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## Chapter 3, Migration

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## CHAPTER III

## MIGRATION

Introduction

Migration, in this chapter, refers to the movements of people in the demographic sense, however, it is also ultimately assumed to be occurring between groups with different allelic frequencies. Although the Deerfield migration data provide an excellent example of the nature of gene flow between microgeographic populations, the full genetic implications are not clear. I have assumed that some genetic differences exist between the sub-populations of this area, and although some evidence for differences does exist, the degree or nature of this difference is not quantifiable with the present data. In this chapter I will attempt to define and discuss the events which have occurred in Deerfield, and relate these to our current knowledge of migration patterns. The primary dimensions to be dealt with are space and time, and although the two cannot be treated with any absolute independence, the temporal aspects of migration will be emphasized in the first section, and the spatial aspects below.

The empirical analysis of migration in human populations has not been prevalent until recently (see Morton, 1969). Many past studies of human populations have proceeded to genetic interpretations by studying one variable and holding all others under Hardy-Weinberg assumptions. As Sutter and Tran-Ngoc-Toan (1957) point out, the facts of observation are very different from this approach, and the character of human migration adds a variety of complexities to the analysis of human populations.

In the early history of Deerfield the town may be easily characterized by certain geographic parameters and by the fact that marriage and the production of offspring is most common between local partners. In spite of this discrete quality, however, the community is in no way analogous to an island model of a breeding population in which marriage partners are shared randomly and equitably with all surrounding villages. The relationship between endogamous and exogamous marriages is one of the major forces in the determination of the genetic structure of a population (Küchemann et al, 1967), and Deerfield provides an interesting example of this relationship. Distance between marriage partners has been selected as the measure of migration not only because it is readily ascertained for Deerfield, but also because historically the majority of migration has taken place at marital age (Bogue, 1969; Hollingsworth, 1969); other studies have indicated that most migration takes place at marriage (e.g. Cavalli-Sforza, 1967). The sample used in the present study includes approximately 1460 marriages over a period of 170 years--the complete record of marriages listed in Vital Records of Deerfield, Massachusetts to the Year 1850 (Baldwin, 1920).

#### Migration in Time

The frequency of exogamous marriages in Deerfield was measured by sorting the marriage records into decades, and by counting the number of marriages in each period. Early in this procedure it became apparent that within a radius of 15 miles of Deerfield the great majority of marriages took place; so, exogamous marriages

were coded for each specific village inside this 15 mile radius, and marriages outside the 15 mile limit were coded by zones based on direction and distance. This 15 mile radius may be somewhat arbitrary, but it includes the area within which 85 percent of all outmarriage occurs. The significance of this perimeter lies in the fact that, to the south, it includes the communities of Northhampton, Hadley, and Hatfield. As discussed earlier, these communities are located along the Connecticut River and were established prior to Deerfield (see Figure 1.1). The Connecticut River provided a major route of travel and communities along the River had greater likelihood of intercommunity contacts, including the exchange of marital partners. A second consideration for the probable significance of a radius of 15 miles is that it is about the maximum distance that could conveniently be travelled on foot or by horse in one day. The railroad did not come to this area until the middle 1800's and did not affect travel for the time period under consideration. The temporal distribution of exogamous marriages is given in Table 3.1.

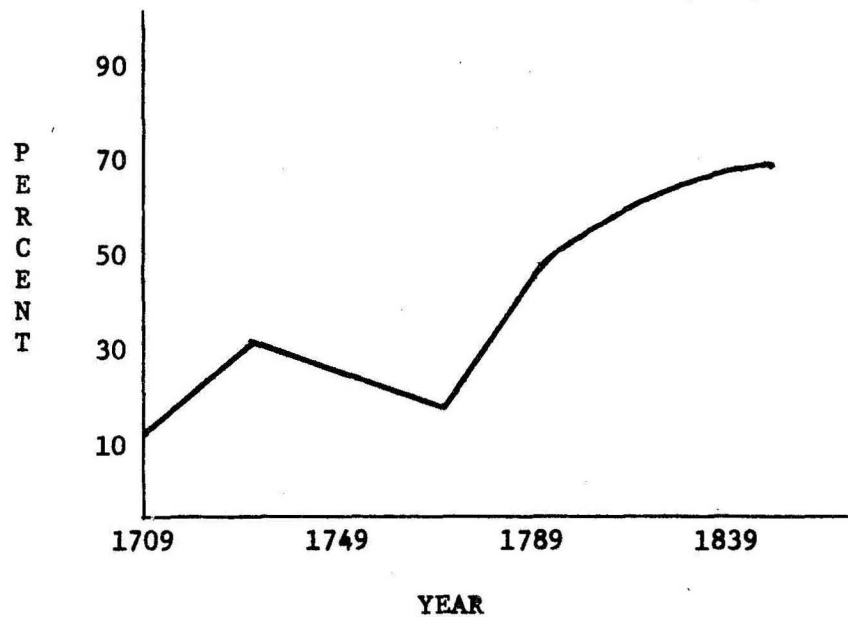
The amount of exogamy has not only increased in absolute frequency, as would be expected with a growing population size, but also the relative frequency has shifted from approximately 14 percent exogamous marriages in 1700, to 65 percent in 1849. This may be seen as a relatively stable trend throughout the 170 year period covered, although at certain intervals the evidence suggests that exogamy decreased (Figure 3.1). Thus, the inhabitants of Deerfield become members of an expanding gene pool. This should not be taken, however, to indicate that the geographic size of the gene pool is correspondingly

