HUMAN REPRODUCTIVE STRATEGY:

THE IMPORTANCE OF INCOME UNPREDICTABILITY,

AND THE EVOLUTION OF NON-REPRODUCTION

A thesis presented
by
James Donald Weinrich

to
The Department of Biology

in partial fulfillment of the requirements
for the degree of

Doctor of Philosophy

in the subject of
Biology

Harvard University

Cambridge, Massachusetts

April 1976

TABLE OF CONTENTS

PART I

PART II

ERRATA

- In Table 10, Part I, page 87, the entry for Eliasson should be one column farther to the right, under the heading "Dreams about sex".

- In the bibliography, Part I, page 105, the first word of the title of the work by Bergström-Walan et al. should be "Modellfall", and the town is Reinbek, West Germany.

- In Part II, all text references to the paper by Raboch, Mellan, and Stárka (1975), "Plasma testosterone in male patients with sexual dysfunction", should instead be to:

  Stárka, L., Iva Šipová, and J. Hynie. (1975). Plasma testoserone in male transsexuals and homosexuals. The Journal of Sex Research 11:134-138.

  The bibliographic reference to the former paper (page 225) should be eliminated and the new reference above inserted on page 228.

COPYRIGHT ACKNOWLEDGMENTS

I gratefully acknowledge permission received to reprint portions from the following works:

- Table 2, page 79, is calculated from Kiser et al. 1968, Table 11.3. Copyright 1968, the Harvard University Press.

- Quotation page 120 is from Money and Ehrhardt, *Man & Woman, Boy & Girl*, (c) The Johns Hopkins University Press.

- Figure page 89 is redrawn and somewhat revised from Smith and Fretwell (1974), original copyright by The University of Chicago Press.

- Quotation pages 60-61 quoted by permission from Sigusch and Schmidt (1974), cited as in the bibliography, published by Plenum Press.

- Quotation pages 134-135 reprinted by permission from the American Journal of Psychiatry, volume 126, #8, pp. 151-154. Copyright 1970, the American Psychiatric Association.

- Table 4 (page 81) is calculated from Rainwater 1965, Table A-8. Quotations pages 37-38 and Table 3 taken from Rainwater 1965, pp. 30-31 and Table 2-1. Reprinted by permission of Social Research, Inc.

PART I

ENVIRONMENTAL PREDICTABILITY AND REPRODUCTIVE STRATEGY: EFFECTS OF CLASS AND RACE IN HUMANS

As statistical ensembles, working-class people act differently from middle-class people, and blacks act differently from whites. Many theories have been proposed to account for this variation, ranging from inborn genetic differences with no adaptive significance to purely environmental effects with no adaptive significance.

As an evolutionary biologist, one should suspect that such theories are unrealistically narrow. Significant behavior differences strongly affecting one's reproductive success must have been subjected to strong selection, leading to behaviors best understood as adaptive for the environments individuals find themselves in. If different reproductive strategies or different sex ratios occur with different frequencies in different environments, adaptive explanations should be sought for these phenomena (see Steffan 1973, 1975, and Trivers and Willard 1973 for some recent attempts). Even in organisms that learn, it can be easier to learn some things than others, and one can investigate the degree to which the learning pattern is adaptive (Garcia et al. 1968).

For decades it has been known that working-class people have larger families than middle-class people; more recently it has been learned that blacks have larger families than whites, all other things being equal. (The pattern has changed over time--see Farley 1970.) In the past thirty years, it has become clear that the social classes and races also differ in several parameters relating to the marital bond

and heterosexual behavior. All these variables are closely tied to the process of getting one's genes into the next generation; they are thus especially amenable to an evolutionary analysis. To make this analysis, one must produce a theoretical argument relating a causal, independent variable to dependent variables; demonstrate that data from the real world are consistent with the model's predictions; and then test the model's adequacy in relation to competing theories of the phenomena in question.

The independent variable I have chosen is the future predictability of those resources most needed for reproduction. In many species, this is food; in humans, family income. (The amount of income or food is often correlated with unpredictability, and some attempt will be made to separate the effects of the two.) I will argue that humans are adapted to sense the degree of income unpredictability expected in their future, and to adjust their reproductive strategy accordingly. I will present data that show it is unlikely that these behavioral differences are due to simple genetic differences, and probably involve mechanisms more subtle than simple socialization, modeling, or learning. Thus I will adopt the position that the patterns seen now reflect relationships that were adaptive in the recent evolutionary past, and may still be adaptive today; and that although the proximal cause of a given response may be environmental, the

more ultimate causes need not involve totally conscious responses devoid of adaptive significance.

Although the majority of data presented will be from humans, the argument will be made in as general a form as possible. Data from non-human animals will be presented where relevant and available.

K-SELECTION, r-SELECTION, STABILITY, AND PREDICTABILITY

The theory of r- and K-selection (MacArthur and Wilson 1967, Pianka 1970, King and Anderson 1971, Roughgarden 1971) and various theories of life history parameters (Murphy 1968, Gadgil and Bossert 1970, Vance 1973ab, Schaffer 1974) have dealt with the relationship between an organism's environment and its reproductive strategy. No comprehensive review of the literature will be attempted here. Rather, I will show that until recently most authors did not distinguish between variability and unpredictability, and most authors still do not distinguish between total reproductive commitment and the way that total commitment should be divided into packets (offspring).

MacArthur and Wilson (1967) formalized the notion that in relatively uncrowded environments, an organism's reproductive success depends more on exploiting resources to attain a high r; and that in relatively crowded situations, a high r is wasteful because the pre-reproductives don't make it into the breeding population, so individuals which can tolerate a high K are favored. This led to the conclusion that species specializing in colonizing new, unpredictably distributed habitats would tend towards r-selection, while those adapted for more crowded, "mature" habitats would tend towards K-selection. Some cichlid fishes in Africa exhibit precisely this pattern (Fryer and Iles 1969). Cody (1966) examined

clutch size in birds in an effort to confirm an earlier version of r/K theory (MacArthur 1962); his treatment considered only seasonality (causing "periodic local catastrophes"). Landahl and Root (1969) found a higher r for milkweed bugs in temperate localities compared to tropical ones, and made the important distinction between seasonality and unpredictability--a high r being favored even in predictable but seasonal localities. Gadgil and Bossert (1970) presented a detailed mathematical model of the expected reproductive effort at various ages given the age-specific "profit" and "loss" values for increased reproduction, balancing higher current reproductive success against lower future reproductive success. (They considered primarily the evolution of iteroparity compared with semelparity.) Pianka (1970) proposed an r/K continuum, with a wide variety of life history parameters varying as a function of variability and unpredictability. Several authors then considered the theoretical conditions under which r- and K-strategists might coexist in a single population (King and Anderson 1971, Roughgarden 1971, Charlesworth 1971); the r-strategists tended to increase when the environment produced high density-independent mortality or unpredictable mortality. There followed several papers that tried to test the various theories empirically. Gadgil and Solbrig (1972) noted that density independent mortality tended to be unpredictable (with exceptions) when compared to density dependent mortality, and

found that genetic differences in dandelions caused individuals in areas of high density independent mortality to devote larger fractions of their resources to reproduction. Tinkle and Ballinger (1972) found that an r/K difference could be observed within a single species of fence lizard, with the r-strategist occurring in the more heavily predated areas. Ballinger (1973) made a similar comparison between two species of iguanid lizard, and found that the group of characters expected to go with r-selection did occur in one species, while the other showed more K-selected features. However, he did not try to correlate this with observed mortality patterns or environmental predictabilities. Randolph (1973) found that two species of land snail varied the expected parameters along an r/K continuum as predicted by the variability of their physical environment, and had adapted genetically different niche tolerances to this variability. Tilley (1973) verified that K-selected characteristics (delayed reproduction) were associated with indications of higher predictability (high adult male survivorship) in a species of salamander; r-selected characteristics were associated with the converse.

That several life history parameters vary together to reflect r- and K-selection is thus fairly well established. However, the notion that these parameters are related to simple "predictability" or even "variability" of the environment has been challenged. Schaffer (1974) showed that the

important feature is whether the variable or unpredictable mortality affects primarily adults or pre-reproductives. If the latter, parents should reduce their reproductive efforts and move towards a K-strategy; if the former, they should increase it and move towards an r-strategy. (Thus, Tilley's finding mentioned above is consistent with Schaffer's conclusion; the fact that male survivorship was high among adults is the important parameter.) Schaffer and Tamarin (1973) made a direct test of this theory in lemmings and voles. Andrews and Rand (1974) considered patterns of reproductive effort in anoline lizards and compared them to the patterns found in birds, concluding that it is indeed the age-specificity of mortality differences that accounts for the degree of r- and K-selectedness. Murphy (1968) had anticipated these developments, although he was primarily concerned with the adaptiveness of iteroparity and not r and K patterns per se. Tinkle and Hadley (1975) showed that many other factors besides r/K position are important in certain lizard species.

