Stochastics and Structure: Cultural Change and Social Mobility in a Yucatec Town[1]

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The study of the dynamic properties of a system of social stratification provides critical structural information on cultural change. Mobility data are particularly useful in the construction of models predicting the structural effects of accelerated change. Data from a small urban setting are incorporated into a stochastic model which yields a structural index of the effects of the introduction of new variables into the system, variables reordering the society and changing its relation to broader levels of sociocultural integration.

RECENT INTEREST IN URBAN STUDIES in anthropology indicates an increasing concern with the phenomena of social stratification and mobility. The focusing of attention on the stratification systems of complex societies is perhaps best exemplified by a decade of theory and research in Latin American settings stemming from Beals' (1953) programmatic essay on social stratification and, in particular, Whiteford's (1960) comparative study of social class in two cities in Mexico and Colombia. Indicative of anthropological and anthropologically oriented concerns voiced in this literature are publications by Erasmus (1961), Tumin and Feldman (1961), Leeds (1964), Kahl (1965), Iutaka (1965), Adams (1965, 1967), and Whitten (1965, 1969).

Though the anthropologist Lloyd Warner established a powerful precedent in the 1930's, the formal study of social stratification has traditionally been of marginal interest to social anthropologists. Yet, quite apart from a certain intrinsic fascination, stratification data—particularly social mobility profiles—provide a convenient index of cultural change, reflecting over time its effects on the dimensions of social status in a society.

Mobility data are thus particularly amenable to the structural analysis of change. Beyond the simple construction of temporal profiles documenting certain social structural concomitants of change, formal data provide the necessary information for the building of mathematical models to predict

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the probable future trajectory of change in a society. The use of stochastic models serves as a device for writing a sort of structural "history" of the subsystems of a given culture and society. Such models are especially useful in charting the real and probable effects of the introduction into a sociocultural system of new variables.

This paper presents data detailing certain of the structural effects of the introduction of new variables into the culture of a bi-ethnic town on the Yucatán Peninsula in Mexico. These variables have had the effect of increasing the tempo of change in the society, reordering its components and its relation to more inclusive levels of sociocultural integration (region, state, nation; see Wolf 1967). The study provides a structural account of the impact of accelerated change on mobility patterns within the community. Though the over-all *structure* of the stratification system has been little modified during the relatively brief period represented here, the rate of population redistribution (social mobility) over the levels of the status hierarchy presages a restructuring of the system as a function of the changing relation of critical sociocultural variables. The construction of a stochastic model projecting mobility patterns into the immediate future provides a useful indication of the rate and direction of cultural change in this small urban setting.

SOCIAL MOBILITY: THEORETICAL AND METHODOLOGICAL ISSUES

Of preliminary importance is the discussion of several theoretical and methodological issues. The first concerns the *nature of mobility* as conceived in this paper, i.e., precisely what is intended by the term "social mobility." Operationally, the construct "mobility" is taken simply to mean *intergenerational status change;* only persons whose status differs from that of their fathers are counted as mobile. The term "status" is used in this paper to summarize the operation of a set of classificatory dimensions, a construct representing the ordering of persons on a locally relevant scale of total social position. The relation of "status" to the somewhat more ambiguous term "social class"—a construct variously defined in the literature (referring to historical divisions, economic strata, etc.)—is close. But the prestige aspect of the traditional Weberian distinctions concerning the bases of social stratification (class, status, power) is here prominent. Structurally, status is a summary construct, the relative product of a set of values on dimensions directly and invariably associated with the determination of broad differences in social rank.

Strictly speaking, three logical and empirically isolable types may be specified under the rubric of mobility: upward mobility, stable mobility (non-mobility), and downward mobility. But, although the mobility defini-

tion is general in character, the form it takes in this report, as in most studies of social mobility, focuses on *upward* mobility.

A related definitional issue involves the perspective afforded by the research design, i.e., the constraints imposed by a particular approach to mobility. The present conceptual framework is structured by the dual dimensions of status and generation, with changing values on both providing the criteria for mobility. It is not denied that a certain amount of mobility might be discerned within a status level, nor is it denied that status changes may occur within single generations. However, the form of mobility most amenable to measurement is that which obtains between generations and across status categories, and in the interests of a clear and uniform treatment it is this form with which the present paper is concerned. Other forms of mobility, though clearly worthy of investigation in their own right, present problems beyond the scope of this discussion.

A final point remains to be made. This involves the basis for mobility classification. For example, primary attention could be given to occupational mobility, a basis for classification currently popular in the literature of sociology. Or, one could focus on income mobility or, perhaps, educational mobility. For this study, however, the existence of a convenient composite index relating ranked status levels to a body of intergenerational information makes it most profitable to consider mobility in broad terms; i.e., the basis for classification is simply *over-all social status.*

Another broad issue which requires some discussion is the matter of the *nature of measurement.* The current literature on social mobility, literature largely falling within the province of sociology rather than anthropology, contains essentially two formal aspects. The first involves concentration on problems of description and analysis, with prediction entering in from the specification of relatively low-order relationships not far removed from the empirical level and limited to a given point in time. The second is concerned with the understanding of process and the construction of broad-scale predictive and temporal models. These two modes are best considered as constituting analytic stages rather than as representing mutually exclusive alternatives, although particular research efforts frequently emphasize one over the other.

