samples of several Middle Uruk ceramic types were recovered on survey. We can show that the potter's shops were concentrated in the three largest communities because both the distinctive ovens and

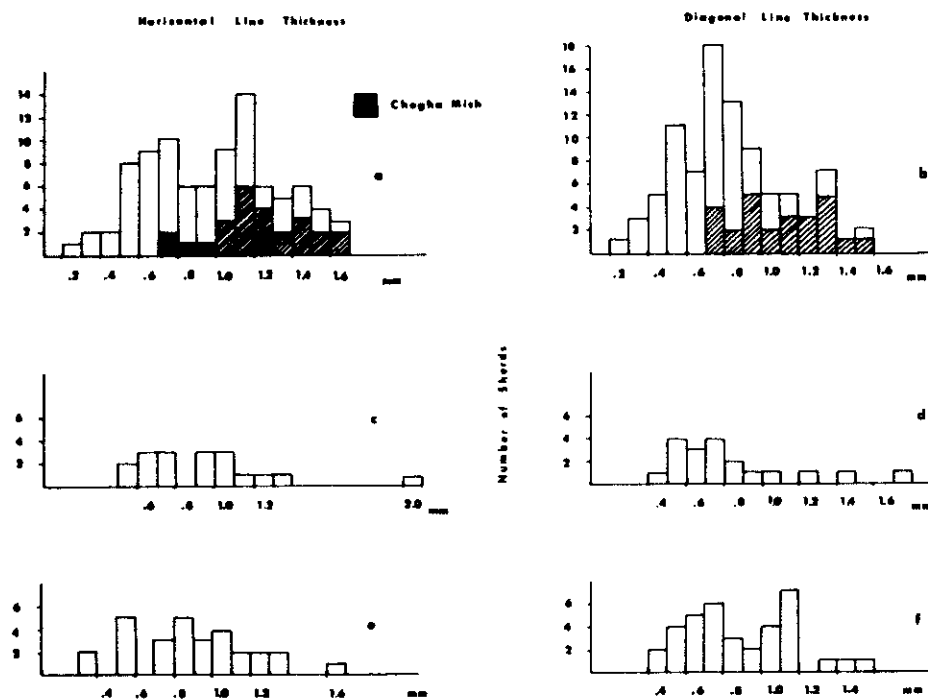


Figure 4. Histograms of incised line thicknesses of Uruk cross-hatched band decoration. a and b are measurements on the total survey sample from the Susiana Plain, plus a sample excavated at Chogha Mish kindly made available by Prof. H. J. Kantor of the University of Chicago Oriental Institute. c and d are measurements on samples from the beginning of Middle Uruk from Sharafabad. e and f are samples from the end of Middle Uruk from Sharafabad. For purposes of Table VII, diagonal lines thinner than 0.8 mm. and horizontal lines thinner than 0.9 mm. are considered to be from the western or Susa-related workshops.

masses of broken and over-fired, warped pottery were found on these sites. As an example of design variability in the Middle Uruk Period, let us consider Johnson's analysis of a type of incised, cross-hatched decoration common on a large jar type (1973:113-118). The histograms on Figure 4 illustrate that line widths are multi-modal with some about 0.7 mm. thick and some about 1.1 mm. thick. The analysis of other attributes of cross-hatched decoration and their associations demonstrates that this variation was not a result of style change through time. The spatial distribution of thick and thin varieties on the Susiana Plain is shown on Figure 5. The fine line variety occurs on small sites around the center of Susa to the west, while the heavy line variety occurs around the center of Chogha Mish to the east. Both varieties occur in the centers themselves and in two lines of sites running from Susa to Chogha Mish and beyond.<sup>14</sup> These aligned sites are on the predicted path of transport routes across the plain, and some of the sites along them, though small, have clay cones on their surfaces indicating the presence of elaborate buildings. A number of other ceramic attribute distributions exhibit multimodalities which show remarkably similar distributions across the plain. Thus, the sum of the evidence from the survey indicates that, in the case of the ceramic craft, items were produced in workshops in the centers and were distributed to the