But even these papers do not distinguish very well between predictability and constancy (Colwell 1974). Schaffer's model (1974), for example, made allowances for good years and bad years, but did not permit the organism to adjust its strategy depending on the goodness of the year it found itself in. With such models, variability clearly is equivalent to unpredictability, and little or no attempt has been made to separate their effects.

INVESTMENT PER OFFSPRING -- PREVIOUS RESULTS

Surprisingly little work has been done relating the optimal investment per offspring to the environmental conditions the offspring will face and the parents' attempt to maximize their own inclusive fitness. Early r- and K-selection theory (MacArthur and Wilson 1967) emphasing as it did the use of an r strategy in colonization, suggested that r strategists would invest less per offspring than K strategists. Pianka (1970) suggested that r strategists should have a relatively small body size. Vance (1973ab) considered the ecological causes of reproductive strategies in marine benthic invertebrates. Although he did not study r and K patterns per se, he found that different patterns of parental investment (production of free-swimming, plankton-feeding larvae; free-swimming, yolk-feeding larvae; and protection of the young by a guarding parent) do reflect different patterns of options available to the young. His analysis is mostly independent of the organism's adult size.

Smith and Fretwell (1974) produced one of the very few theoretical considerations of this topic. They showed that under quite general conditions, there exists an optimum investment per offspring, and that parental reproductive success is maximized when parents divide their investment into equal packets of this size. Clutch size, then, is to be considered a function of total reproductive effort and

investment per offspring. (Of course, if egg size is close to constant within a species, then clutch size is an acceptable measure of reproductive effort.)

This prediction of constant per-offspring investment is fairly well established in plants, since seed size is so easy to measure. Harper, Lovell, and Moore (1970) reviewed much of the evidence, noting that "The size of seeds within many species is so stable that the grain was used as a primitive unit of weight" and found that mean seed size does not vary as a result of changes in intraspecific density. Significant differences are seen as a result of changes in interspecific density and site, and also from year to year. The year-to-year variation can be seen as an attempt by the parent plant to "predict" the conditions its offspring will face and to adjust investment accordingly. The interspecific density changes are apparently a result of asynchrony in provisioning the developing seed and may be an artifact of the domesticated nature of many of the plants studied (Harper et al. 1970). The constancy under intraspecific density changes, however, could be understood as a reflection of one presumed purpose of seed production--the dispersal of an individual's genes away from the effects of local crowding--since the species density presumably approaches some constant pattern regardless of where the parent plant is. The variation due to the site should depend specifically upon the mean distance seeds disperse; species whose seeds go far from the parent should

show less variability in size, since the conditions upon arrival are less correlated with the parental site.

THE INFLUENCE OF UNPREDICTABILITY ON INVESTMENT PER OFFSPRING

None of the papers mentioned so far consider the relationship (if any) of the optimal size of parental investment in a single offspring to uncertainty in the offspring's environment, and few connect it to the predictability of the parents' "income stream," or material available for investment. This section will attempt part of such an analysis. Using quite different arguments, Levins (1968, ch. 2) anticipated some of these results. After this manuscript was prepared, Brockelman (1975) published results of other, independent work on this subject.

The argument is easiest to express by elaborating the graphical technique of Smith and Fretwell (1974), which will be reviewed briefly. Figure 1 is their hypothesized relationship expressing expected reproductive success of an offspring as a function of parental investment in that offspring. If the parents' total investment available is large compared to the optimal per-offspring investment $\underline{P}^*$, then parents should invest $\underline{P}^*$ in each and produce as many as possible under this constraint.

If total investment available is not very large compared with $\underline{P}^*$, however, Smith and Fretwell argued that feeding and development rates can be adjusted to make the optimal clutch or family size become an integer. For many species, this is not a viable alternative: birds cannot always squeeze in an

extra clutch before winter, and humans cannot always squeeze in an extra family before they die. In such cases, the extra parental investment might as well be allocated to the young, even though it may result in per-offspring investments somewhat higher than P*.

How this optimum can theoretically be calculated is shown in Figure 2. In many cases, maximal reproductive success for the parents is obtained by dividing total resources equally between the offspring. If the parents have even less investment available (Figure 2D), it may be optimal to allocate resources unevenly and have only one child.

Smith and Fretwell's argument, and its extension in Figure 2, were only given for a constant environment. If the x-axes in Figure 2 are regarded as indicating total rates of investment (per unit time) required for a given level of reproductive success (rather than total breeding-season amounts), if investment is allocated to offspring over a period of time and if parents can control the relative rates of investment in different offspring, then different conclusions can be reached if the environment changes, in an unpredictable fashion, the maximum parental investment rate possible.

The argument begins with hatching asynchrony in nidicolous birds. Lack has put forth the following view in several places (Lack 1954:40; 1966:33, 123, 223; 1968:175; 1962:14, 235, 245). In many nidicolous birds, successive eggs are laid

one or two days apart and incubated immediately, so they hatch one or two days apart. If the food supply available after hatching is unexpectedly low, the parents preferentially feed the older, more vigorous young, and the younger ones starve. (Lockie 1955 showed experimentally that this indeed happens in the Corvidae.) If the food supply turns out unexpectedly high, all the young survive. Lack (1966:33) suggested that the function of the starvation is "to reduce the brood-size quickly when food is sparse . . . without wasting food on those who would die anyway." Once the unexpected shortage of food occurs, this is correct; but what must be explained is why "the normal clutch tends to be somewhat larger than the number of young that the parents can raise in an average year" (Lack 1954:41), for in this case there is an average waste of parental investment. If there are non-linearities in the curve relating parental investment and reproductive success, it is possible for an act with an expected negative effect on investment to have an expected positive effect on reproductive success. Specifically with regard to asynchronous hatching, laying an extra egg gives the parents an entire extra offspring in good years at a small cost to the other nestling's reproductive success, yet reduces the other offsprings' reproductive success almost not at all in bad years, wasting only the part-offspring that was hatched last.

If this interpretation is correct, then several predictions follow which are confirmed in the literature. First,

it is the unpredictability of the food supply that drives the system, not its variability or harshness. (Unless, of course, the birds are unequipped to deal with variable but predictable resources, which amounts to functional unpredictability.) Second, continued parental investment is required; i.e., lizards which lay eggs and then leave them have offspring that may face unpredictable food supplies, but asynchronous hatching should not evolve to better adjust their numbers to the food supply because the food is not allocated by the parents. (Exceptions could only occur by way of kin selection, if the young lizard siblings compete mostly with each other for a limited food supply.) Third, the longer the period of parental care the easier it is to cut off investment in a given offspring early, and thus minimize losses if food becomes scarce late in the breeding season. Fourth, differences of "opinion" are expected between parents and offspring, and between offspring, as to just when a given young should be sacrificed (Trivers 1974), since permitting oneself to die for the benefit of one's siblings is an altruistic act.

Empirical evidence is as follows. First, Ricklefs (1965) clearly saw the "wasteful" nature of asynchronous hatching in terms of parental investment, but showed how it helps curve-billed thrashers to increase reproductive success. Ricklefs also showed the importance of unpredictability of food availability, and Lockie (1955) noted the unpredictable nature of the earthworm supply in Corvidae which breed

asynchronously. Lack (1966:33) showed how Great Tits' hatching varies from mostly synchronous to mostly asynchronous as the food availability becomes more undertain late in the breeding season. Lack (1968) showed asynchrony to be common in nidicolous birds, where parental investment is over a long period of time, and uncommon in nidifugous birds, where offspring forage for themselves much sooner. Third, Lack (1968:235) showed that many of the exceptions to the nidicolous/nidifugous rule nevertheless fit the underlying rationale. Fourth, some highly circumstantial (but suggestive) observations have been made of possible conflict between the offspring. A simple argument (Figure 3) shows that conflict between parents and offspring is expected to be much more intense when food is scarce; in such cases, it is more likely that an offspring must die to maximize parental inclusive fitness. Lack (1966:223) seemed puzzled by this conflict, which was presumably the cause of Schüz's white stork nestlings being killed (Schüz 1957), and attributed it to parents speeding up "deaths that would occur anyway." But Ricklefs (1965) observed a case where it was the larger bird that "fell out" of the nest, a death which was almost certainly not "going to occur anyway," and which suggests that the larger sibling was actively helped out of the nest by the smaller. (Consideration of the situations intermediate between Figures 3a and 3b implies that the transition between a food level producing minor squabbles and one producing life-and-death struggles is fairly sharp.)