The first involves thoroughgoing reliance on *classic statistical methods* characteristically focusing on correlational approaches and the formulation of prediction equations from regression coefficients expressing relationships between variables. The objective is the prediction of status on the basis of specified variables, separately or in combination. In terms of mobility, straightforward statistical analysis typically provides direct measures at some point incorporating intergenerational correlation coefficients, i.e., expressing the

degree of correlation between fathers and sons and providing a summary statement of the relationship by means of a standard measure of linear regression.

A recent and convincing study of the American occupational structure by Blau and Duncan (1967) is a detailed example of classic statistical approaches to status and mobility, supplemented by multiple classification techniques, covariance analysis, and (mobility) path analysis. Formal techniques, including several methodological innovations—some stemming from the work of Goodman (1965)—are extensively applied to description, analysis, and limited prediction.

For purposes of exposition, it is useful to contrast this approach to the study of social mobility with the more abstract *stochastic processes* approach. The concern here is less with intergenerational correlations and prediction equations than with the formulation of models of broad temporal change in structural systems. The focus is on systemic processes rather than limited discrete relationships. The principal feature is the construction of models which make considerable use of the theory of Markov chains in discrete time. Elementary discussions of Markov processes may be found in Kemeny and Snell (1960). The point to be noted here is that finite models of a stochastic type provide the analyst with mathematical tools for the projected development of a structural system rather than limited concentration on a set of relationships fixed in time, as is characteristic of standard statistical analysis. The work of Prais (1955) contained an early suggestion of the utility of stochastic models for the study of social mobility. Various of such models are discussed by Bartholomew (1967).

In the pages which follow the ethnographic sketch, both approaches will be utilized. Correlational data will be presented initially. Following this, as a summary statement of the over-all structural system and temporal changes, a simple stochastic model will be offered suggesting the future development of the system over a limited time span.

A YUCATEC TOWN

Ticul is the largest community in western Yucatán, a center of trade and minor industry with a population of 13,000 (1968). It is an old town, with mention in the famous 16th century *Relación* of Diego de Landa, the Spanish Bishop of Yucatán (Tozzer 1941), and in the Maya chronicle copied into Spanish script during the early colonial years, *The Book of Chilam Balam of Chumayel* (Roys 1933). Today it is the administrative center, the *cabecera,* of a like-named local territorial and political unit—a *municipio*—containing nearly 40 villages, hamlets, haciendas, agricultural colonies, and *ranchos.* With 87% of the *municipio* population of approximately 15,000, it

is a true urban unit maintaining an electric plant, a water system, a bank, resident doctors and dentists, a secondary school and several primary schools, appliance stores selling television sets and motorcycles (among other items), movie houses, numerous general stores, and several automobiles.

A little over half the men in town are corn farmers, *milperos,* scratching out a traditional existence from the stony soil by age-old slash-and-burn techniques. But the community is unique in Yucatán, for the economy is not primarily dependent upon the produce of bush and cornfield. Ticul boasts an active and extensive cottage industry complex, employing some 30% of the men most of the year, who labor in small establishments and specialize in the production of shoes, hats, and pottery. Though not an industrial center in the usual sense of the term, Ticul is a production community thoroughly geared to a modern regional marketing system which weekly distributes large quantities of leather and synthetic fabric shoes for women and palm leaf fiber hats for men. Pottery is typically distributed by the producers themselves; it is a venerable folk industry of lesser economic significance to the community. The growth of the major industries of shoemaking and hatmaking principally derives from the period of economic stimulation provided by World War II regional and national shortages in finished goods. Working chiefly with local capital, Ticuleño entrepreneurs responded to market conditions and developed these formerly insignificant industries into a complex of small establishments today employing nearly 1000 persons. Demand has remained consistent over nearly three decades, although seasonal fluctuations of the annual economic cycle regularly result in temporary periods of unemployment for less skilled workers. Laborers operate on a piecework basis, producing shoes and hats primarily by hand but with an essential assist from minor mechanical equipment (notably heavy-duty sewing machines).

Combined with recent national, regional, and local emphasis on the public schools (a secondary school was constructed in the mid-1950's), this industrial development is particularly evident among the modern sources of sociocultural change. A quarter century of relatively rapid growth has had considerable impact on the community; through increased wealth and a diversification of employment opportunities this growth has helped considerably to bridge the traditional gap between the wealthy few, the Spanish-speaking merchants and landowners, and the poor majority, the predominantly Maya-speaking corn farmers. Work in the shops provides an alternative for many to the traditional life of the *milpa,* opening up mobility channels to socio-economic levels unattainable through the limited resources of the *milpero.*

As in most of Middle America, Ticuleños draw a pervasive, though some-

times subtle, distinction between categories of persons on the basis of the regional form of the Indian-Ladino dichotomy. As elsewhere, the dichotomy is a contemporary structural result of a long acculturative history, a product representing locally salient differences in group identification. In the image of a centuries-old dominance mode in group relations, Ticuleños of recognized Maya heritage are uniformly accorded less prestige than those considered to represent non-Maya (Hispanic-Yucatec) heritage. Unlike the relatively isolated communities of the Highland Maya area, however, ethnic separation in this highly acculturated region does not assume firm caste-like dimensions, although older residents of the town recall a time when segregation and differences in prestige were considerably greater than at present.