TABLE 3.1  
FREQUENCY OF DEERFIELD MARRIAGES

Time	Endogamy(%)	Ex. Males	Ex. Females	Total
1680-89	1 (100)	0	0	1
-1699	15 (78.9)	3	1	19
-1709	24 (85.7)	2	2	28
-1719	15 (71.4)	3	3	21
-1729	17 (68.0)	1	7	25
-1739	25 (89.2)	3	0	28
-1749	40 (74.1)	9	5	54
-1759	43 (71.7)	10	7	60
-1769	59 (88.1)	3	5	67
-1779	57 (76.0)	7	11	75
-1789	40 (50.0)	12	28	80
-1799	76 (48.1)	48	34	158
-1809	61 (38.9)	45	51	157
-1819	70 (46.4)	45	36	151
-1829	62 (37.3)	57	47	166
-1839	58 (33.5)	67	48	173
-1849	68 (34.2)	82	49	199
TOTAL	731 (50.0)	397 (27.2)	334 (22.8)	1462

FIGURE 3.1  
 FREQUENCY OF EXOGAMOUS MARRIAGES AT  
 20 YEAR INTERVALS

N=731



expanding. Although it is true that marriages between great distances are somewhat more common in the later periods, the most frequent exogamous marriages remain those within a 15 mile radius of Deerfield. In fact, 84.4 percent of all exogamous marriages prior to 1849 have occurred within this 15 mile radius. Mean marital distance tends to be very low throughout the 170 year period and, in fact, the average marital distance for all periods combined is only 7.44 miles (Table 3.2). Much of the increase in local exogamy may be attributed to basic cultural and demographic factors. During this period Deerfield and the surrounding area is experiencing rapid growth. Population density is increasing

TABLE 3.2  
 MEAN MARRIAGE DISTANCE FOR DEERFIELD (1690-1849)\*

Interval	$\bar{X}$ Miles	N
1690-1719	5.11	54
1720-1739	3.65	52
1740-1759	5.45	113
1760-1779	2.02	135
1780-1799	11.42	221
1800-1819	7.40	315
1820-1839	9.70	335
1840-1849	10.34	216
TOTAL	7.44	1441

\*N=number of marriages.

Distance for endogamous marriages =  
 0 miles.                      Mode = 0

and many new communities are being founded. The founding residents of these new communities are often former residents of neighbor communities. People from the various villages have much in common, they share the Puritan tradition, and probably become acquainted readily if they do not already know each other. It is clear, then, that the increase in exogamous marriages throughout Deerfield's history is a product of an increasing interaction between local communities rather than a strict distance mobility relationship.