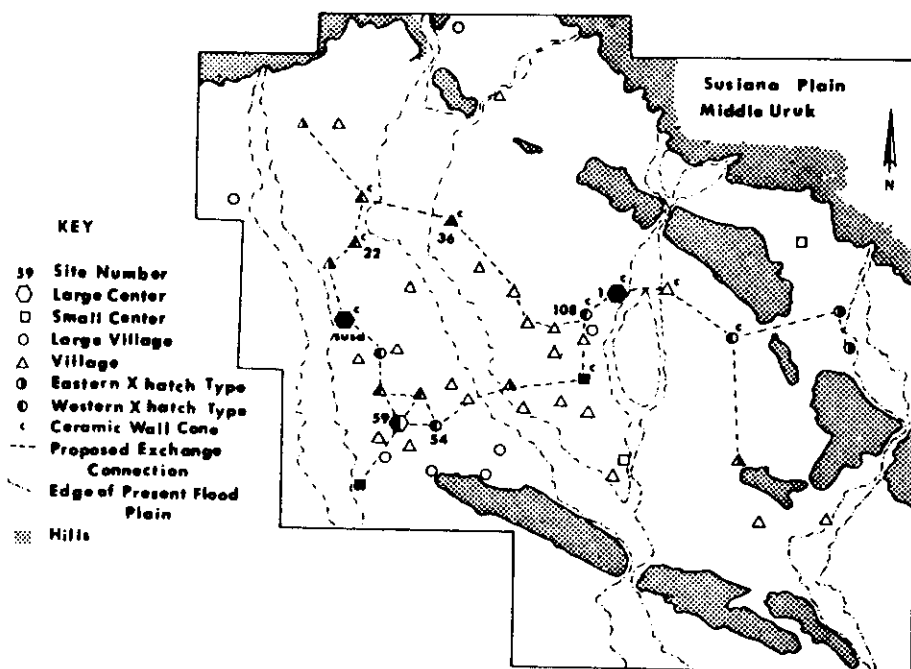


Figure 5. Middle Uruk settlements on the Susiana Plain showing the distribution of varieties of cross-hatched shoulder decoration.

small settlements, either directly or by way of the other centers or administrative posts on the routes between them.

A refinement and second test of the local exchange construct is possible using the cross-hatched decoration and other design features on ceramics from the excavations at Tepe Sharafabad, the small settlement whose administrative technology was previously contrasted with that from Susa. This center is equidistant from both Susa and Chogha Mish near a point where the Dez River could be forded en route between the two centers. Ceramic samples are available from deposits of the very beginning and the very end of the Middle Uruk Period.<sup>15</sup> The former samples could conform to one of three possible situations: (1) one center could completely control craft supplies for Sharafabad, resulting in 100% of the varieties being from one center or the other; (2) access to the centers could be a simple function of distance, in which event the Susa varieties and Chogha Mish varieties would occur in equal percentages; or (3) access to the centers could be a function of the distance and the size of the centers, in which event Susa varieties would constitute more than sixty percent of the assemblage. Figure 4 shows the distributions of horizontal and diagonal line thicknesses on cross-hatch bands for the survey sample and both of the Sharafabad samples, while Table VII shows the varieties of cross-hatched band based on the two different line measurements. While the samples of vessels are small, and the problem of the overlapping tails of distribution is difficult, it is still possible to evaluate the above possibilities. Figures 4c and 4d show basically one mode with a skew to the right at the beginning of Middle Uruk. This mode is very near the Susa mode. Figures 4e and 4f show that by the end of Middle Uruk,



TABLE VII. CERAMIC VARIETIES FROM SHARAFABAD, SUSIANA PLAIN

	Western Variety Counts	Eastern Variety Counts
<b>Earlier Middle Uruk</b>		
Cross-hatched Bands		
Diagonal Line Width	18	5
Horizontal Line Width	8	10
<b>Later Middle Uruk</b>		
Cross-hatched Bands		
Diagonal Line Width	20	20
Horizontal Line Width	15	14

when Chogha Mish was certainly a large center, there is apparent multimodality, with modes in both the Susa and Chogha Mish range. Since Sharafabad has a cone-decorated building, we would predict this on the basis of Johnson's survey study. Table VII shows the counts of varieties of line thicknesses. The cross-hatched bands conform most closely to the second of the three possible situations outlined above. However, it would be best to have samples from other settlements at varying distances from the different large centers. In any event, neither the second nor the third possible situation is compatible with a simple redistributive model for the economics of ceramic distribution (Polanyi et al. 1957:viii, 253-254; Wright 1969:76-77).