As in most of Middle America, manifest ethnicity is a cultural concept with little racial significance and is not immutable as it applies to the folk classification of individuals. In modern Ticul ethnic group membership is relatively easy to change, as attested by the fact that perhaps three in each four members of the Ladino sector count recent Maya heritage. Furthermore, the great majority of those who aspire to change ethnic identification are able to do so without achieving the dubious distinction of becoming the permanently marginal individual who is accepted by neither group: the well-known Marginal Man of social science literature. And, as has been implied above, many who change do so through the economic advantages and general Ladinizing influence of labor in the cottage industries and recent trends in public education.

It is of interest to pause momentarily and consider the matter of labels which serve to identify ethnic segments in Ticul. The Hispanic-Yucatec sector, that of the high-prestige person who speaks Spanish exclusively (at least ideally) and wears European-style clothing—particularly the all-important pair of shoes instead of the heeled Yucatec sandal (*alpargata*)—is referred to as "Catrín," a term roughly equivalent to the use of "Ladino" in Chiapas (Mexico) and Guatemala. However, in view of the facile use of ethnic terminology in the anthropological literature, it is of some interest that the term uniformly applied to the wearer of the folk costume and the fluent speaker of the Indian language (though seldom monolingual in urban Ticul) departs completely from the terminology usually reported in Middle American ethnographies or in comparative research. (For a recent review of the literature, see De la Fuente 1967.) The non-Ladinized Ticuleño (or other Yucateco) is a member of the Mestizo group. The product of the colonial period and historically applied to persons of mixed blood, the term "Mestizo" is today commonly utilized in local settings in Mexico and in the anthropological literature to signify not the non-Ladinized sector but rather the *Ladino* sector specifically—the *non-Indian*!

Thus, totally contrary to generally recognized Middle American nomenclature patterns, Mestizos represent in this setting the acknowledged bearers of a heritage strongly associated with the Indian pole of the sociocultural spectrum. The form of this association and its meaning to Ticuleños is a function of the mutually acculturative tradition of Yucatán and the influence of the local urban environment. Most of the Mestizos of Ticul consider themselves to be simply Mestizos, the products of an extensive history of cultural and biological admixture. To them the "true" Mayas, those knowledgeable in the ancient customs, are no longer in existence except perhaps in isolated bush villages not far away in the tropical rain forests of the Federal Territory of Quintana Roo. Yet, when one changes to Catrín, the features of identification which are modified are those generally regarded both by Mestizos and Catrines as being specifically associated with the *Indian* past—speech, clothing, and the practice of the Maya customs of bush, field, and home. The term "Mestizo" cannot be fully defined by Ticuleños without reference to Maya heritage, and the definition of the term "Catrín" ideally ignores folk culture, specifically Maya features. Thus, regardless of centuries of acculturation and the modern form of classificatory labels, the bifurcation of the social fabric preserves a local variant, though considerably modified, of the traditional Indian-Ladino ethnic dichotomy recognized in various forms throughout Middle America.

But, there are not simply Mestizos and Catrines; rather, there are subtypes of each. Careful and formal elicitation reveals the existence of six labeled status classes, rank-ordered categories of persons representing a social reality attended to by most Ticuleños, the product of complex application of the locally salient criteria of wealth, clothing style (regional versus European), education, occupation, language ability (facility in Spanish), family background, surname (Maya versus Spanish), and occasionally darkness of skin.

Though ethnic differentiation is still apparent, the increasing trend toward Ladinization, the modern ease of passage from the Mestizo sector to the Catrín, and the diminishing caste-like component of group relations have produced a system in which social status is a function of a *single* set of variables. The criteria given above (which incorporate ranges of values) are recognized by Ticuleños as the dimensions of status across *both* groups; i.e., the placement of individuals in the six broad categories given below operates according to the same set of criteria throughout the system, which may be regarded as a single social structure segmented by unequally-ranked ethnic units.

At the Catrín end of the spectrum, the end with the greatest prestige, income, and education, there are three named status levels: the wealthy (*Catrín Rico*), the ordinary (*Catrín Regular*), and the relatively poor (*Catrín*

Pobre). The *Wealthy Catrín* is the rich and usually well-educated entrepreneur or professional who is typically descended from equally placed parents; he is nearly always of Spanish surname, very fluent in Spanish, and sometimes affects the regional costume on annual festive occasions. The *Ordinary Catrín* is of considerably less wealth and education, often works in the cottage industries—sometimes as the owner of a small shop—speaks Spanish well, and is frequently of Mestizo parents. The *Poor Catrín* also often has employment in the cottage industries, has good command of Spanish and occasionally disavows knowledge of Maya, generally has more education than Mestizos, and sometimes tends to exaggerate the social distance between himself and Mestizos, although he is almost always of Mestizo parentage.