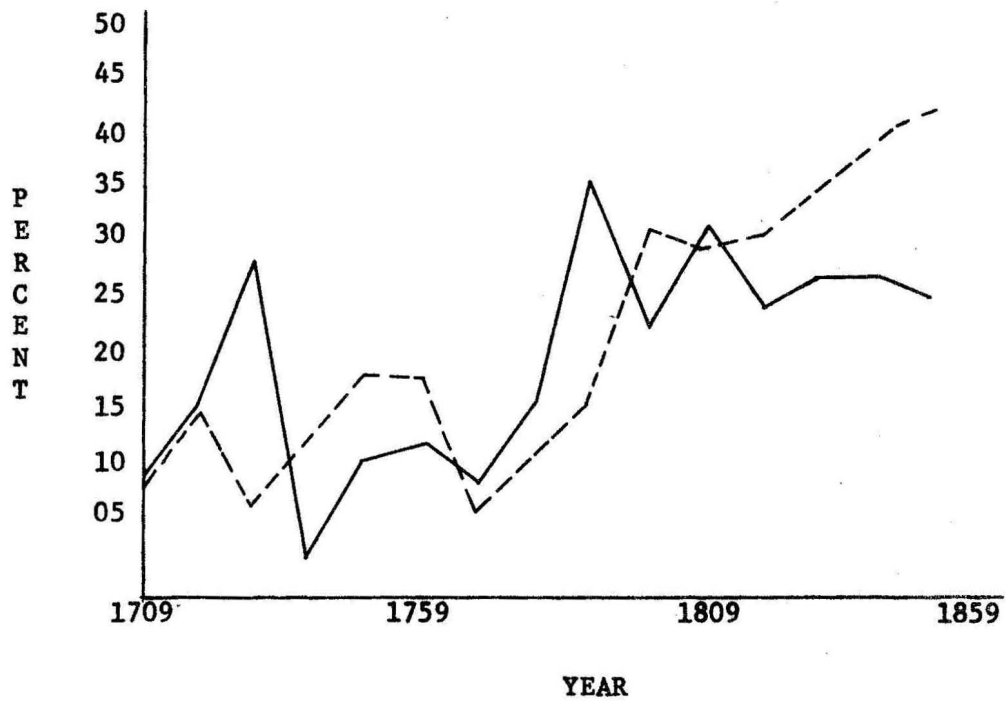
Boyce et al (1968) found this to be true in their study of Charlton, England, and determined that mean marriage distance prior to 1850 was between 4-8 miles.

From values derived on the basis of sex, it is apparent that some differential factors are involved in the frequency of exogamy. Of all marriages recorded for Deerfield between 1680 and 1849, 339 males married outside females, and 398 females married outside males. The difference between these values is significant  $P < .05$  ( $\chi^2 = 4.723$ , d.f.=1), and the effect seems the result of marriages taking place at a distance of greater than 15 miles; that is, a larger proportion of males from greater than 15 miles ( $n=133$ ) marry Deerfield females than outside females ( $n=94$ ) marry Deerfield males ( $\chi^2 = 6.70$ ,  $P < .01$ ). The explanation of this difference may be based on two factors: (1) there is the possibility, even likelihood, that the Western custom of having the marriage ceremony occur at the residence of the bride has resulted in an underenumeration of marriages between Deerfield males and outside females (this was indicated to be the case in the historical study of Charlton, England, by Kuchemann et al, 1967). Although this may be viewed as a very possible contributing factor in the Deerfield material, it would not appear to be the single responsible factor. The distribution of frequencies of exogamous marriages, plotted by sex for Deerfield, indicates a relatively even number of outside marriages between males and females until the early 1800's (Figure 3.2). Also, the Deerfield records include a very large number of marriages which actually occurred in other towns, but included a Deerfield individual. (2) Another possibility



FIGURE 3.2  
FREQUENCY OF EXOGAMY BY SEX  
IN DEERFIELD, MASSACHUSETTS

N=731



Dotted line is females; solid line males.

is that males simply tend to be more mobile than females, and that during a period when a town is undergoing rapid growth, more males would be expected to settle than females. In the time period from 1800-1849 Deerfield experienced a 56 percent increase in population. And during this same time period females married 69 more outside males than Deerfield males married outside females. It would seem that differential immigration, by sex, is the most likely explanation for the significant difference observed.

In regard to male and female migration patterns, it should be noted here that the result of sexual residence practices could be a very important factor if one were to analyze specific, sex-linked loci in a given exchange between populations. For example, if two populations engaging in gene flow, have two distinct alleles at a given sex-linked locus, then residence patterning will affect the amount of admixture between the two populations. This is a clear case of a cultural practice affecting genetic structure.

To illustrate this factor, let us assume that a population ( $P_1$ ) exchanges marriage partners with another population ( $P_2$ ) at the rate of .02 per generation. (1) If matrilocality is the practiced residence pattern, then only males will be exchanged between  $P_1$  and  $P_2$  and the contribution of X chromosomes by one population to the other will be .02. The frequency, then, of the allele  $P_1$  being passed to  $P_2$  will be .02; in the first generation of offspring the males would pass the new allele to 50 percent of their offspring (the females). (2) If patrilocality is the pattern, then only females will be exchanged between  $P_1$  and  $P_2$ . The contribution of X chromosomes then becomes

.04. The frequency of allele  $P_1a$  contributed to  $P_2$  will also be .04, and 100 percent of the new allele would be transmitted to the first generation of offspring from the exogamous females. (3) And if no residence pattern exists, then equal numbers of males and females will be exchanged at the rate of .02, providing an exchange of X chromosomes (and new alleles) at the rate of .03. In the residence pattern cases, equilibrium frequencies will be reached for the newly introduced allele within a few generations, but the important point here is that the equilibrium frequency for the female migration pattern (patrilocality) will be achieved faster than the male pattern (matrilocality), given the same rates of migration.