The preceding arguments can be summarized as shown in Figure 4. Given two organisms facing the same expected (average) food abundances, it may be reproductively advantageous for the one with the less predictable food supply to produce an extra young by reducing investment per offspring, even though this reduces reproductive success in an average year.

Another line of argument, less applicable to birds but more applicable to humans, leads to a similar conclusion. Up to now, I have assumed that curves of reproductive success versus parental investment (Figure 1) are identical for all offspring. If, on the other hand, substantial variability is expected due to environmental or genetic influences, this may affect the optimal investment strategy. (This variability in offspring "quality" is equivalent to making the curve in Figure 1 steeper or shallower for different offspring.) For a completely predictable set of offspring quality curves, there must be some optimal number of offspring n; reducing per-child investment in order to sequeeze in an $(n+1)$th offspring must reduce total parental reproductive success. But if the offspring quality curves vary unpredictably about the mean, parents have another option--reduce per-offspring investment to squeeze in an extra offspring, watch the way they develop, and then bias the allocation of the remaining resources strongly towards those n offspring showing themselves to be of "best" quality. The parents lose most of the

investment in the worst-quality young, but might more than gain it back by the environmental or genetic luck of the extra young. For a given mean offspring quality, this is most likely to be possible when the variation about the mean is large.

There are thus two lines of argument leading to the prediction that environmental predictability should increase per-offspring investment by parents in species showing extended brood care. The first focuses on unpredictability of the parents' food (income) supply, and the second on the unpredictability of an offspring's return in reproductive success for a fixed amount of investment from the parents. These two unpredictabilities are conceptually separate, but are sometimes correlated in nature. For example, the dominance rank of a chimpanzee is correlated throughout much of its life with that of its mother (Kawai 1965). If high dominance implies a higher resource predictability, then mothers low in dominance will also tend to have offspring whose expected reproductive success is (low and) unpredictable.

THE INFLUENCE OF UNPREDICTABILITY ON THE PAIR BOND

Certain features of a species' breeding system should be influenced by the predictability of the male's food supply. Trivers (1972) noted that since a male's investment in sperm is less than a female's investment in ova, a male must choose how to allocate energy between investment in offspring (which helps some offspring's survival at a cost to other current or future offspring) and male-male competition (which helps no offspring). What I note here is that there is sometimes a cost of maintaining a pair bond that was not noted by Trivers --the cost to the male of maintaining the female at times when the reproductive return is low. A male facing an unpredictable food supply is more likely to follow an opportunistic pattern of reproduction, and is less likely to be willing to pay that cost. He is more likely to reproduce when food is abundant, and to break the pair bond when food is scarce to avoid wasting the investment on young that have little chance of surviving. A male facing a more predictable food supply is more likely to make the initial investment in a female that a pair bond requires.

There are, of course, a great many other factors that influence the strength of a species' pair bond. Wilson (1975:327-329) noted the "Orians-Verner effect" (Orians 1969, Verner 1965), which attributes the evolution of polygyny to high variability in the males' attractiveness, making it

advantageous for the females to abandon a high-investing male with a poor territory and join a low investing male with an excellent one. While high unpredictability can often cause high variability and thus promote polygyny under the Orians-Verner model, I am proposing an additional route. If a female is likely to desert a male when the food supply is low--to join another male or to give up on reproduction for the season--then a male facing a relatively unpredictable food supply would be more likely to lose any investment given to the female before the young are grown. He would thus be more likely to devote a larger fraction of his resources to male-male competition, forming a pair bond only when resources seem to be plentiful enough to assure breeding success.

Pitelka, Holmes, and MacLean (1974) described the breeding systems of several closely related arctic sandpipers that are consistent with this interpretation. Reporting on 24 species of the subfamily Calidridinae, they separated species into two groups according to the "variability in amplitude and in predictability over both space and time" of their food. The "conservative" species exploited relatively predictable resources; the "opportunistic" ones took advantage of relatively unpredictable ones. Pitelka et al. did not specifically relate this to a higher probability of desertion by the female, although they noted in passing one species where there was a "tendency" for the female to leave the male to raise the brood to fledging after hatching.

PREDICTABILITY: ITS RELATION TO HUMAN SOCIAL CLASS AND RACE

In this section I will show that, all other things being equal, a human member of the working class faces a more unpredictable future than a member of the middle or upper class; similarly, a member of a racial group facing significant racial prejudice faces a more unpredictable future than a person of a more privileged race. By "future" I mean that collection of opportunities and resources required for raising children successfully. In Western societies, this is the family's income stream, as subjected to the risks of unemployment, death, or disability of the family's wage earners.

A recent study (Levison 1974) has stressed the importance of such unpredictabilities for working-class American men. Regarding disability, American workers face much higher levels of job-related injuries and death than middle-class individuals (Levison 1974:78). Regarding unemployment, the 1970 percentages of those unemployed at some time during the year ranged from 14% to 31% of various working-class job categories, while middle-class categories ranged from 5% to 12% (Young and Michelotti 1971, Levison 1974:82). These same sources showed that when unemployment came it was more likely to be of long duration for working-class men; and moreover working-class men were more likely to have two or more spells of unemployment during the year. The 1973 figures (Young 1974, U.S. Dept. of Labor 1975) show a similar pattern.

These statistics show that working-class jobs produce income streams that are inherently less predictable than those from middle-class jobs. There is a second reason why working-class families face a more unpredictable future--the simple fact that working-class jobs pay less money, which provides a much smaller cushion for riding out short-term environmental fluctuations. According to the Bureau of Labor Statistics (reported in Levison 1974:32), in 1970 about 30% of American working-class families (with employed heads) had total incomes putting them in the "poor" budgetary category; another 30% were above poverty but below Levison's so-called "shabby intermediate" category. Even this intermediate budget only allows extremely sparse expenditures. (For example, neither the poor nor the intermediate budgets allocate anything whatsoever for savings.) It is not surprising, then, that "for most workers, a single economic crisis can wipe out the work of a lifetime" (Levison 1974:103).

Work-experience data also bear out the hypothesis that certain blacks face more unpredictable income streams than whites. In 1973, for example, a larger percentage of the white male population had work experience than the black population, black men were more likely to face longer periods of unemployment, and black men were more likely to face more spells of unemployment if they worked at all (all regardless of age; U.S. Department of Labor 1973, Table C-1). There is only one table permitting a separation of the effects of race

and class (Table 1); here an interesting pattern emerges. Black men in most middle-class jobs were more likely to work part time than white men in similar jobs, and blacks with some full-time middle-class employment were more likely to have that employment last less than 50 weeks. In contrast, for working-class jobs, black and white men with some full-time work during the year did not differ in any consistent way in the length of that employment, although whites were somewhat more likely to have had part-time jobs during the year. Thus, being black does seem to exert an independent effect on income unpredictability for middle-class jobs, but not for working-class ones.

FAMILY SIZE, SOCIOECONOMIC STATUS, RACE, AND PREDICTABILITY

The relationship between income and fertility has traditionally been thought of as having three different sorts of causes, operating independently of each other. These three causes are biological ones (such as low fecundity during heavy lactation) caused by hormonal mechanisms, rational ones (such as desiring a good education for one's children) caused by conscious contraceptive mechanisms, and non-functional ones (such as dressing one's children better than they really need) caused by societal mechanisms operating through norm and value transmission. This section examines the extent to which this trichotomy can be collapsed into a single evolutionary set of explanations.

Economists often assume that married couples act to maximize a utility function with differing utilities for child quantity, child quality, time available away from children, and so forth; they proceed to deduce what set of family sizes maximizes the utilities of the couples, given the constraints in income, time, etc., that they face. An evolutionary approach assumes that the form of the utility function is relatively simple--the sum of the reproductive successes of the couple's offspring. (A more sophisticated model would count the number of grandchildren; models involving kin selection add in children of relatives devalued by degrees of relatedness.) This approach assumes that all aspects of

behavior are integrated to maximize reproductive success, whether the mechanism is conscious or unconscious, affirmed by society or rejected by it, hormonally automatic or willingly chosen. One author noted in a slightly different context that "it is unreasonable to argue . . . that human beings, alone among living organisms, have failed to develop any density-dependent mechanisms of population control" (Dumond 1975). Likewise, it seems unlikely to a biologist that any significant set of human behaviors should have maladaptive consequences over significant periods of evolutionary time. The rest of this section is a first attempt to see whether this presumption is consistent with the facts.