On the Mestizo side, that of less prestige, income, and education, there are likewise three status levels: the "fine" or "perfect" (*Mestizo Fino*), the ordinary (*Mestizo Regular*), and the poor (*Mestizo Pobre*). The *Mestizo Fino* (a term difficult to gloss in English) is something of an anomaly in modern Ticul. Occasionally numbered among the wealthiest men in town, he frequently has acquaintances among both Catrines and Mestizos. But his devotion to tradition in the face of changing times is striking. It is not an exaggeration to say that he takes considerable pride in his Maya heritage, and in most social encounters recognizes no superiors, except an occasional Wealthy Catrín. The *Ordinary Mestizo,* on the other hand, is a transitional type. Heavily involved in the Ladinizing cottage industries and generally earning as much as *Mestizos Finos* (except that he is not rich), he demonstrates little desire to achieve *Fino* status. He is often simply in the process of becoming Catrín, either in one generation or, at most, across two—depending upon the extent of his status aspirations and his facility in the speaking of Spanish (a critical variable throughout the status hierarchy). The *Poor Mestizo,* whose status segment is the largest (about 40% of the population), is usually a *milpero*; he generally lacks the education and economic resources to change to Catrín, although he may desire to do so—and many do. The necessity for constant relation to the agriculturally oriented Maya-Mestizo tradition often overshadows contact with town and city.

Random sample data (see "Methodology of the Study," below) give some indication of the population distribution over the six status categories. For a 123-person group, with status evaluation by native assistants, the following obtains: Wealthy Catrines—5% (6/123), Ordinary Catrines—10% (12/123), Poor Catrines—16% (20/123), *Mestizos Finos*—11% (14/123), Ordinary Mestizos—20% (24/123), and Poor Mestizos—38% (47/123).

Some 60-70% of the population is Mestizo. But the percentage diminishes rapidly over descending age segments (especially below age 30), as younger

Mestizos are particularly subject to the Ladinizing influences of the nationally oriented public schools and employment in the cottage industries.

METHODOLOGY OF THE STUDY

A random sample of 123 informants (85 Mestizos and 38 Catrines) was constructed through the device of area selection, with each individual being chosen from a different residential block of the town. All were male and married. Of the original group, intergenerational data were available for 111 (73 Mestizos and 38 Catrines), this number constituting the mobility sample size.

Each informant provided general data through a series of extended structured interviews. The status of each was judged by a native of the town, who also evaluated the status of the father of each individual. Though not necessarily acquainted personally with every informant, the native judge received considerable advance information through accompanying the researcher to the home of each for an initial visit, thereby engaging the informant in conversation, observing the home environment, etc., prior to private interviews with the researcher. Upon completion of data collection and status evaluation for the entire sample, a second native judge was brought in "blind" in order to ascertain the reliability of the first. The second judge had no knowledge of the evaluations of the first and only limited knowledge of each informant. That interjudge agreement reached a convincing .80 is indicative of the reality of the status categories and their underlying dimensions (e.g., wealth, occupation). Because of the information differential between the two judges, the evaluations of the second served corroborative rather than classificatory purposes. The full group of 111 informants was retained for the calculation of mobility statistics, with final placement only by the first (the better informed) of the two judges. The decision to classify on the basis of the evaluations of a single native judge represents an unavoidable, although defensible, compromise between the exigencies of a particular field work situation and an ideal circumstance involving several knowledgeable local judges.

The six-level status system represents a simple scale of social position in the community. In order to allow correlational analysis, the numbers 1-6 have been assigned to the status categories, the order going from Level 1 (Poor Mestizos) to Level 6 (Wealthy Catrines).

MOBILITY: CORRELATION AND REGRESSION

Approximately 38% (41/111) of the Ticuleños in this random sample show intergenerational increment in status, 24% (29/111) of them having gone from Mestizo to Catrín. To focus on the relation of the cottage industries to mobility, approximately 52% (17/33) of the cottage industry laborers in

this group show positive status change, compared to only about 31% (24/78) in the remainder of the sample. Concerning Mestizo-Catrín ethnic changes (here there are data for the entire 123-person sample), nearly one-third (11/36) of the cottage laborers have effected the ethnic transition, compared to only about one-fifth (18/87) among those not working in the cottage industries. Beyond direct participation, of course, there is the broader impact on the community and the status system of the general increase in wealth and material goods generated by the cottage industries.

Turning now to the measurement of mobility, the father-son status correlation shows quite clearly the effects of recent changes in Ticuleño society. The correlational (and regression) approach to mobility has a straightforward interpretation. In a perfectly rigid society, one in which the son would be simply ascribed the status of the father and in which no opportunity for mobility existed, one would expect to find a perfect positive father-son correlation of 1.00. That the intergenerational relationship in Table 1 is not in such perfect association is an indication both of the latitude of influ-

TABLE 1
Correlation between the Status of Fathers and Sons

N	111
r	.43
η_{yx}	.63

ence and change across generations. In one view, it is obvious that there is a strong influence of the status of the father on that of the son. From another point of view, it is equally clear that the size of the correlation coefficient leaves considerable unaccounted-for variance; i.e., much of the status of sons reflects factors other than simple status "inheritance" from fathers, factors which might be called "chance" here, as they are not necessarily the direct result of the status level of the father.