In addition, during the Middle Uruk Period there is indirect evidence of the distribution of grain to institutional workers. Ubiquitous at Uruk sites is a crude mold-made bowl known as the "beveled rim bowl" (Delougaz 1952:178). These had previously been found stacked in or near possible temples and had been termed "votive" bowls. Hans Nissen of the Institute für Vorderasiatisches Altertumskunde of Berlin hypothesized that the manufacture, frequency, and distribution of the bowls could best be explained if they were used for the issue of daily rations to institutional workers (Nissen 1970:137). Such ration systems are well known for the later periods (Gelb 1965:230-243). Nissen predicted that the bowls would conform to approximately regular units of measure. Our bowl samples from both survey and excavation on the Susiana Plain tend to be about 0.92 liters, 0.65 liters, and 0.46 liters in volume. The even ratio of 1.00 : 0.75 : 0.50 supports Nissen's hypothesis and indicates that there was a system of grain redistribution in Middle Uruk times. It is interesting to note that the most common bowl size, that of 0.65 liters, would contain just enough grain to make the amount of bread commonly eaten daily by an adult villager on the plain today (Gremiliza 1962:92).

The complicated local distribution system indicated by the lines of evidence presented above probably existed in the Early Uruk Period as well. First, Early Uruk small sites were evenly spaced around larger centers as were Middle Uruk sites. Second, although Early Uruk occupations are often covered by Middle and Late Uruk occupational layers and our sample of Early Uruk ceramics is thus small, it was possible to measure a series of a diagnostic jar type. Two workshop centers supplying the southeastern and northwestern portions of the plain are indicated (Johnson 1973:92-94). Third, the prototypic form of the beveled rim bowl is widespread, although we have few measurable examples, which suggests that grain distribution systems were operating.

In contrast, in the preceding Terminal Susa A Periods, the settlements are small and occur in a few, widely separated clusters rather than in a regularly spaced pattern. There is evidence of the manufacture of ceramics on the smaller sites rather than simply on the larger centers. Ceramic samples were not adequate for the type of analysis outlined above; nonetheless, there were no mass-produced "throw-away" vessels like the beveled rim bowl. The Susa A Period has not yet been analyzed so carefully as the succeeding periods. While exchange undoubtedly occurred, we have no reason to believe a centralized production and local exchange system was important at this time.

Thus, for the first time—at the beginning of the Early Uruk Period—specialized local administrative and exchange networks apparently developed in close articulation. Why did such seemingly inefficient networks, perhaps involving transport and labor costs outweighing the labor-saving of mass-production in larger shops, come into existence? Craft organization can be expected to vary with consumer demand. A recent mathematical model of service industry distribution presented by Kochen and Deutsch (1970:153-173) indicates that unpredictable fluctuations in demand would select for such a centralized shop pattern. In Mesopotamia, the most logical cause of such functions would be the periodic appearance on the lowland plains of large groups of specialized nomads in need of goods. Unfortunately, we do not yet know exactly when or why such nomad groups first developed.

#### CONCLUSIONS

Although Southwest Iran has been the object of intense archaeological study for more than ninety years, the data on primary state formation are remarkably incomplete. The Late Susiana societies of the region occupied a dense scatter of centers and subsidiary settlements. In the Terminal Susa A Period, all these societies suffered a decline, those on the small marginal plains being virtually destroyed, and those on the central Susiana Plain being reduced in size and fragmented. While there seems to be a trend toward undecorated, mass-produced ceramics during this time, we do not have a detailed study of any craft. We know nothing of farming, and nothing of local administrative organization. While there are indications of conflict on a marginal plain, we have little evidence of the overall pattern of relations between societies. At the beginning of the Early Uruk Period a number of changes take place. There is a marked increase in population everywhere, and on the Susiana Plain, there develops an ordered hierarchical pattern of settlements dominated by a large center. A series of mass produced ceramics, very similar to those we know to have been made in central shops a few centuries later, is distributed. There are local increases in the production of chert, bitumen, and alabaster; the last two are evidently exchanged from plain to plain within the region. There is some inter-regional movement of metals, but little else. Although these changes are evident in craft production and exchange, once again we have not one detailed study of a craft and we know little about agriculture. There is no direct evidence of administration or of relations between societies. Certainly the inception of state organization in this period is correlated with a number of changes, but the relations between variables are not demonstrable. In the Middle Uruk Period, there is further increase in population within the settlement framework established during the previous period. There is direct documentation of primary and tertiary levels of administrative control, perhaps of plant and animal products. There is independent evidence for the production of ceramics and chipped stone tools, and for their distribution by very different channels. We do not yet have evidence of plant and animal raising from enough small settlements to show the relation of agricultural activities to others. We also lack evidence of the relations between societies. However, our knowledge of Middle and Late Uruk Southwestern Iran in a systemic perspective is fast improving. With more fieldwork on both the smaller settlements of the central plain to improve our knowledge of farming and administration, and on the intermediate administrative centers both in the central plain and on the margins, we should be able to formally