As argued earlier in this paper, one should arrive at predictions about family size via predictions concerning optimal investment per offspring ("child quality," as DeTray 1972 put it). The curve relating family size to socio-economic status can be deduced from Figure 5. There are, however, some uncertainties in that argument. The straight line in Figure 5 assumes a certain minimum income (i) is required to support the parents, and the rest is allocated to reproduction. At low values of total parental investment (PI), and thus at high levels of parental resource unpredictability, we expect the fraction of resources devoted to reproduction to increase, so the line in Figure 5 probably curves towards the origin as shown by the dotted portion. (This probability will be further discussed below.) At high

levels of available PI, the fraction devoted to reproduction might decrease somewhat, but this would not affect the conclusions reached below.

Also shown in Figure 5 is a curve relating the optimal PI per child to the total PI available. This is obtained by way of the predictability argument of Figure 4. At high income levels, income predictability is most likely to be high, and the optimal investment per offspring should be very close to P* in Figure 1. To the right the curve thus approaches an asymptote. To the left, unpredictability increases, and optimal investment per child drops below P*. Whether this curve approaches the PI axis away from the origin (solid curve in Figure 5) or near the origin (dashed curve) has only a minor effect on the results.

The curve of family size versus income resulting from these considerations is shown in Figure 6. Family size increases on both sides of point m, which is where the two functions in Figure 5 have the same slope. The rise to the right of m is an almost unavoidable consequence of the PI-per-child curve approaching an asymptote. (It can fall to the right of m only if the total PI allocated for investment eventually approaches an asymptote faster than investment per child does--a virtually impossible condition.) Whether family size turns down again to the left of m (dashed portion of Figure 6) depends on the precise form of the leftmost portions of Figure 5; hence, our predictions will not concern this portion.

If different population subgroups differ as a function of income unpredictability, more predictions can be made. The argument in Figure 7 shows that family size should increase at all levels with an increase in income unpredictability but much more so at lower income levels than at upper ones, and that the bottoming-out point of minimum family size should shift to higher income levels. (If data above a certain income level are lumped together, they may seem to show a higher fertility at high incomes in the more predictable-income groups if the higher-predictability individuals are more likely to have the highest incomes.)

I will not make any complete attempt to review the voluminous data on income and family size. However, the data I have consulted are very suggestive. Figure 8 gives the most recent available U.S. Census data, and shows a pattern consistent with the model if one assumes that rural non-farm occupations have more unpredictable incomes than urban ones, since they depend more closely on the fate of farmers, which in turn is highly dependent on weather and other unpredictable factors. (Data for rural farm whites are also consistent with higher unpredictability but are not shown, since the higher fertility might also be seen as a way of producing cheap labor. See references in Simon 1974.) Table 2 attempts a more careful, three-way control for predictability, using husband's occupation and education, and wife's age at marriage. (A late age at marriage usually reflects a late age at first

reproduction, which in turn indicates a less opportunistic, higher-investment-per-child strategy. Likewise, wife's education correlates with the desire to postpone first reproduction, and should also be a proxy for expected income predictability. These arguments are elaborated below.) From Figure 7b, it is clear that for the middle-range incomes usually tabulated in censuses, data from groups with more predictable incomes should be more likely to show a positive relationship between income and family size, and low-predictability-of-income groups a negative relationship. This is exactly what the most recent data available with a detailed breakdown show (Table 2).

Simon (1974), in his extensive review of the income-and-family-size literature, found that many of these effects are quite general. For example, the "Sanderson-Willis effect" (pp. 59ff) reveals that "at higher levels of women's education and husband's income, an increase in husband's income will indeed produce an increase in children, but at low levels of women's education and husband's income an increase in husband's income produces a decrease in fertility" (emphasis in original). This contrast is completely understandable in the light of the above arguments. In fact, this principle is borne out at innumerable points in Simon's review. There are many cases where the effect of income on family size is positive in all subdivisions when the wife was 22 or older at marriage, but is much less regularly so if the wife married younger--

just as in Table 2. Simon's finding (pp. 62ff) that higher income increases the probability of additional children being born in small families but decreases the probability of more children in large families (considered in cross section) is also consistent with this mechanism.

So far, I have been concerned with the cross-sectional effect of income on fertility. Simon (1974:23-34) summarized the studies dealing with time-series evidence. He found that a short-term increase in income (above the long-term trend) almost invariably increases fertility (above the long-term trend). He attempted a formal reconciliation (his Appendix A) with the cross-sectional evidence that higher income lowers fertility, which I believe is unnecessary. Short-term, business-cycle fluctuations are the essence of income unpredictability. By definition, they do not constitute long-term changes in one's expected income predictability. Those members of the population pursuing a relatively opportunistic reproductive strategy due to the unpredictable nature of their income streams would correctly interpret an economic upswing as simply the beginning of good times, with poor times to follow at some unpredictable point in the future.

A control for race can add additional support to the theory. Kiser et al. (1968) reported that

> "among women 35-44 years of age whose husbands were in one of the three broad white-collar classes . . . or in the service worker class, the average number of children ever born was larger for nonwhite than for white women if the wife was under 22 at marriage. The

> fertility rate was smaller for nonwhite than for white women if the wife was 22 or over at the time of marriage. Within the other occupation groups . . . the fertility rate for nonwhite women exceeded that for white women regardless of the wife's age at marriage. However, the percent excess was consistently much lower for the wives marrying relatively late" (Kiser et al. 1968:217; emphasis in original omitted).

Keeping in mind the point above about lumping families in high income brackets, this pattern is completely consistent with the model in Figure 7. In a working-class family with high income unpredictability, one considers curves further to the right; additional uncertainty due to racial prejudice increases optimum family size sharply, but especially when additional uncertainty is shown by early marriage. In middle-status families, one considers curves more to the left; racial prejudice should result in significantly larger families when age at marriage indicates more unpredictability, but only slightly or insignificantly larger families when the wife marries late.

More mathematically sophisticated models, however, make the independent effect of racial prejudice more uncertain. DeTray (1973) found that "race may play virtually no role in determining family size" in his multiple-regression model holding education and income constant. But Gardner (1973) found that "non-white families have 1.2-1.3 more children than white . . . ceteris paribus." Both studies were hampered by the use of smaller samples than the census data reported in the previous paragraph, and Gardner's by a restriction to

rural (farm and non-farm) families. On the other hand, multiple regression and more precise hypotheses make these studies more useful in other ways.

The explanations proposed here, dealing as they do with data collected for other purposes, cannot be regarded as conclusive. Perhaps the strongest point in their favor is the absolute requirement that family size eventually turn up if income becomes high enough. That this occurs with regularity has only recently been agreed upon by economists modeling family dynamics (Willis 1973:553).

There is, however, one set of data which could more directly confirm the theory presented here. Most economic studies have attempted to correlate demographic variables with fertility, tending to ignore many "softer" sociological measures. Groat and Neal (1967) contended, however, that much of the variability in family size within demographically quite homogeneous groups could be explained by precisely such sociological measures. Specifically, they found that measures showing high degrees of powerlessness, meaninglessness, normlessness, and social isolation among women were significantly associated with higher fertility in most cases, even when other important demographic parameters were controlled. Bauman and Udry (1972) added weight to this sort of explanation when they concluded that "powerlessness is found to be a relatively strong predictor of the regularity of contraceptive practice, even when eight other related variables are controlled."

Once it is seen that powerlessness and income unpredictability are strongly and causally related, it is clear that these results are quite consistent with this paper's central theme.

In addition, Simon (1974) quotes recent work by Easterlin (in press) that confirms some of this paper's theories. Easterlin has been attempting to correlate expected income (rather than actual income, retrospectively reported) and expected unemployment with the observed data on American fertility during this century. Both sets of correlations reportedly display highly significant relationships. His unemployment approach is, of course, very similar to the method I use above to estimate income unpredictability.

OTHER EXPLANATIONS OF INCOME/FERTILITY PATTERNS

The author of this paper is not an economist; in comparing this theory with the theories of others, I must let economists evaluate each other. One succinct evaluation was made by Ben-Porath (1973): "There are evidently more aspects and relevant considerations than there are actually measurable variables."