In regard to the present study, residence patterns are pertinent. One finds that it was most common in early England and Colonial New England for wives to take residence in the locality of their spouse (patrilocality). Samples of various years of exogamous marriages indicate that this was generally true in Deerfield. This would confirm previous observations that while males are more mobile in exploring for wives, the wives are actually more mobile in the sense of gene flow (Hiorns et al, 1969:248).

If sexual migration is unbalanced, then residence patterning can have other marked effects on the nature of gene flow between populations. For example, if we assume allelic differences between Deerfield and its nearby neighbor villages, then the gene flow rate can be noted as differentially expressed due to residence patterning (Table 3.3). Gene flow has been calculated as:

$$f = \frac{O_m}{2N_m}$$

TABLE 3.3  
GENE FLOW RATES INTO DEERFIELD (1690-1849)

N=1462

Pattern	T 1	T 2	T 3	T 4	T 5
Patrilocal	.0024	.0120	.0113	.0089	.0062
Matrilocal	.0133	.0120	.0058	.0054	.0075
TOTAL	.0157	.0239	.0171	.0144	.0137

N = Number of marriages. T = Town. Showing different rates depending upon whether matrilocality or patrilocality is practiced.

TABLE 3.4  
FREQUENCY OF MATING TYPES FROM THREE SAMPLES

Sample	Endogamy	Ex. Males	Ex. Females	Total
*Deerfield	734 (50.0)	398 (27.0)	339 (23.0)	1471 <sup>1</sup>
*Charlton	297 (66.7)	112 (25.2)	36 ( 8.1)	445 <sup>2</sup>
Xavante	206 (91.2)		20 (8.8)	226 <sup>3</sup>

\*1650-1850. 1=Present study. 2=Küchemann et al, 1967.  
2=Salzano et al, 1967.

where  $O_m$  are the number of out-marriages from a particular locality and  $N_m$  is the total number of marriages. As can be seen in Table 3.3, if all out-marriages from each of the neighboring communities are ultimately contributing to Deerfield's population, then gene flow is considerable. More important, however, are the variable rates depending on whether patrilocality or matrilocality is practiced. Contributions from Town 2, for example, would be the same regardless of residence pattern; but contributions from Town 1 are noticeably different with matrilocality, providing a more marked effect on the town of Deerfield than patrilocality would.

The rate of endogamy in Deerfield varied from 89 percent (1730's) to 34 percent (1840's), with a mean rate of endogamy for the whole period at 50 percent. The amount of endogamy is thus relatively low and would probably minimize the role of genetic drift, at least in the later periods discussed. A comparison of the frequencies of exogamous and endogamous marriages from various societies point to expected results (Table 3.4). For example, studies done on a group of South American aboriginal communities provide an average endogamy rate of 91.2 percent (Salzano et al, 1967). This is much higher than the rates found for Deerfield and Charlton, England, during the periods 1650-1850 (Table 3.4). We would expect the inter-village mobility in pre-industrial England or the United States to be much greater than in tribal populations of Brazil under previous assumptions (e.g. Neel, 1958:54), however, Salzano et al are quick to point out that even their endogamy frequencies may be unrealistic due to intergroup mobility among the Xavante (1967).

In this section I have indicated that, for Deerfield, the rate

of migration increases with time, and this is true of other historical populations studied (Küchemann et al, 1967; Alström and Lindelius, 1966; Cavalli-Sforza, 1967). It must be emphasized, however, that this increase in migration, or exogamy, is not necessarily closely correlated with increasing distance in specific cases.

#### Migration over Space

As indicated above, any comparisons between village populations, regardless of their degree of cultural development, and the concept of isolated breeding populations are greatly abstracted from reality. However, there is also evidence that while the limits of outbreeding for a village population cannot be considered spatially as its immediate environs, it can be viewed as somewhat limited over space. In this section I will attempt to provide a systematic interpretation of differential migration over space in regard to the Deerfield material.