demonstrate many of the relations between variables expressing the operation of this established state system in all its many aspects. By the end of the Uruk Period we see population decline, evidence of conflict on the central plain itself, and evidence of the beginning of increases in the volume of inter-regional exchange. These changes, which are beyond the scope of our present inquiry, may have to do with increased interaction between the various primary and secondary states of Greater Mesopotamia.

What can be done with this fragmentary evidence? In spite of its weaknesses, it is very useful in testing certain single variable explanations recently discussed in the literature. Not all such propositions can be tested with our data. For instance we cannot yet deal with irrigation as a prime mover. However, this has been discussed several times using evidence from nearby Southern Iraq where irrigation was more crucial to settled life (Adams 1960: 1965:41, 44; Adams and Nissen 1972:12, 28). We content ourselves with considerations of population and exchange as prime movers.

There was no unprecedented population increase immediately prior to state formation. Population at the time of the first state during the Early Uruk Period in fact barely surpassed that of the Susiana d Period several centuries earlier. This is not to say that population had nothing to do with state development, or that later secondary states did not form in contexts of population expansion. However, the hypothesis that population growth in a circumscribed area is in itself a necessary and sufficient condition for primary state formation must be rejected.

Likewise, there was no primary expansion of exchange just prior to state formation. Inter-regional exchange did not increase markedly until the end of the Uruk Period. Even intra-regional and local exchange seem to have been transformed concomitant with state emergence, and they may therefore be an effect of administrative transformation. This is not to say that trade networks developing around primary states did not lead to secondary state formation. We have evidence that it did on the Deh Luran Plain (Wright 1969:104). Nor would we deny that changes in local exchange had something to do with primary state formation. However, the hypothesis that increased inter-regional exchange alone leads to primary state formation must also be rejected.

We would argue that careful research will always result in the rejection of explanations relying on single variables. The reason for this in the present case is as follows. Although knowledge of Susiana d and Susa A organization is limited, two points are difficult to deny. First, these are multi-community systems in which a center dominates a number of smaller communities. Second, those of the communities which have been excavated, large and small, have evidences of a wide range of agricultural and craft activities. There is little evidence for the specialization or centralization of productive activities. In such a system, any and all local communities would ordinarily be capable of regulating a change in a single variable. For example, if population increased, compensation in fertility, mortality, agricultural practices, or other variables would be possible. Only rare sudden changes in single variables would require regulation by supra-local authority. The capacity of such authorities to handle such problems would seldom be exceeded.

What kind of changes would force not simply the addition of a new level of regulation, but a shift from a system in which each local community was a semi-autonomous component containing many activities to one in which each activity was a semi-autonomous component operating in many communities? To illustrate, we have presented some evidence that ceramics came to be produced in large centers and were distributed to others. The ceramic craft was probably a self-regulating component of the entire system. Other activities may have been similarly reorganized. We suggest that only multiple variable changes could cause such a transformation. At least three possible mechanisms of multiple variable interaction can be proposed:

(1) The relations between variables could simply be additive. Although any single variable might be easily regulated, enough were changing so that the information-processing capacity of the societies' decision-makers was exceeded. A set of specialized administrative assistants was added to the political hierarchy to help with those activities causing problems. An explanation using this type of construct would be assuming only a channel capacity or "requisite variety" principle.<sup>16</sup> It would express the simplest kind of multiple variable interaction and could thus serve as a baseline against which the effectiveness of the more complex explanation might be measured.