One area of explanations, however, can be dealt with biologically. It has sometimes been thought (for example, by Fisher 1958, ch. 9-11) that individuals differ genetically in fertility, and that high fertility itself causes low socioeconomic status because of the difficulties involved in raising a large family. Fisher presented data purporting to show a high hereditability of fertility, but this view is no longer tenable (Imaizumi et al. 1970). Although genetic influences on social class should not be dismissed out of hand (Udry et al. 1970), such influences neither support nor dispute the central arguments in this paper, since all that is considered is the question of the adaptiveness of a given behavior at a given level, and genes differing across individuals need not be invoked for this question to be answered.

Returning to strictly economic models of fertility, the inverse relationship between wife's education and fertility is usually given an "opportunity-cost" explanation (Simon

1974:144). The higher education is seen as raising the wife's wage rate outside the home, raising the utility of work relative to that of children, and thus reducing the number of children she wants to have. But Simon noted (1974:172):

> "Additional women's education (and earning power) does not lead to lower fertility among U.S. white women whose husbands have high education. Why does the opportunity-cost explanation fail here?"

The theory proposed in this paper explains this finding as a result of the fact that the white women with highly educated husbands are already in highly stable situations, and additional own education would not indicate much more of an expectation of stability. Accordingly, little difference in fertility behavior is expected.

Another set of models has to do with the social and psychological influences on fertility. I have already indicated how some of these influences (Bauman and Udry 1972; Groat and Neal 1967; and, below, Rainwater 1965) can be integrated into an evolutionary model. Regarding views like Blake's (1968) critique of the economic theories of family size, I am more ambivalent. On the one hand, the model I have proposed supports Blake's contention that ". . . the inverse relation of family size and income is not because of lack of contraception among the poor, but is also due to the desire for larger families among them." Even data from some economists supports this conclusion; DeTray (1972:62) concluded from his model of American fertility that "the data offer no support for the contention that differences in birth

control knowledge are of major importance in fertility decisions," and for the Philippines (a country with even larger education differences than in the U.S.) Harman (1970: 42) concluded that "neither total nor recent fertility is significantly influenced by 'use' of a birth control method as measured by responses to survey questions." (Data on sexual behavior in the next sections of this paper will show, moreover, that a disinclination to use contraception, even in the face of adequate knowledge about it, is common in situations of high income unpredictability.) On the other hand, Blake's explanation of why it is that poor families do not have a smaller number of children in which they invest more per child seems just as unsatisfactory as the "ignorance" view of contraceptive non-use that she attacks:

> "Why do the poor not choose to have very few higher quality children, rather than more lower priced ones? The answer is, in part, that poorer people are not actively dissatisfied with low-priced children because they cannot transcend their own limitations to that extent. Low-quality children fit in with the way of life of the poor and, in an atmosphere of general scarcity and limitation, parents are not goaded into dissatisfaction with such children to the extent of making changes in their own lives and objectives to rectify the situation. Since poorer children only rarely come into direct contact and competition with wealthier ones, poor parents are shielded from comprehending the overall effects of low price on comparative child performance." (Blake 1968:19-20)

In short, Blake attacks ignorance of contraceptives as an explanation, but substitutes ignorance of how to go about investing more intensively in fewer children!

In contrast, I have proceeded on the assumption that poor parents are showing the effects of mechanisms that recently were adaptive, given the constraints of the highly unpredictable income streams they find themselves receiving. Certainly other cultures have found ways of adjusting family size (Dumond 1975; Langer 1974ab) in the absence of "sophisticated" contraceptive techniques. Adding income predictability to Ben-Porath's many "aspects and relevant considerations" can be more than just another complication if it is realized that utility functions should also be quite simplified. Such an undertaking is especially worthwhile given that the important demographic parameters seem to affect families in rather similar ways, with minor differences due to race (Farley 1970), decade (Kiser 1933), and political system (Berent 1970).

HETEROSEXUAL BEHAVIOR AND UNPREDICTABILITY

In an earlier section, I reasoned that individuals of a species whose food supply is unpredictable should prefer a more independent pattern of heterosexual behavior--that is, a weaker pair bond. Similar arguments apply to humans facing an unpredictable income stream. Lacking an adequate quantification of unpredictability, I will rely on comparisons between groups differing by two correlates of unpredictability: social class and race.

Rainwater made the first precise study of American marital relationships as a function of class and race (Rainwater 1960, 1965). His picture has not been significantly challenged since then, and others have confirmed various portions of it (see LeMasters 1975, especially pages 41, 84, 89, and other references therein; also Hammond and Ladner 1969). Rainwater found that one of the most important parameters characterizing American marriages was the "Conjugal Role Relationship" (hereinafter CRR) of the partners. (This concept was originated by Bott 1957.) A joint CRR is characterized by

> ". . . activities carried out by husband and wife together (shared) or the same activity carried out by either partner at different times (interchangeable) . . . [E]ven where there is a division of labor in task performance . . . each is expected to be interested in and sympathetic to the other in his assigned duty." (Rainwater 1965:30)

The other extreme, a segregated CRR, is characterized by

> ". . . activities of husband and wife that are separate and different but fitted together to form a functioning unit or that are carried out separately by husband and wife with a minimum of day-to-day articulation of the activity of each to the other. . . . Such couples tend to emphasize a formal division of labor in the family rather than a solidarity based on interchangeability of role activities, or the identification and empathy of each with the other's activities and concerns." (Rainwater 1965:30-31)

There is also an "intermediate" CRR, between these two extremes.

The study of non-human species has produced a clear consensus regarding one connection between environmental factors and the degree of sexual dimorphism (Wilson 1975:334): when there is strong selective pressure for early reproduction, sexual dimorphism (including behavior) increases to make the partners "fit in" with each other more quickly, at the cost of a longer-range, more efficient adjustment to each partner's individual strengths and weaknesses. Thus, an opportunistic pattern of reproduction should result in a marital relationship quite similar to a segregated CRR, and the degree of CRR jointness should be strongly correlated with our correlates of income predictability.

This is indeed the case. Table 3 (Rainwater 1965, Table 2-1) shows the distribution of CRR's by social class in Rainwater's sample. Note especially the absence of segregated CRR's in the middle classes, and the virtual absence of joint CRR's in the lower-lower class. Note also that the trend persists when race is controlled, and that

blacks also tend to have more segregated CRR's than whites when class is controlled, although this last is only a weak trend (consistent with the weak or absent independent effect of race on income unpredictability in the lower class).

Rainwater also gathered some data with direct bearing on the links I hypothesize between income instability and social class. Table 4 shows that the lower the class, the more likely it is that "money and job instability" would be mentioned by the husband as the main problem in the marriage, among those who felt there was any significant problem in their marriage. Again, this trend persists across classes when race is controlled, but is ambivalent across race when class is controlled.

The rest of this section focuses on behavior that is more explicitly sexual. Table 5 lists all[1] the studies of

---

[1] I am aware of one study not listed, Hobart (1972), which was not included for methodological reasons. Its comparison between university and trade school students, and between anglophone and francophone groups, showed promise of a simultaneous control for class and ethnic origin. However, the questions on behavior were not properly translated between the two languages, and age differences in attendance between the schools precluded any meaningful comparisons being drawn on this score. Nevertheless, much of what is proposed below is consistent with Hobart's results.

sexual behavior since Kinsey that I could find in any nation that reported the presence or absence of correlations between sexual behavior and social class or race, and which used standard Western interviewing techniques.[2] There are in addition many papers dealing with relationships between social class or race and sexual attitudes which I will not consider in this paper. Although attitudes and behavior are clearly somehow related, they are not always identical (this paper, Table 10; Kinsey et al. 1948:385; Christensen and Carpenter

---

[2] Missing from Table 5 are studies from the small but important Russian literature. The two papers reporting class or educational differences had to be excluded for methodological reasons. Barash (1926) compared his study of workers in Moscow to university students from a study conducted by Kharkov; such inter-sample comparison is always risky, especially when Barash's questionnaires were "not dissociated from all our . . . preventive work, but . . . used . . . as an important means of focusing the attention of the workers on the question of venereal diseases" [emph. in original]. This, and the heavily ideological tone of the article, make it impossible to evaluate the degree to which Barash's data can be accepted. Matushkin (1927) broke down certain statistics by whether the respondent was an officer or an enlisted man; however, all subjects were patients at a venereal disease clinic, and cannot be considered representative of the population as a whole.

1962; W. C. Wilson 1975:50). I choose to study behavior because it is more closely tied to biological consequences. It is not at all unusual, even with non-random samples, to find that attitudes differ much more strikingly between groups than actual behavior does (Pomeroy 1972; Athanasiou 1972).