It will be noted in Table 1 that both linear (r) and curvilinear (η_{yx}) coefficients are included and that there is a considerable disparity between the two, the size of the deviation determining the actual form of the intergenerational relationship. As may be seen from the analysis of variance format in Table 2, the inclusion of two correlation coefficients is not merely a statistical nicety. Rather, the father-son relationship deviates considerably from linearity ($F = 9.23$, $P < .001$), a deviation assuming more than abstract mathematical significance; the curvilinear correlation incorporates the effects of sociocultural change, revealing quite graphically the structural effects of the rapidly changing sociocultural system. The linear component of

the relationship, that part measured by "r" in Table 1, is only of moderate intensity and is positive in sign (r = .43). But the total relationship, measured by *eta* (η_{yx}), is strong and contains a prominent negative component along with the incorporated positive component (η_{yx} = .63; *eta* has no sign). The negative component, which is strong enough to produce marked curvilinearity in the over-all relationship, is in large part a function of the fact that nearly 65% (72/111) of the individuals in the group originated from the lowest status category, i.e., they have Poor Mestizo fathers. Yet, many of them have status considerably divergent (more than one level) from that of their fathers, in a number of cases moving from Mestizo to Catrín. The high incidence of disjunctive cases has considerably affected the form of the curve describing the intergenerational relationship.

TABLE 2

Intergenerational Status Correlation: Analysis of Variance Test for Nonlinearity of Regression

	Sum of Squares	Df	Variance Estimates	F
Total	301.10	110		
Linear	55.70	1		
Nonlinear	63.83	4	15.96	9.23*
Unexplained	181.56	105	1.73	

* Deviation from linearity significant at $P < .001$.

With the broadening of the occupational structure and increased emphasis on formal education in the last two decades, younger residents of the town have become quite mobile. The effects of these changes are mathematically reflected in the curvilinear form of the relationship between the status of fathers and sons. On the basis of these data, it is hypothesized that such nonlinear associations are characteristic of rapidly changing social systems, a proposition warranting later discussion (see "Conclusions," below).

As is customary in formal studies of social mobility, correlational statistics are here calculated into an equation specifying the prediction of a Y variable (status of son) from a knowledge of an X variable (status of father). The usual regression model is a linear one. Unfortunately, the clearly nonlinear relationship in these data is more difficult to work with and yields regression results of less immediate intuitive significance. The mathematical machinery of linear models is considerably better developed than curvilinear counterparts; consequently, linear relationships are better understood. The subject of nonlinear regression is complex, for once we have gone beyond the classic straight line there are various types of equations which represent the different forms of nonlinear relationships. An alternative to the existence of a linear association in a given body of data involves the possibility of effecting

a *linear transformation* of variables which are *curvilinearly* related. Fortunately for present purposes, the intergenerational status relationship is described by a curve of the gently sloping type (initially rising, then flattening) which allows for linearization through the use of a relatively simple logarithmic model. By transforming the data from an original score format to the common logarithms (i.e., base 10) of these scores, a regression equation of a linear type may be written. Linearization produces these correlation coefficients: $r = .61$, $\eta_{yx} = .62$. It may be seen that the linearized r of .61 is a considerable improvement over the original linear coefficient of .43 given in Table 1. This done, the regression equation takes the form:

$$\log Y = a + b \log X$$

in which $a = .197$ and $b = .758$, producing the final regression equation:

$$\log Y = .197 + .758 (\log X)$$

Plugging in a specific X value (status of father) of, say, 2 (Ordinary Mestizo level), results in

$$\log Y = .197 + .758 (.30)$$

where .30 is the rounded logarithm of $X = 2$. Thus,

$$\log Y = .424$$

and the antilog of Y, the real number corresponding to log Y, is 2.66.

For each unique value of log X a corresponding Y value is located. The linear relationship between log Y and log X is presented in Figure 1. The reader is again reminded that the relationship is between the logarithms of variables and not between the variables themselves. The logarithmic model is merely a device for treating curvilinear variables by transforming them to the familiar linear form. The important datum about the intergenerational status relationship remains the fact that it is curvilinear (though it may be mathematically treated as if it were linear), a function of the rapidity of change in Ticuleño society.

Antilogs used in plotting the line in Figure 1 are the following:

When	$X = 1$, $Y = 1.58$	$X = 4$, $Y = 4.49$
	$X = 2$, $Y = 2.66$	$X = 5$, $Y = 5.35$
	$X = 3$, $Y = 3.64$	$X = 6$, $Y = 6.14$

A STOCHASTIC MODEL

At the current mobility rate and with an impressive number of Ticuleños changing to Catrín, what sorts of predictions could be made about the future development of the society? Besides the rather obvious inference that Catrines

will eventually come to predominate numerically, it is possible to derive suggestive mathematical estimates as to the probable progression of the population distribution over the six status categories through a limited future time span.