(2) There could be a required time order in which a set of variables must change. For instance, initially there might be changes that forced the creation of administrative assistants, perhaps in the manner outlined above. Ordinarily these would be unspecialized and would control enough different activities to provide them with the independence to foment conflict leading either to the decimation of the society or to a division into smaller more manageable units. However, if there were subsequent changes that led to complementary functional specialization of these assistants, the regulating cycle of rebellion, conflict, and reduction in societal size would not be possible, and state development in our terms would result. Such functional specialization could be facilitated by a change from a fairly constant demand in time and space for goods and services to unpredictable, fluctuating demand as suggested by Kochen and Deutsch (1970). An explanation using this type of construct would be assuming principles of channel capacity and of cost-benefit optimization.

(3) There could be interaction between variables. Two regulatory processes which, when they operate alone have a damping or negative feedback effect, could have a positive effect when they operate simultaneously. For example, suppose the internal prosperity of the society is signaled by the amount of goods redistributed from the center to smaller communities. When lesser amounts of these essentially symbolic commodities are given out, rebellion becomes more likely, producing a more effective leadership or smaller, more manageable societal units. Also suppose that regional population is in part regulated by raiding. These two devices would operate on different organizational levels and perhaps at different times as well. If, however, raiding thoroughly fragmented existing social units to the point where goods were being distributed to units which might in fact raid in return, then redistribution becomes a payment rather than a signal, and a constant flow of goods requiring a reorganization of production would be needed. Reorganization of some productive tasks could lead to complementary specialization and reorganization of others, with consequent specialization of task control, increased information flow, and subsequent increased hierarchical complexity.

These brief sketches are not intended as testable propositions. They do not formally define either the variables that might be involved or the principles that relate these variables. They only suggest patterns or mechanisms by which variables might be related. These three suggestions do serve to indicate the approaches to field research which will be needed if any multiple variable explanations are to be tested.

If we are to demonstrate the relations between sets of interacting variables, newly introduced methods must be applied throughout Southwest Iran and Greater Mesopotamia. First, we must recover site constituents in correct proportion to one another. This requires the application of the screening and water flotation techniques introduced into the area by Hole et al. (1969:26, 385). Second, we must recover these constituents from known volumes of strata of known depositional origin. This aim can be facilitated by a series of measurements and record forms we have developed in the course of the excavations at Farukhabad and Sharafabad. Third, we need better knowledge of how objects are incorporated into site deposits in order to estimate the proportion of different constituents lost under various conditions. This will require both experiment and observation of living Susiana communities, both of which pursuits have hardly begun. When information from

such observation is combined with the above mentioned volume observations, estimates of absolute discard rates of site constituents should be possible. Fourth, we must recover representative samples from each ancient community. We have tried several approaches to this problem, and have found it difficult to sample simultaneously for small rare items like copper, and large common features like buildings. Possibly multi-stage, stratified samples will solve such problems. If all these changes in method can be applied together, each excavated site should provide information on the organization of domestic units and other institutions, and on changing rates of population growth, production, exchange, consumption, and information flow, all of which we need if multiple variable hypotheses are to be tested.

New methods and thus new data stem from a rethinking of problems including basic assumptions and perspectives, definitions of variables, and the principles that relate them. Our efforts to test single variable hypotheses have led to the various survey and analytical methods used in this paper. It is the rejection of these hypotheses that has forced us to reconsider the problem of primary state origins in a multiple variable or systemic perspective, and to propose the approaches and methods outlined above.

## NOTES

<sup>1</sup> The Museum of Anthropology's work in Southwestern Iran has been carried out jointly with the Iran Archaeological Service, now the National Research Centre for Art History and Archaeology. We thank the Délégation Archéologique Française, The British Institute of Persian Studies, The American Institute of Iranian Studies, the Institute of Archaeology of Teheran University, The Oriental Institute of the University of Chicago, and the Rice University Prehistoric Project, all of whose directors and staffs have assisted us. Our work was supported by National Science Foundation grants GS-1936, GS-2194, and GS-3147 and by two University of Michigan Rackham Research Grants.