For some time now it has been recognized that marriage outside a central, home-base tends to decrease in frequency with increasing distance. In addition, the consensus has been that mating distance as a measure of migration follows a leptokurtic distribution, rather than the normal originally proposed by Wright in 1943 (see Schull and MacCluer, 1968). The empirical evidence that mating distance for natural populations of animals is leptokurtic was provided relatively early (Bateman, 1950; Skellam, 1951) and empirical studies demonstrating it for man came shortly thereafter (Sutter and Tran-Ngoc-Toan, 1957). More recent research on man confirms this distribution for several different populations (e.g. Cavalli-Sforza, 1958; Alström, 1958; Morton, 1964; Roberts, 1965; et al). This relationship of migration

to distance, of course, relates to the form of gene dispersal for populations of organisms. The function which appears to best fit the observed distributions seems to be the exponential (Morton and Yasuda, 1962; Morton, 1969):

$$y=ae^{-bx}$$

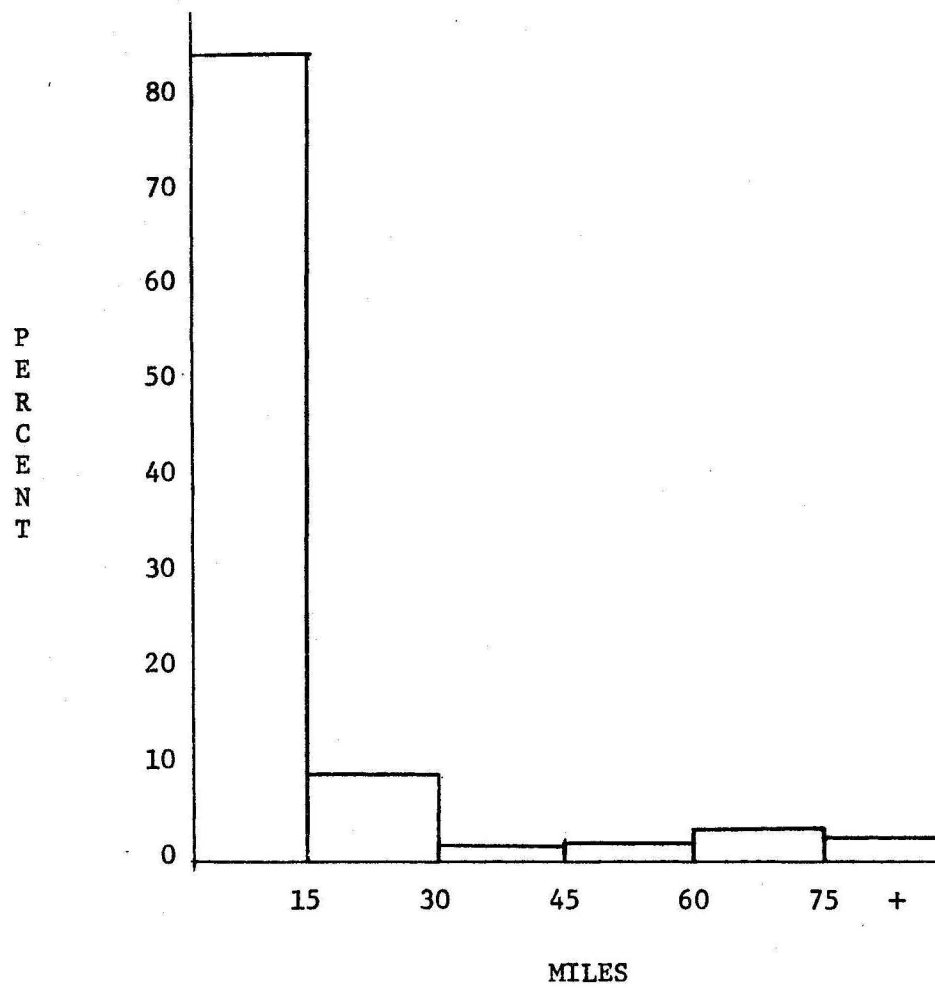
although the geometric has been used as well (Boyce, Kuchemann, and Harrison, 1967; see Morton, 1969). That the exponential function is of general ecological significance in regard to human population density and movement has been suggested (Clark, 1951; Duncan, 1957; Morrill, 1965).

For the present analysis, a sample was obtained by taking all marriages registered for Deerfield individuals in 20 year intervals. As indicated above, exogamous marriages have been classified by zones surrounding Deerfield. These primary zones are located at 15 mile intervals, so that an individual will be identified by a number indicating his exact distance if under 15 miles from Deerfield, or, as being from 15-30 miles away, 30-45, 45-60, 60-75, and greater than 75 miles away. Since only 29 marriages occurred with an individual from greater than 75 miles for the entire 170 year period (.18 individual/year), marriages from this "outside world" perimeter were not included in the sample. The mean marriage distances are presented in Table 3.2, indicating the very low average distance between Deerfield matings. The leptokurtic nature of mating distance may be clearly seen in Figure 3.3, where we find 85 percent of all marriages occurring within 15 miles of Deerfield.