A central theme in what follows is that certain sexual behaviors should reflect an individual's expected future income unpredictability. This is strongly correlated with one's own adult social class. It should not be expected to correlate well--if at all--with parental occupational class. This caveat was exceptionally well illustrated in the correlation between religious devoutness and virginity in a study by Schofield (1965:148-149). In this case, the usual strong (p less than 0.001) positive correlation was found between the two when it concerned the boy's or the girl's own church attendance. However, "there was no association between parental church-going and the levels of [the children's] sex activity." It will be seen that much the same pattern occurs with regard to occupational class of an individual and his parents.

Coitus versus other pair-bond maintenance activities. Coitus is the one sexual act (short of artificial insemination) which can result in conception. On the other hand, there are many sexual acts which can help to maintain a pair bond over long periods of time. Thus, the relative importance of simple

coitus versus other joint sexual acts should be an indicator of the strength of the marital pair bond. Males facing relatively unpredictable income streams should favor uncomplicated coitus over other more "advanced" techniques, in comparison to males with more predictable incomes, all other things being equal. They should also care relatively more about their own satisfaction compared to that of their partner. Females, on the other hand, should desire a relatively strong pair bond to the extent that it makes the husband more likely to be around to invest in her offspring (Trivers 1972). But "males, being more dominant, have more effect on female sexual behavior than the reverse" (Pomeroy 1972:470), so wives of men who care little about female satisfaction can be expected to reject sexual relations relatively often, and to put forth the notion that they are uninterested in sex (on the husband's terms). Males with more predictable incomes should assess their wife's degree of sexual pleasure more accurately, and should be willing to expend more effort to please her with actions that result in her orgasm. Finally, to the extent that masturbation after marriage represents a spouse achieving release without imposing his will on his partner, or without going outside the marriage, it should be found more often in couples with more predictable income streams.

Table 6 summarizes the studies that have attempted to measure the above parameters among married couples as a

function of race and class. The two cases where a correlation was sought with parental occupational class produced negative results, as expected. Rainwater found a weak (possibly non-significant) effect of race once class was controlled; Hunt found that the blacks in his sample were clearly less likely to use oral-genital techniques than whites. Since Rainwater's comparisons were only within the lower class, and Hunt's blacks and whites were of similar middle-class urban status (Hunt, personal communication), these findings are consistent with the economic data on income unpredictability. Regarding husband's occupational status and educational level, there are no studies with findings in the direction opposite to those theorized; only Hunt's data found no relationship for some of the variables. Hunt's respondents covered a much narrower range of educational levels than the Kinsey group's did; his no-difference findings must be considered as underestimates. (They are further considered below under the heading Sexual patterns over time.) The wife's educational level gives results quite similar to those of the husband's.

Extramarital experience. Regarding sexual involvement outside of marriage there are two important distinctions to be made. The first is between extramarital involvement with and without expected investment in any children which result. In much of Western society, there is no institutionalization of the concubine. This pattern is therefore most often put into

effect by divorce and remarriage--serial polygyny. There should thus be an important distinction between extramarital intercourse with prostitutes, where the investment comes as a cash payment at the time of the act, and extramarital intercourse with companions, where the act can be a prelude (however tentative) towards divorce, remarriage, and investment.

The second important distinction is between extramarital coitus early and late in marriage. Extramarital involvement early in marriage is more likely to be an extension of the behavior occurring just before marriage; late in marriage it is more likely to involve affairs with investment. (This is especially important in the Kinsey group's studies, where a couple was not required to have a formal marriage license to be considered married.) Moreover, there is a statistical weeding-out process whereby unstable marriages break up; those that survive the longest are likely to be disproportionately weighted with couples with predictable incomes.

Thus, two different patterns of extramarital intercourse for husbands should exist. Intercourse with prostitutes should be more common at all ages among husbands with unpredictable income streams. Intercourse with companions should decrease among this group with age, but it should increase with age among husbands with predictable incomes.

Evidence relating to these points is contained in Table 7. The four entries in the "Kinsey et al. (1948)" row do not do

justice to the wealth of information the Kinsey group collected on this topic. It is perhaps better summed up in the following quotation:

> "The most striking thing about the occurrence of extra-marital intercourse is the fact that the highest incidences for the lower social levels occur at the youngest ages, and that the number of persons involved steadily decreases with advancing age . . . In striking contrast, the lowest incidences of extra-marital intercourse among males of the college level are to be found in the youngest age groups, . . . and the incidence increases steadily . . ." (Kinsey et al. 1948:587).

Precisely this pattern was also found in Sweden by Zetterberg. (His data do not separate male from female responses in this case. Since the female extramarital pattern is relatively constant--see below--this pattern is nevertheless what would be expected from theory.) Hunt (1974:259) also found essentially the same pattern. On the other hand, a lifetime ever/never incidence figure is biologically not very significant; the early and late extramarital relations tend to wash each other out. Thus, two studies found no relationship with education for this variable, and Deggeller et al. (1969) express little confidence in their finding of a weak positive correlation with class (p. 114). An ever/never incidence for individuals of greatly differing ages can, in contrast, be of use, and two studies confirm the predicted relationship.

I know of only two sources concerning class differences in extramarital intercourse for females (see Table 7). Accordingly, any explanation is almost necessarily ad hoc. Trivers (1972) reasoned that a female's reproductive success

tends to depend more on how much she and her husband can invest, while a male's is relatively more sensitive to the number of females inseminated. For humans, then, it is reasonable to suppose (ad hoc) that a woman's extramarital involvement should depend in a statistical sense mostly on what her husband is doing with his investment. Considering the pattern for males, upper-level women should increase their extramarital intercourse as their husbands begin to stray; there should be little difference at early ages across class. One source is consistent, the other mildly inconsistent, with this logic.

I know of no data concerning racial differences in extramarital intercourse.

Premarital experience. It was shown above that individuals with different income predictabilities should show different patterns of sexuality once they begin to have a family. Patterns of premarital sexual behavior should reflect different ways of getting to those strategies, depending on the amount of income unpredictability an individual can expect to be subject to.

Premarital coitus can be directed at two biological ends: Reason one--It can represent the initial stages of pair-bond formation, and thus be a simple prelude to marriage. If marriage is viewed as a more or less arbitrary and culturally variable point between a time when the spouses did not know

each other and the time when a baby that both parents plan to invest in is born, then a certain amount of premarital coitus is less and less surprising the closer one gets to the wedding. If this reason is an important one, group differentials in the age at first coitus should sharply decrease when age at marriage is held constant.

Reason two--It can represent an attempt to coerce investment in offspring. The logic of Trivers (1972) predicts a sex bias in the way this coercion should operate. Males would be more likely to impregnate and attempt to avoid investing in the resulting offspring. Females would be more likely to allow impregnation and then use this to extract investment from the father. (The converse situations occur, too, but with much lower frequency.) This sort of premarital coitus, then, should be decidedly promiscuous for males and pair-bond-directed for females.

This reasoning leads to a number of consequences. Boys who expect relatively predictable future income streams (those with high education, those who end up in higher-class jobs, those who are white--all other things being equal) should especially fear the female-favoring half of reason two, compared to other boys. This should lead to a preference to non-coital means of pair-bond formation, and a relative avoidance of the male-favoring half of reason two. Compared to boys with less education, poorer jobs, and blacks, these boys should have a late age at first premarital coitus, a low

coital active incidence and low coital rate among those active, a high incidence of petting, more elaborate petting techniques, less coitus with prostitutes, fewer coital partners, and a higher frequency of petting to orgasm among those active in petting. The early age at marriage of boys expecting unpredictable income streams should only slightly further decrease the age at first coitus.

Girls of all levels should fear the male-favoring half of reason two, but should often value reason one. Girls expecting low-predictability income streams should find the female-favoring half of reason two somewhat more attractive, however. Taking their earlier age at marriage into account, girls who expect relatively unpredictable future income streams (those with little education, and those who are black--all other things being equal) should have a lower age at first premarital coitus than other girls and a higher coital active incidence; but these should mostly disappear when age at marriage is controlled. The same holds true with petting experience; however, since petting is non-reproductive and coitus often is not, more upper-level girls should stop at petting. Since girls gain little biologically by promiscuity, there should be no difference in number of coital partners.

A final set of consequences deals with correlations with parental socio-economic class. It should be clear from the reasoning so far that the various correlations should have

much more to do with the socioeconomic level one ends up at than the level one's parents start one out at. (That, after all, is the whole point of hoping for a "better life" for one's children.) Whatever correlations with parental class exist should be further weakened if the conflict between offspring and parents (Trivers 1974) is expected to vary as a function of the parents' income unpredictablity. (Simple arguments show that such variations are expected. For example, an earlier section argued that children should each receive less parental investment under conditions of high resource unpredictability. A reproductively altruistic act that makes one child nonreproductive, say, costs such a parent less than when each child is the result of a large investment.) In any case, correlations with parental class might even represent nothing more than differences in parental ability to control their children.