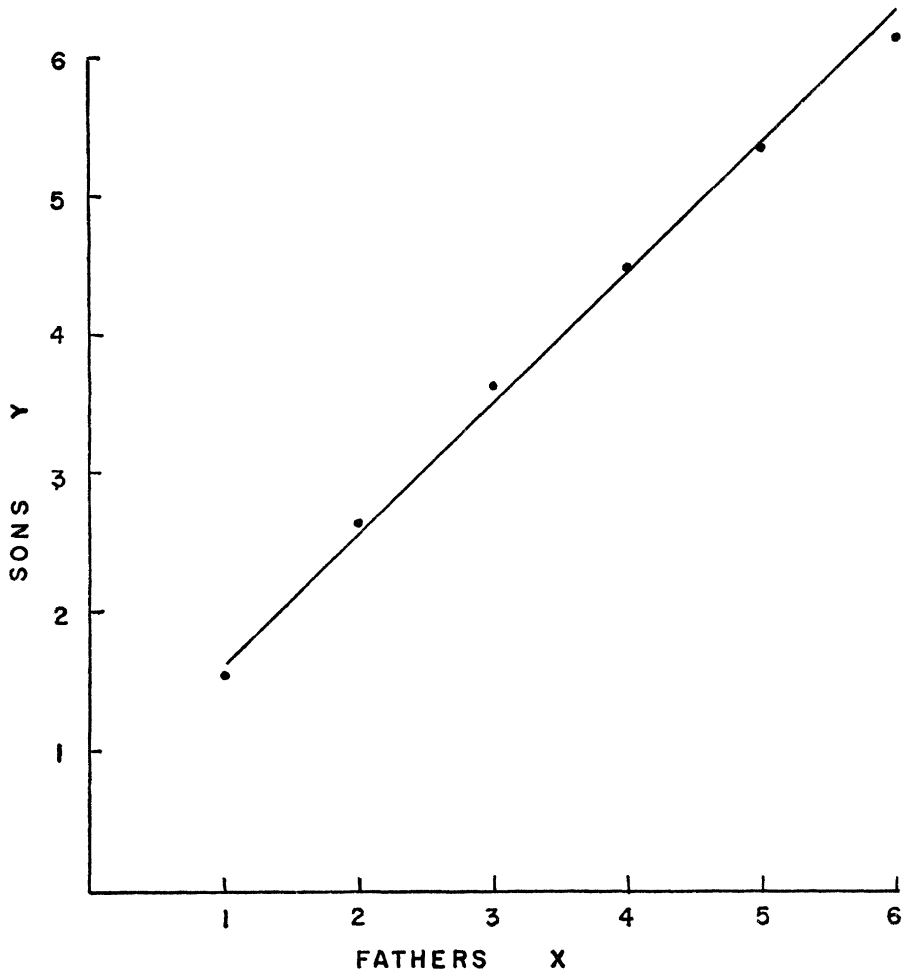

Fig. 1. Linearized regression line: plotting log Y (status of son) on log X (status of father).

The procedure is a straightforward mechanical one, involving nothing more than a rough prediction of the immediate future development of the system based on the current rate of intergenerational status change. By utilizing sample figures for the percentages of sons having the same or differing

from the status of their fathers, a simple stochastic model may be constructed projecting the distribution of the status categories into the near future—keeping clearly in mind that the word "stochastic" is derived from a Greek root which means essentially "to guess," albeit in this context an attempt to make a rather precise mathematical guess.

The basic assumption is that the development of the system is Markovian, i.e., that the particular numerical composition of the six status categories at a given point in time depends upon the distribution at the preceding point in time. This is not to say that the population distribution over the six categories is independent of prior distributions but, rather, that it depends at most on the *immediately* prior state of the system. Furthermore, the numerical progression is of a probabilistic nature, i.e., its advancement through time must be specified stochastically.

The empirical justification for the Markov model lies in the fact that the system is clearly not deterministic. Ticuleños are obviously mobile, and the prediction of the future development of the status system can only be phrased in terms of the current number of individuals either maintaining or deviating from the status of their fathers; there is no other basis for prediction. Unfortunately, the data represent only a limited generational span. There is no way of incorporating or making provision for mobility differentials over several generations. The best that can be done is to calculate the development of the system over a fairly limited time range on the basis of a likewise limited empirical span.

This particular usage of a Markovian approach to the construction of a model of the Ticuleño status follows a suggestion in the recent book on social organization by Buchler and Selby (1968). Working with a problem on the projected temporal progression of the Galla age grade system by Hoffmann (1965), they demonstrate in detail the utility of a stochastic approach to the study of aspects of social structure (1968:60-63). By inference, the present work applies the same logic and techniques to the problem at hand. As Buchler and Selby have noted, processual data pertaining to the development of a structural system are seldom amenable to treatment by exact deterministic measures. To quote them, "We must often be content with the more oblique probabilistic information that is generated by stochastic models" (1968:61).