In order to focus specifically on the relationship between

FIGURE 3.3  
DISTRIBUTION OF DEERFIELD MARRIAGES (1690-1849)

N=1462





migration and space, another sample was gathered which controlled for time. This second sample is based on the total number of marriages occurring between 1810-1819; in collecting the information this way, the frequency of matings should reflect the nature of a breeding population for a specific point in time, and indicate the degree and kind of interaction between local populations during this time. The data include: (1) all matings occurring within a distance of 15 miles. Since for any 10 year period in Deerfield matings at greater than 15 miles are very few, I concluded that a study of the properties of mating distance would be most easily understood within the 15 mile parimeter, where controls and sample size were maximum. (2) The contribution of each neighbor village expressed in spouse's per 1000 inhabitants (village size was based on the census of 1810). (3) No assumptions are made about the ultimate residence of the marriage pairs, the sample is designed to analyze the number of "marriage contacts" between various sub-populations, and the only criterion for inclusion in the sample is that an individual have married a Deerfield citizen in the years 1810-1819. These data were collected specifically for the purpose of comparison with previous studies on migration distance.

Findings: A recent study by Boyce, Küchemann, and Harrison (1967) represents one of the few attempts to develop an explanatory model for the observation that the frequency of marriage decreases exponentially with distance. Their model is based on the concept of "neighborhood knowledge," and in order to test this concept, the Deerfield sample was drawn to be comparable to the model sample.

The assumptions concerning "neighborhood knowledge" are as follows (p. 33-36):

(1) "...the frequency of marriages with the numbers of a village in the neighborhood of the home base is directly proportional to the number of inhabitants and to the frequency of visits to that village. The frequency of marriage when divided by the number of inhabitants is thus directly proportional to the number of visits."

(2) "...the frequency of visits to a village at a particular distance from the base is equal to the frequency of visits to all villages at that distance divided by the number of villages at that distance..."

(3) "...the frequency of visits to villages at a particular distance from the home base is equal to twice the frequency of journeys to and beyond that distance (since each outward journey is followed by an inward journey)."

(4) "...it is assumed that the frequency of journeys to villages at a particular distance from the home base is inversely proportional to a power of twice that distance."

"It therefore follows, from the above assumptions, that the frequency of marriages with the inhabitants of a village at a particular distance from the home base, when allowance is made for the number of inhabitants, is inversely proportional to that distance to the power  $b$ . Under the above model therefore, there is an exponential relationship between frequency of marriage and distance" (p. 336).

Boyce, Küchemann and Harrison's empirical test of this exponential relationship (1967), made on the parish of Oxfordshire, England (1861

census), provided the expected distribution. On the basis of 23 surrounding communities and their respective contributions of marriages to Oxfordshire, a geometric curve was fitted that indicates agreement with the assumed relationship ( $y=4.75x^{-1.88}$ ).

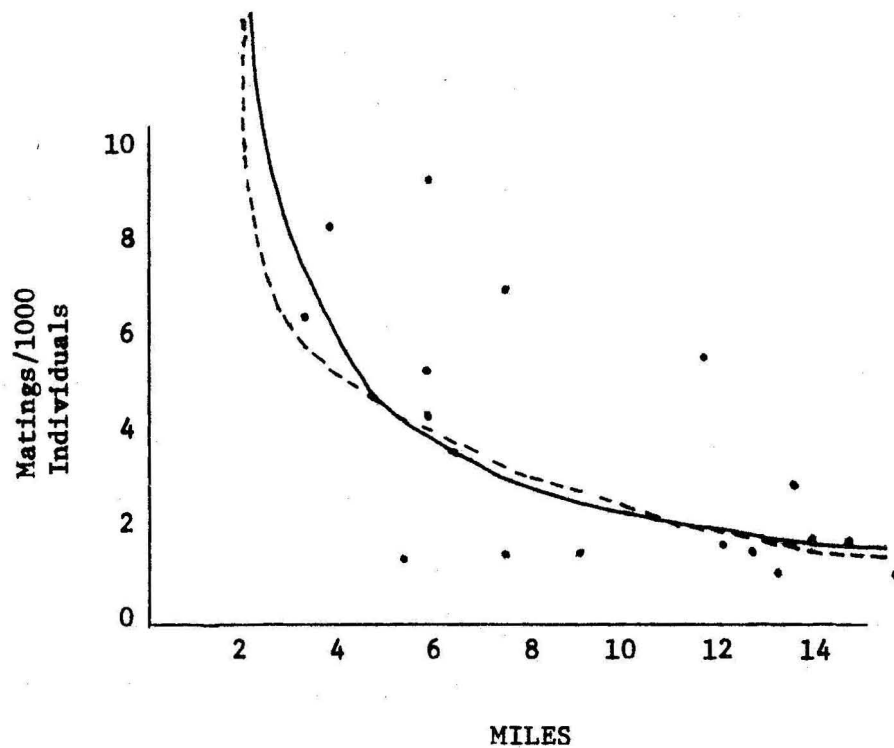
The 1810-19 marriage frequencies for Deerfield were compared with those of Oxfordshire in regard to exogamous unions. The Oxfordshire sample was, as stated above, comprised of 23 surrounding communities. These were located within a 6 mile radius of Oxfordshire parish. To achieve a similar number of surrounding communities in the Deerfield study, it was necessary to expand this radius to 15 miles ( $n=17$ ). Thus, the population density in the Deerfield area is considerably less. In addition, it was found that the proportion of marriages per 1000 inhabitants corresponded to the proportion of marriages per 100 inhabitants in the Oxfordshire sample.