Tables 8 and 9 present the data on these questions in cross-cultural overview. (It is perhaps surprising to learn that we know so much about premarital sexuality, and relatively little about marital sexuality.) First, the highly spotty--and usually non-existent--correlations with parental socioeconomic class are evident. Only somewhat more than half of the correlations run were significant (most of them abroad), and many of those are arguable. (For example, Schofield (1965) seems at one point to feel that some of these correlations exist (pp. 43, 47) but denies them

elsewhere (p. 141).) Moreover, few of them are found in the U.S. The notion that a child passively acquires the sexual behavior of the community around him receives little support (as a general proposition) from such studies. Accordingly, I will henceforth ignore results showing correlations with parental social class.

When it comes to age at first coitus, there is not a single exception: all studies (over a dozen) show that lower socioeconomic class men and women have coitus earlier than those college-educated or in other upper socioeconomic strata. The closest approach to an exception is W. C. Wilson's study. Since this is a probability sample of the U.S. adult population, it must be carefully considered. Wilson found, for men only, a curvilinear relationship between education and age at first coitus, with high-school-educated men beginning earliest, followed by the other two groups virtually tied. Wilson (1975 and personal communication) feels that the unusually late age of first coitus for elementary-school-educated men "is probably a product of the . . . failure of accurate memory for events of 40 years ago"--this group was disproportionately weighted with men over 60 years old. Moreover, the question was asked in a written questionnaire, while the Kinsey group's studies (and those of many other investigators) were interviews; the Kinsey interviewers used special techniques to pinpoint the time various events occurred (Cochran et al. 1954:301-303).

Only the Kinsey group's studies controlled for age at marriage. As expected, the studies show the class difference disappearing almost entirely for women, but not at all for men, when age at marriage is controlled (1953:294-295). Bumpass and Sweet (see Table 6) did control for age at marriage in their study of marital break-ups. They found the class difference decreasing much more for the female's age at marriage than for the male's.

All studies (four of them) agree that black females have coitus earlier than whites. Kantner and Zelnik (1972) controlled only by parental indicators of socioeconomic status. Hunt (1974) compared blacks and whites of similar (middle-class) status. The third (Gebhard et al. 1958) controlled for education, and found similar large differences in both high school and college educated groups. The last (Bell 1968) included all educational levels (not broken down) and also found earlier coitus among black men. I know of no other study of racial differences in age at first coitus among men, except that Hunt (1974:149) apparently reported no difference in his sample.

Regarding coital frequency among those coitally active, the Kinsey group's results are in agreement with our pattern. Schmidt and Sigusch (see Table 9, "Other") do not agree; their results will be considered below.

Regarding active incidence of coitus, all studies are in agreement. (The Kinsey group's results are not listed

due to space limitations; they are LE, LJ, OPJ for males (T 85, p. 351, T 111) and LE for females (p. 296).) (Mann's Canadian data only relate to parental class, and his UPJ finding is in any case probably a result of class differences in religious devoutness.)

For active incidence of petting, there are the Kinsey group's studies in the U.S. and three European ones. They confirmed the hypothesized pattern.

Frequency of petting to orgasm, among those active, wavers between no relation and a confusing one. For males Kinsey et al. found no relation of median frequency to educational level (1948: Table 84), but a positive relation to mean frequency; and a positive relation between both averages and job classification. They found no relation among women (1953:241). No other study reported a result, and from a biological point of view, one can only produce weak (and ad hoc) arguments in favor of high frequencies among the better educated.

The use of "elaborate" petting techniques in premarital relationships foreshadows their use in marriage. All studies are in agreement.

All three studies dealing with male coitus with prostitutes agree that lower-class males use this outlet more than upper-level ones. Hunt's study in addition noted that black males do so more than whites.

The Kinsey group's study and the Schmidt and Sigusch German study agree that working-class men have more premarital coital partners than upper-educated men. The latter study found no difference for women, as expected. Curiously, the Kinsey group did not break down the number of women's coital partners by educational classes (p. 292).

I have not hypothesized concerning age at first masturbation or masturbation frequency because it is difficult to understand the biological significance of differences in this parameter. The data on age at first masturbation are highly conflicting. The studies on frequency of masturbation, however, are quite consistent, with the exception of Hunt's study, which found no class differences. (As explained above, Hunt's sample was underrepresented among grade-school-educated groups, and thus tends to underestimate the true size of the class difference. With an activity as widespread as masturbation, his non-significant findings are not surprising.) The Kinsey group explained this difference as the result of lower-class people accepting only coitus as a legitimate sexual outlet. I have attempted to explain this latter fact, but there is no strong biological reason why an emphasis on coitus when it is available should lead to a devaluation of masturbation when it is not. Accordingly, the data on masturbation are presented only for completeness. (See, however, the next section on parental socialization of the sexual habits of children.) Some have argued that masturbation constitutes

practice for sexual fantasy, which is more common in better-educated groups. Equally possible, among males, is the use of masturbation for practice in quickly reaching orgasm, which should be more common among those less highly educated. This suggests a hypothesis for future study, not covered by any investigation I know of: boys who end up in the working class should have masturbatory histories characterized more by a desire for quick ejaculation than boys who end up in middle- and upper-class jobs.

Zetterberg's (1969) and many of Simon et al.'s (1972) results are not included in Table 9 because they do not separate pre- from post-marital behavior. They are nevertheless consistent with the theory:

Zetterberg

LE, LJ, LPJ: only coitus last month (T IV:3)

UE, UJ, UPJ: coitus plus petting and/or masturbation in last month (T IV:3)

UE?, UJ?, UPJ?: much pleasure from coitus (T IV:4)

Simon et al.

UE: unusual coital positions (p. 241), more non-coital techniques (pp. 243-250, 760)

UE: prefer coitus in dark (p. 776)

UE: sex has been "marvelous" or "satisfactory" (p. 722)

LE: never talk about sexual problems (p. 552)

Other sexual behavior. For completeness, several miscellaneous sexual acts are listed in Table 10. There are many studies indicating a larger use of erotica and sexual fantasy at the upper socioeconomic levels, especially among males. (Merritt et al. 1975 found that this behavior does carry over to attitudes; the higher one's education, the more likely it is that one will call the effects of pornography largely desirable.) However, sex dreams, the use of erotica, and imagining one's coital partner to be someone else will not be subjected to biological analysis until the biological functions of fantasy are better understood.

Some conclusions can be drawn concerning the sexual socialization of one's children, however. The best study here is Sears et al. (1957); the Kinsey data are impressionistic, not precise, and the other studies each reported answers to a single question. (An unpublished manuscript, Maccoby and Gibbs 1953, controls for mother's education and ethnicity, finding that substantial class differences remain. This rules out one possible explanation proposed by Bell 1969.) The class differences in socialization regarding nudity and masturbation reflect the parents' attitudes towards what has been best in their own sex lives. They are thus not at all in conflict with the greater so-called "permissiveness" of the lower classes, as has been stated by some (Reiss 1965: footnote 33; Lindenfeld 1960: footnote 7). This "permissiveness" extends only to certain highly circumscribed behaviors; other groups are more "permissive" in other areas.

However, the ultimate causes of the differences regarding sex play with other children and what children should be taught about sex might be deeper. Trivers' paper (1974) on parent-offspring conflict argued that conflict between parents and offspring is an expected feature of sexual reproduction. Indeed, the argument of Figure 3 is applicable here. When resources are scarce, small changes in allocation among offspring are exceptionally effective in affecting total parental reproductive success; conflict over the allocation of these resources is expected to be large. Marriage of an offspring usually represents a sharp decrease in the rate of parental investment in that child--especially in working-class families. Factors that help the parent control the marriage of an offspring are thus relatively more valued by low-income parents than by high-income ones. Withholding information about sex from an offspring reduces the possibility that the offspring's love or other considerations will get in the way of the parents' decision.

At the moment, this line of argument is highly speculative. It has a wealth of consequences, however, many of which could be tested in future research.