<sup>2</sup> We are not here concerned with the origin of development of "urbanism" or "urban society" as a whole. State origin involves definable changes in a few variables, but urban emergence involves an indefinitely complex series of changes, of which state development is a small although crucial aspect. If the explanation of urban society were our objective, our research would doubtless have proceeded in a very different manner.

<sup>3</sup> Morton Fried (1967:231-235) has termed states with no such articulation "pristine states." There were no more than two such developments.

<sup>4</sup> Tepe Sharafabad was excavated in 1971, and analysis is not yet complete. This paper contains the first published data from this site with the exception of some ceramic measurements in Johnson (1973:134-135).

<sup>5</sup> The survey data on Susa A sites is a collation of those sites with fine bird motifs (Pottier 1913, IV:1-2, VI:2, IX:7-9; Dollfus 1973, Fig. 14:2,4), "X" motifs (Pottier 1913, VIII:5, Fig. 13:1,3,4) and line dot motifs (Pottier 1913, VIII:2, XI:1), as represented in collections by Robert McC. Adams in 1961, Frank Hole in 1969, ourselves in 1971, and Robert Wenke in 1973. As Susa A is often the last occupation on a site, erosion has perhaps destroyed more sites than usual. In particular, seventeen sites totaling 18.6 hectares have the fine line motif typical of, but not exclusive to, the Susa A phase. However, the addition of some or all of these sites would not affect our assessment of hierarchy or our subsequent arguments about population change.

<sup>6</sup> We concur with Amiet's judgement that the large ceramic stamps from Djaffarabad and Susa are not seals (1972:6-7).

<sup>7</sup> Early sites on the Susiana Plain were surveyed by the individuals noted above. Those on the Deh Luran Plain were surveyed by Hole and K. V. Flannery in 1961 (Hole et al. 1969) and by Neely in 1970-71. Those on the Ram Hormuz Plain were surveyed by Wright and E. Carter in 1969. We are indebted to all of these individuals for access to their notes and collections.

<sup>8</sup> We need not reiterate Johnson's extensive discussion of relative and absolute chronology (1973:29-64) summarized in our Table I. The three part subdivision of the Uruk can certainly be refined, but it is adequate for our present purposes.

<sup>9</sup> There is no published stratigraphic demonstration that Susa A represents a period succeeding Susiana d. We accept the position of LeBreton (1957:79-114) on the basis of the sum total of statistical and stratigraphic information available to us.

<sup>10</sup> Extensive studies of our bitumen samples have been conducted by Dr. Robert Marschner of the American Oil Co. and techniques have been developed for establishing the region of origin of archaeological specimens. Unfortunately, modern source and archaeological samples from Iraq have not been available to us so we cannot be certain that bitumen from Southwestern Iran was moved to Iraq or vice versa.

<sup>11</sup> The 1949 excavations of D. McCown were not directed toward questions of exchange and screens were not used to recover waste materials systematically, so one cannot directly compare the artifact counts with those from other sites. However, relative changes within the site provide a useful comparison to those from Farukhabad. These data were made available by J. R. Caldwell of the University of Georgia and Donald Whitcomb of the University of Chicago.

<sup>12</sup> The sounding of Robert Dyson of the University Museum in the Acropole of Susa (1966) is, of course, a small excavation in this important large center. It is, however, one of the few adequate excavations on the site and the only one to penetrate the entire Susa A and Uruk sequence. Furthermore, the data from it seem comparable to those from other excavations at Susa and on the Susiana Plain.

<sup>13</sup> This approach was pioneered by James Deetz (1965), William Longacre (1970), James Hill (1970), and Robert Whallon (1968), but we have modified it to meet the constructive criticisms raised by Margaret Hardin Friedrich (1970) and William Allen and James Richardson (1971) and to allow application to workshop situations.

<sup>14</sup> We are indebted to Jean Perrot and Helene J. Kantor for specific permission to examine material from the excavations at Susa and Chogha Mish.

<sup>15</sup> The study of cross-hatched decorations from Sharafabad was initiated by Michael Lambek of the University of Michigan Museum of Anthropology to whom we are much indebted. We are presently attempting to devise a completely new way of testing the local exchange construct by studying the mineral content of sherds.