A stochastic model specifies the probabilities governing transitions between the states of a system. A simplified technical discussion of the language and logic of the mathematics of stochastic processes may be found in Kemeny, Snell, and Thompson (1966). The aforementioned Buchler-Selby volume considers various anthropological applications.

The numerical properties of the status system—the number of individuals and their distribution over the six categories—may be termed a *vector,* as

they describe an ordered system at a given point in time. The temporal progression of a system, its history, may be given through the changing values of the components of its vector. In the language of Markov processes, these components are termed "states." From sample data, the current states of the status vector are given in the following distribution over the six categories (N = 123): S_1 (Poor Mestizos) = 47, S_2 (Ordinary Mestizos) = 24, S_3 (*Mestizos Finos*) = 14, S_4 (Poor Catrines) = 20, S_5 (Ordinary Catrines) = 12, S_6 (Wealthy Catrines) = 6. In order to translate these numbers into vector notation, they may be construed as percentages of the total: $S_1 = .38$, $S_2 = .19$, $S_3 = .11$, $S_4 = .16$, $S_5 = .10$, $S_6 = .05$.

The resultant vector (.38, .19, .11, .16, .10, .05) is termed an "initial probability vector," describing the states at the beginning of an arbitrary time sequence, which may be indicated here for convenience simply as T_1. As a current empirical structure provides the data for the model, T_1 is to be understood as the ethnographic present, 1968-1969.

One other notion from the mathematical machinery of Markov chain processes remains to be introduced. For these data, the matrix arrangement of the status of sons according to their origins (status of fathers) may be termed "transition probabilities," as they are taken to represent the rate of intergenerational status change which enters into the estimation of the future distribution of the system. Loosely phrased, the percentages of sons inheriting and differing from the statuses of fathers provide the transition metrics between the current states of the system and the predicted future states—again, based on the sample distribution and rates of change.

Following the mathematics pertinent to matrix operations, the multiplication of a probability vector by a matrix of transition probabilities has as its product a second probability vector. As the time span here is abstract, the point in arbitrary time represented by this vector will be termed simply T_2.

With these preliminary concepts introduced, it is appropriate to proceed to the presentation of the full matrix (Table 3). The figures in the matrix represent the percentages of sons classified according to the status of fathers.

TABLE 3

Ticuleño Status System: a Stochastic Model

$$(.38, .19, .11, .16, .10, .05) \begin{pmatrix} .62 & .11 & .05 & .15 & .05 & .00 \\ .00 & .47 & .00 & .32 & .21 & .00 \\ .00 & .18 & .45 & .09 & .09 & .18 \\ .00 & .00 & .00 & .50 & .50 & .00 \\ .00 & .00 & .00 & .33 & .67 & .00 \\ .00 & .00 & .00 & .00 & .00 & 1.00 \end{pmatrix} = (.24, .15, .07, .24, .22, .07)$$

For example, of S_1 fathers (Poor Mestizos), 62% of sons are also at S_1, 11% are at S_2 (Ordinary Mestizos), 5% at S_3 (*Mestizos Finos*), 15% at S_4 (Poor Catrines), 5% at S_5 (Ordinary Catrines), and none at S_6 (Wealthy Catrines). Each *row vector* (an orderly collection of numbers written in a row) has the same interpretation: each represents the status distribution of sons according to their origin (status of father). *Column vectors* (orderly collections of numbers written in columns) specify the origin of persons at each status level.

The full model includes the initial probability vector (at left in Table 3) and the matrix of transition probabilities, along with the product of the multiplication of the two, the resultant vector, which is given in the figures to the right in Table 3. The components of this vector specify the predicted future states of the system.

In order to emphasize the predicted changes in the system between T_1 and T_2, the initial probability vector and the resultant vector may be abstracted from Table 3:

	T_1	T_2
S_1	.38	.24
S_2	.19	.15
S_3	.11	.07
S_4	.16	.24
S_5	.10	.22
S_6	.05	.07

As may be seen, the stochastic model predicts the following: (1) Poor Mestizos will drop from 38% to 24%, (2) Ordinary Mestizos will shift from 19% to 15%, (3) *Mestizos Finos* will decrease from 11% to 7%, (4) Poor Catrines will increase from 16% to 24%, (5) Ordinary Catrines will rise from 10% to 22%, and (6) Wealthy Catrines will shift slightly from 5% to 7%. It is also to be noted that the vector of T_2 shows a shift to a Catrín majority: at T_1 68% are Mestizos; at T_2 53% are Catrines. The model thus roughly predicts the point at which the population will make the transition from one ethnic majority to the other—within the limits of the data provided by the random sample here under consideration.

But these predictions are abstract, existing in the framework of an arbitrary time sequence. Is it possible to suggest real-time referents? The temporal status of the initial vector is known, as the present states of the system provide the data for the model. But can the resultant vector, that representing the second (future) stage of the sequence, be given true-time approximation? By consideration of the generational characteristics of the sample group, a line of logic may be developed which will lead to the suggestion of the future

point in time corresponding to T_2, an approximate specification of the time span encompassed by the two vectors.