Fitting a curve to the Deerfield observations gave  $y=22.4x^{-1.05}$ , using the family of curves  $y=ax^{-b}$ . The value of 1.05 is much lower than the 1.88 found for Oxfordshire; however, it is close to the total value for all periods found for Oxfordshire (Boyce, Küchemann, and Harrison, 1968), which was close to 1. The constant of 22.4, as compared to 4.75 for Oxfordshire, relates to the greater distance units used for Deerfield (see Figure 3.4). Using the following function for the Deerfield material:

$$y=ae^{-bx}$$

the value of a is found to be 8.331 and b is -.1324. A comparison of the two curves (Figure 3.4) shows their very similar shape.  $X^2$  values for the two curves indicate a slightly better fit with the

FIGURE 3.4  
 COMPARISON OF THE GEOMETRIC AND EXPONENTIAL  
 CURVES FOR MARRIAGE DISTANCE: DEERFIELD



Dots represent 17 communities surrounding  
 Deerfield. Dotted line=Exponential curve.  
 $\chi^2=23.96$ , d.f.=15,  $P>.05$ . Solid line=  
 Geometric curve.  $\chi^2=25.98$ , d.f.=15,  $P<.05$ .

exponential ( $P > .05$ ). Morton (1969) has suggested that  $X^2$  is often significant for these curves, and that possibly no better fit can be expected in light of the various factors affecting human migration. In the present analysis the small number of observations may also be considered, and the visual fit is good. In any event it is clear that the evidence from these two studies corroborates the observation that mating distances tend to follow a leptokurtic distribution and that distance is expressed by an exponential relationship. What neither study provides is data concerning the actual, observed, frequencies of types of journeys from a home base.

While the information from Deerfield basically confirms the observations of Boyce, Kuchemann, and Harrison (1967), certain assumptions must be more closely scrutinized. As they note (p. 395), although neighborhood knowledge is certainly an important factor when considering human population movement, village density and distance are of critical importance as determinants of neighborhood knowledge. Demographers have noted the significant effect of distance for many years: Ravenstein (1885) as quoted by Lee (1966:48) states: "The great body of our migrants only proceed a short distance" and "migrants enumerated in a certain center of absorption will... grow less [as distance from the center increases]." Zipf (1946) defined the obstacles that mitigate against migration as an inverse function of distance. So that a prime determinant in the possibility of obtaining marital partners, or of migrating, is the distance over which man can travel in a given unit of time. As Boyce, Kuchemann

and Harrison further point out (p. 335), for thousands of years man's ability to travel has been confined to animal transport of his own feet, and this will necessarily limit the frequency and magnitude of migrations. In the United States, even as late as the 1960 census, the great majority (63%) of all migration was intra-county (Bogue, 1969:757). Also, as the Deerfield material suggests, the simple facts of population density will, in part, determine the distance travelled for marriage partners or other migration motives.

An additional factor to which Boyce, Küchemann, and Harrison (1967) did not originally allude, is that man may also migrate selectively in regard to direction, regardless of village distribution or density. As they point out in a later paper (1968), the distribution of roadways and rivers caused differential migration in relation to direction. Thus, communities of the same distance may not be visited with equal frequencies, due to a number of cultural and physical heterogeneities, and the second assumption is subject to several non-random factors for man. This, as noted, is reflected in the Deerfield sample. The fourth assumption, that frequency of visits and presumably matings is inversely proportional to the square of the distance, does not seem to fit well with the available data. Neither the English sample (Boyce, Küchemann, and Harrison, 1968), the present study, nor work done on parishes in France (see Sutter and Tran-Ngoc-Toan, 1957) indicate a good fit with 2 as the power of b. Nevertheless, the concepts and assumptions involved in the "neighborhood knowledge" model seem generally to correspond well with existing empirical data.