<sup>16</sup> This principle has been extensively discussed by Ashby (1956). It was introduced into the consideration of early state operation by Wright (1969:3-6) and was applied to the problem of primary state origins by Johnson (1973:1-4).

## REFERENCES CITED

- Adams, Robert McC.  
1960 Factors Affecting the Rise of Civilization in the Alluvium. *In* City Invincible. C. H. Kraeling and R. McC. Adams, Eds. Chicago: University of Chicago Press.  
1961 Agriculture and Urban Life in Early Southwestern Iran. *Science* 136:109-122.  
1965 Land Behind Baghdad. Chicago: University of Chicago Press.  
1966 The Evolution of Urban Society. Chicago: Aldine.
- Adams, Robert McC., and Hans J. Nissen  
1972 The Uruk Countryside. Chicago: University of Chicago Press.
- Allen, William, and James Richardson  
1971 The Reconstruction of Kinship from Archaeological Data. *American Antiquity* 36:41-53.
- Amiet, Pierre  
1972 La Glyptique Susienne. Mémoires de la Délégation Archéologique Française en Iran XLIII. Paris: Paul Geuthner.
- Ashby, W. Ross  
1956 Introduction to Cybernetics. New York: Wiley.
- Binford, Lewis  
1968 Post-pleistocene Adaptation. *In* New Perspectives in Archaeology. S. R. Binford and L. R. Binford, Eds. Chicago: Aldine.
- Braidwood, Robert J.  
1960 The Agricultural Revolution. *Scientific American* 203:130-141.
- Caldwell, Joseph R.  
1968 Tall-i Ghazir. *In* Reallexikon der Assyriologie und Vorder-asiatische Archäologie, Band III:349-355.

- Carneiro, Robert  
1970 *The Origin of the State*. *In Science* 169:733-738.  
1972 *From Autonomous Villages to the State, a Numerical Estimation*. *In Population Growth, Anthropological Implications*. B. Spooner, Ed. Cambridge, MA: MIT Press.
- Childe, V. Gordon  
1957 *New Light on the Most Ancient East*. New York: Evergreen.
- Christaller, Walter  
1966 *Central Places in South Germany*. New York: Prentice-Hall.
- Cook, S. F., and Robert F. Heizer  
1968 *Relationships Among Houses, Settlement Areas and Populations in Aboriginal California*. *In Settlement Archaeology*. K. C. Chang, Ed. Palo Alto: National Press.
- Deetz, James  
1965 *The Dynamics of Stylistic Change Among the Arikara*. Urbana: University of Illinois Press.
- Delougaz, Pinhas  
1952 *Pottery from the Diyala Region*. Oriental Institute Publication LXIII. Chicago: University of Chicago Press.
- De Mecquenem, Roland  
1943 *Fouilles de Suse, 1933-39. Mémoires de la Mission Archeologique en Française en Iran XXIX:3-161*. Paris: Paul Geuthner.
- Dollfus, Genevieve  
1973 *Les Fouilles á Djaffarabad de 1969 a 1971. Cahiers de La Délégation Archéologique Française en Iran 1:17-162*. Paris: Paul Geuthner.
- Dyson, Robert H.  
1966 *Excavation on the Acropole of Susa and the Problems of Susa A, B and C*. Doctoral Thesis. Harvard University.
- Engels, Friederick  
1910 *The Origin of the Family, Private Property, and the State*. Chicago: C. H. Kerr.
- Flannery, K. V.  
1965 *The Ecology of Early Food Production in Mesopotamia*. *Science* 147:1247-1256.
- Fried, Morton  
1967 *The Evolution of Political Society*. New York: Random House.
- Friedrich, Margaret Hardin  
1970 *Design Structure and Social Interaction*. *American Antiquity* 35:332-343.
- Garner, B. J.  
1967 *Models of Urban Geography and Settlement Location*. *In Models in Geography*. R. J. Chorley and Peter Haggett, Eds. London: Methuen.
- Gelb, Ignace J.  
1965 *The Ancient Mesopotamian Ration System*. *Journal of Near Eastern Studies* 24:230-243.
- Gremlixa, Frederick  
1962 *The Ecology of Endemic Diseases in the Dez Irrigation Pilot Area*. New York: Development and Resources Corporation.
- Hill, James A.  
1970 *Broken K Pueblo*. *Anthropological Papers of the University of Arizona No. 17*. Tucson: University of Arizona Press.
- Hole, Frank, Kent V. Flannery, James A. Neely, and Hans Helback  
1969 *Prehistory and Human Ecology of the Deh Luran Plain*. University of Michigan Museum of Anthropology, Memoir No. 1.
- Johnson, Gregory A.  
1973 *Local Exchange and Early State Development in Southwestern Iran*. University of Michigan Museum of Anthropology, Anthropological Paper No. 51.
- Kochen, Manfred, and Karl W. Deutsch  
1970 *Decentralization and Uneven Service Loads*. *Journal of Regional Science* 10:2.
- Le Breton, Louis  
1957 *The Early Periods at Susa*. *Iraq* 19:79-114.
- Le Brun, Alain  
1973 *Recherches Stratigraphiques a L'Acropole de Suse. Cahiers de la Délégation Archéologique Française en Iran 1:163-233*. Paris: Paul Geuthner.
- Lloyd, Seton, and Pinhas Delougaz  
1942 *Pre-Sargonic Temples of the Diyala Region*. Oriental Institute Publication No. LVIII. Chicago: University of Chicago Press.