The random sample covers roughly a two-generation age span; the range of the group is from age 20 to age 63. Now, in order to give temporal meaning to the predictive phase of the stochastic model, the characteristics of the current population represented by the sample group must be considered. It is justifiable to assume that T_2 represents a future point in time in which the sampled portion of the total Ticuleño population will have been "replaced," that is, when *both* generations of the informant group have passed beyond the upper limits of the age range. This is simply to suggest that the stochastic model is predicting to a temporal point at which the current population represented by the sample group will have been replaced entirely and its generational characteristics replicated by incoming groups. In a Markovian sense, two generations hence (roughly 40 years) may be said to describe the point at which the *current* states of the status system will shift to the immediately *prior* states on which the new ones will depend for their properties.

Following this logic, the stochastic model would appear to be a bi-generational predictive device, each point in the Markov chain following the prior point by approximately two human generations. Actually, considering the apparently increasing incidence of change among the members of the non-adult sector of the society—a subpopulation not represented in these data—there is some reason to believe that the shift to a Catrín majority will occur in less than two generations. Indeed, casual observation suggests this as a strong possibility, as adolescents are becoming Catrín at a daily-accelerating rate. For this reason, although it is theoretically possible to make further predictions over progressive two-generational intervals (2-4-6, etc.) through taking powers of the matrix, this likelihood makes it probable that the model would be increasingly unstable and that further projections would be prohibitively misleading. More specifically, it is hypothesized (subject to future empirical test) on the basis of casual data that the transition rates would tend to be unstable as the stochastic model is extended. Formal data warrant a limited future projection, but the changing aspect of Ticuleño society suggests the need for a certain caution in abstract prediction.

A structural description of the inferred population distribution over the status system from empirical data and the predictions of the stochastic model would cover some five generations of Ticuleños: the informants and their fathers together span approximately three adult generations, and the model projects the system two generations into the future. For comparative purposes, to indicate the changes in the status system over this general span, Table 4 provides a profile of the changing distribution over the six status categories for fathers, sons (informants), and the predicted future group. The

greatest change in Table 4 is in the rapid shift to the Catrín sector: only 9% of the fathers of this informant group are Catrines, compared to 31% of informants—and 53% projected for the future two generations hence. Nowhere is the changing nature of Ticuleño society more graphically apparent than in these data, which show the rapid rate of ethnic transition; and the projected patterns which are meant to be predictive of the future very likely provide a conservative estimate.

TABLE 4
The Status System over Time

	*Fathers**	*Sons**	*Predicted Future**
Poor Mestizos	.65	.38	.24
Ordinary Mestizos	.17	.19	.15
Mestizos Finos	.10	.11	.07
Poor Catrines	.02	.16	.24
Ordinary Catrines	.03	.10	.22
Wealthy Catrines	.04	.05	.07
	(N = 111)	(N = 123)	

* Percentages of persons in each status category.

CONCLUSIONS

The analysis of mobility data suggests one approach to the mapping of cultural change. The intergenerational distribution of individuals over a status hierarchy can be expressed in a mathematical form, and this form may be viewed as providing a structural representation of the temporal effects of a specified class of variables in relation to developmental change. In a strict sense, of course, we are not actually measuring cultural change. Rather, we are describing certain of its structural concomitants.

In the present case of a local part-society which is well integrated into a larger system, the disjunctive relationship between generations yields a measure of the changing nature of a small urban community, a town in which the economy is rapidly shifting from an agrarian base to a plural system of small agriculture and cottage industry, and in which recent trends in public education are modifying perspectives. As patterns of change are a product of less than three decades, it is probable that most indices of change (of which mobility is one) will represent diachronic shifts of irregular form, in sum, that they must be described by equations for nonlinear functions. The mobility data in this paper provide a graphic illustration of the tenability of this hypothesis, as the introduction of new variables has had the effect of considerably redistributing the population over the status hierarchy within a brief time span. Though there are undoubtedly constraints to the future develop-

ment of the cottage industries of Ticul, it seems clear that the community has entered a period of accelerated change—a local "take-off" point. The spiraling effects of this pattern of change suggest as a reasonable prediction a relatively extensive restructuring of the society within a few decades. The microevolutionary model with the greatest utility for describing the system and projecting its future development is thus a nonlinear one.

The implications of this ethnographic case are of some interest. Periods of rapid cultural change are, by definition, periods which trace a nonlinear microevolutionary trajectory. The present general hypothesis specifies that such temporal phenomena are a function of the introduction into an empirical system of new variables which alter the form and degree of its integration, particularly integration within larger sociocultural systems. The mapping of change within a culture may be approximated by writing the history of its sub-systems (e.g., the status system). An abstract structural statement of the history of a system may be given by stochastic models, which project future patterns from a body of diachronic data, the sum constituting a structural summary of temporal effects. It follows that accelerated temporal effects may be mapped through the construction of stochastic models which generate *linear approximations* of the probable progression of the states of sociocultural subsystems as a function of new variables operant within a culture.

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