Neighborhood knowledge, and the simple effects of distance, can only be expected to operate in a highly predictable way within a limited radius of the home base. Long range migration of genetic significance is presumably controlled by additional factors. For example, the tendency that demographers have noted for migration to be selective in favor of urban centers (e.g. Bogue, 1969) has probably affected man for the last several thousand years. Also there is the possibility that the frequency of long-range marriages may be proportional to long range visits with consanguineous relatives, presumably a selective factor for travelling long distances (Morrill, 1965; Morton, 1969:102).

These possibilities are evidenced in the Deerfield material. The higher frequency of matings with individuals from the Boston area (58.9%) as opposed to the 7 other zones at the same distance is evidence of this urban trend. Further, the number of marriages outside the 15 mile radius seems to correlate to increased contact with relatives who have outmigrated or who form the original enclaves of Deerfield families (discussed above in relation to inbreeding).

This kind of distance model is well suited to populations who migrate and who can be classified by some common home base; it is not, however, entirely suitable to migrant populations such as studied by Morton (1964). The migrant population, which has no common origin in regard to at least one spouse of each married pair, may tend to corroborate that mating distance is generally leptokurtic and small in total distance for man, but it cannot relate to a specific class of settlement pattern which may be deterministic in mating distance;

or account for other non-random factors which any specific geographic locality may present. Homogenizing several specific localities may actually obscure the operation of significant evolutionary mechanisms.

In the study of human migration, of great importance is the nature of settlement pattern. Early human organization, and even most non-human primate organization seems to be oriented around a home base from which migration takes place. Even hunting and gathering societies who exploit large territories tend to have clear boundary zones between distinctive geographic and cultural units. The fact that Boyce, Küchemann, and Harrison (1967) relate mating distances to population size, and the fact that the Deerfield material point to the importance of village density clearly suggest reasons for variability in the frequency of matings observed in different regions, such as Italy and Sweden (e.g. see Cavalli-Sforza, 1967; Alström, 1958).

Recently the discontinuity between populations of plant and non-human animal species has been noted, with evidence that very little gene flow between such populations occurs (Ehrlich and Raven, 1969). Man is frequently referred to as the social animal in contrast to other animals. This social propensity of most of the anthropoids must be assumed to enhance the spread of genes as well as good and bad will. Nevertheless, as the present study and others indicate, the distance from which any "discrete" population's genes are spread, generally, is probably very little. On the other hand, between sub-populations of a given microgeographic region, gene flow is probably great. The effect in the past has probably been that in newly settled areas "homogenization" has taken place rapidly (see Hiorns et al, 1969),



but between areas of great distance, or where cultural or geographic barriers intervene, differences are likely to be great.

In light of the foregoing statements, it is difficult to accept the results of certain recent investigations. Cavalli-Sforza (1958, 1962, 1969) has noted significant allele frequency differences, using blood group data, for a group of village populations in the Parma Valley, Italy. The explanation invoked for these differences is genetic drift, and demographic data were collected to try and reject or substantiate this explanation. The full substantiation of drift is not really accomplished and it remains to be seen whether or not drift actually determines the frequencies observed. Localized selection, problems associated with sampling, and incomplete mixture of sub-populations (see Kalmus, 1969) are possible alternative explanations. The fact that 80 percent of children were found, in the actual analysis, to be born in the same village as their parents, would indicate a reasonably high rate of migration, mitigating against drift.

Whereas some models (e.g. Malecot, 1969) attempt to account for limitations in the island and neighborhood (isolation by distance) models, as Bodmer and Cavalli-Sforza point out (1967:566): "... real populations are almost very irregular in their geographic distribution. Population size, density, and mobility are not constant with respect to space and time." Thus, although the desirability and need for simulation models is clear, it also remains clear that the empirical demonstration of evolution in human populations will require use of empirical data on specific populations. Recent attempts (e.g. Cavalli-

Sforza, 1967; MacCluer and Schull, 1970) to derive information from actual populations, and then simulate temporal effects, while provocative and very useful, are nevertheless hypothetical. At this time it would seem important that investigators having the opportunity to study real populations should attempt to discover and explain real events.

What emerges from Deerfield and other recent studies, however, is that it is possible to view human migration systematically. While many variables are different in specific cases, the nature of migration distance is predictable; given certain controls, quantifiable. Future empirical studies may be expected to corroborate the leptokurtic distribution, and future models to incorporate the exponential curve.