- Wright and Johnson] *POPULATION, EXCHANGE, STATE FORMATION* 289
- Longacre, William  
1970 *Archaeology as Anthropology*. *Anthropological Papers of the University of Arizona No. 18*. Tucson: University of Arizona Press.
- Naroll, Raoul  
1962 *Floor Area and Settlement Population*. *American Antiquity* 27:587-589.
- Nissen, Hans J.  
1970 *Grabung Der Quadraten K/L XII in Uruk Warka*. *Baghdader Mitteilungen* 5:102-191.
- Nordbeck, Stig  
1971 *Urban Allometric Growth*. *Geografiska Annaler* 53:B:1:54-67.
- Oberlander, Theodore  
1965 *The Zagros Streams*. *Syracuse Geographical Series 1*. Syracuse: Syracuse University Press.
- Polanyi, Karl, Harry Pearson, and C. M. Ahrensburg  
1957 *Trade and Market in the Early Empires*. Glencoe: Free Press.
- Pottier, Eduard  
1913 *Etude Historique et Chronologique sur les Vases Pientes de L'Acropole de Suse. Mémoires de la Délégation Perse XIII*. Paris: Paul Geuthner.
- Redding, Richard William  
1974 *Faunal Remains from Tepe Farukhabad*. M.A. thesis, Department of Geology, University of Michigan, Ann Arbor.
- Sanders, William T.  
1968 *Hydraulic Agriculture, Economic Symbiosis, and the Evolution of States in Central Mexico*. *In Anthropological Archeology in the Americas*. Betty J. Meggers, Ed. Washington, DC: Anthropological Society of Washington.
- Sanders, William T., and Barbara J. Price  
1968 *Mesoamerica: Evolution of a Civilization*. New York: Random House.
- Stephenson, Robert L.  
1968 *Population and Political Systems in Tropical Africa*. New York: Columbia University Press.
- Steve, M. J., and H. Gasche  
1973 *L'Acropole de Suse. Mémoires de la Délégation Archéologique Française en Iran XLVI*. Paris: Paul Geuthner.
- Tobler, Waldo  
1969 *Satellite Confirmation of Settlement Size Coefficients*. *Area* 1:3:31-34.
- Whallon, Robert  
1968 *Investigations of Late Prehistoric Social Organization in New York State*. *In New Perspectives in Archaeology*. S. R. Binford and L. R. Binford, Eds. Chicago: Aldine.
- Wright, Henry T.  
1969 *The Administration of Rural Production in an Early Mesopotamian Town*. University of Michigan Museum of Anthropology, Anthropological Paper No. 38.  
1972 *A Consideration of Inter-regional Exchange in Greater Mesopotamia*. *In Social Exchange and Interaction*. Edwin Wilmsen, Ed. University of Michigan Museum of Anthropology, Anthropological Paper No. 46.
- Wright, Henry T., J. A. Neely, G. A. Johnson, and John Speth  
1975 *Early Fourth Millennium Developments in Southwestern Iran. To appear in Iran XIII*.