Sexual patterns over time. Hunt (1974) made a series of comparisons between the data he gathered in the early 1970's and the data the Kinsey group gathered in the 1940's. (He was careful to compare his sample, which is disproportionately

college- and high-school-educated, with only the corresponding better-educated portions of the Kinsey group's sample.) If we assume American society has progressed to the point where income streams are in all classes more predictable, then we would expect America's sexual pattern to have correspondingly shifted to a pattern biologically better adapted to that predictability. Indeed, we find the following pattern:

> Marital sexuality: married couples are engaging in longer periods of foreplay, more manual breast play, more manual penile contact, more mouth-breast play, more fellatio and cunnilingus, all especially so at lower educational levels (pp. 195-198).
>
> Premarital sexuality: unmarried couples are engaging in more "variant" coital positions and more premarital coitus; there is probably a decrease in the percentage of those restricting premarital coitus only to a fiancé(e). Upper-educational levels have especially increased the second, and lower educational levels the first (pp. 138, 151, 167). However, all levels have decreased exposure to prostitutes (pp. 144-145).

The decrease in prostitute contact shows that the above pattern cannot be accounted for simply by a change in religiosity (low religious devoutness is associated with an increase in <u>all</u> sexual outlets, prostitution included) or other general "permissiveness" parameter. On the other hand, if the thesis presented in this paper is correct, the higher

coital rates of college students stick out like a sore thumb in Hunt's study, and must be explained. College students are fairly well studied, luckily; virtually all studies have confirmed that college students are indeed showing higher rates of premarital intercourse, the change occurring mostly in the late 1960's (Cannon and Long 1971; Christensen and Gregg 1970; Bell and Chaskes 1970; Vener and Stewart 1974; Robinson et al. 1968, 1972; Bauman and Wilson 1974a). It was precisely in the late 1960's when reliable contraceptives first began to be easily available. Such availability radically alters the biological significance and dangers of coitus. Returning to the logic of the premarital experience section, "reason two" leads to the prediction that upper-level individuals (students) will prefer petting to coitus in pair-bond formation activities. Effective, easily available contraception should result in the partial substitution of coitus for petting to orgasm. All available evidence is consistent with this conclusion; unfortunately, there is little of it. Hunt (1974:137,151) stated that petting "is an acceptable compromise for a shorter period of time than formerly," and that the young of today are "handling premarital intercourse much as the young of a generation ago handled petting." Moreover, the premarital coitus increase observed in the Bauman and Wilson study (1974a) was accompanied (Bauman and Wilson 1974b) by a sharp increase in the use of the pill as a contraceptive and a sharp decrease in the use of withdrawal.

(Withdrawal is, of course, virtually an example of petting to orgasm.) Finally, Vener and Stewart (1974) reported that in their high school sample, significant increases occurred in coitus but not in any of several levels of petting. They concluded that "To use change in coital activity as the sole indicator of change in other levels of sexuality is apparently unjustified." This paper has reached a similar conclusion; one's sexual behavior is not adequately described as a single point along a "permissiveness" scale.

One final point is worth considering. When the average level of income unpredictability rises, it is the working classes that should first show the effects. The only source I have been able to find on this question is Shorter (1971), whose study is marred by an apparent ignorance of the complex set of increases and decreases expected. Nevertheless, he found that "in England and Western Europe . . . roughly between the middle of the eighteenth and the end of the nineteenth centuries, . . . a revolution in eroticism took place, specifically among the lower classes, in the direction of libertine sexual behavior," by which he mostly meant illegitimacy. This clearly shows that a simple cultural-diffusion model, where the better-educated classes are the first to perceive the need for a change which then filters down to those less highly educated, needs revision. If this was a period of increasing income unpredictability, then Shorter's observation is consistent with the theory presented in this paper.

Sexual patterns between cultures. Only in West Germany are data available for considering changes over time in sexual behavior as a function of social class. Schmidt and Sigusch (1972) gathered data from their studies of 10 years earlier and found that sharp decreases in age at first coitus occurred in both upper and lower educational groups, but much more so in the upper ones. They also found that the use of various petting techniques increased sharply at lower educational levels. Unfortunately for our purposes they had not asked these latter questions of their upper educational group, and so the prediction that changes should have been much smaller for them remains untested for West Germany. These authors do not believe the changes they measured can be accounted for by increasing acceptance of the pill, however:

> "The difficulties involved in obtaining the pill for girls under 18 are so great that this problem alone negates the significance of the pill with respect to youth sexuality."

There are, however, other forms of contraception; at about the same time as the pill came increased acceptance of abortion and increased availability of other contraceptives. Clearly, further study is required to resolve this issue for the West German samples.

Tables 8 and 9 show that class differences between American and Western European populations lie in the same direction. They were not designed to show that the baseline figures are quite different. Sigusch and Schmidt (1971)

found, in fact, that the European populations resemble one another quite closely, showing relatively small class differences and baselines in the direction of what the present paper would describe as a high income-predictability environment. Sigusch and Schmidt explain these differences as follows:

> ". . . both those members of the lower-lower class which Rainwater studied in the U.S.A. and those individuals studied by us belong to the most underprivileged sixth of the members of their respective societies. Nevertheless, there are considerable differences in their standards of living. Rainwater (1965:24) describes his sample as follows: ' . . . often they work only intermittently or are chronically unemployed . . . Although they may earn fairly good wages when they work . . . , the seasonal or intermittent nature of their jobs and their relatively impulsive spending habits often prevent them from maintaining what most Americans regard as a "decent" standard of living.' By contrast, the individuals investigated in our study had a steady job, were continuously employed, and did not live in slums; they were neither threatened in terms of their material existence nor socially insecure to the same degree applicable to the American workers of the lower-lower class.
>
> "Therefore, the differences in sexual behavior and in sexual attitudes between the American and the West German as well as the Scandinavian lower-lower class can be imputed to their differing socioeconomic situation. What we have described as the Scandinavian pattern of lower-class sexuality is actually the pattern of the 'stable working class' or affluent workers; what we have described as the American pattern is the pattern of the 'unstable working class' or nonaffluent workers." (Sigusch and Schmidt 1971:42-43, incorporating corrections included by the authors with a reprint).

Clearly, then, the West German situation constitutes a "control" for the effects of income versus income unpredictability--the low-income workers there have high income predictability, relative to those in the United States. Indeed, while unemployment is common in the U.S., in most western European

countries there is the reverse--more job vacancies than there are people willing to fill them. The theory presented in this paper predicts that the foreign migrant workers now causing social upheaval in Europe should show sexual and marital patterns quite similar to those Rainwater found in the lower-lower class here. (A profile of one such migrant-worker family, published after this passage was prepared, confirms this--Kramer 1976:70, 74-76, 78, 83.)

Rainwater (1965) did make some controls by the degree of jointness of the CRR (conjugal role relationship). To the extent that this is a proxy for income unpredictability, class differences should disappear (or at least be drastically reduced, to allow for inexact "proxying") when the CRR jointness is controlled. For the data we used from Rainwater (see Table 6) it is indeed true that the middle-class patterns (which are all joint and intermediate CRR's) are very close to the lower-class intermediate patterns, with the segregated lower-class patterns standing out as sharply different (Rainwater 1965: Tables 3-1, 3-2, 3-5, and 3-6). Likewise, Eliasson (1971:3) found that "among those who state that their parents are happy together, the occurrence of expressions of affection is unrelated to socioeconomic group" (misspelling corrected). In this respect, then, the so-called "class differences" in sexual behavior might more accurately be referred to as "income predictability differences." In future studies, a more direct measure of income unpredictability should provide more careful verification.

Non-cross-sectional studies. There are several studies which attempt to describe the sexual habits of groups of people, without dividing them according to class or racial subgroups.

Rainwater (1964) compared his own studies with those of others (Lewis 1951, Slater and Woodside 1951, and Stycos 1955). In these "four cultures of poverty" he found a great degree of similarity--wives who characterized their sexual needs as weak, highly segregated conjugal role relationships, low tolerance for casual nudity in the home, a low level of sex information given to children (especially females), a low degree of mutuality in sex relations, a common expectation of extramarital relations for the male (in two of the cultures this was not studied), and the existence of a "good girl/bad girl" dichotomy (women who dislike sex are good and become wives; women who like sex are promiscuous and prostitute themselves). Rosenberg and Bensman (1968) studied three "American underclass" cultures. Among the poor whites of Appalachian origin in Chicago, they found the good girl/bad girl dichotomy, and a slight tendency away from the sex-segregated pattern of recreation that is common after marriage. Among Puerto Rican youth living in New York City, they found "uninhibited foreplay" at certain parties, and disgust for highly promiscuous "street girls." Among poor blacks living in Washington, D. C., they found a large, imperfectly understood knowledge of contraception and reproduction learned from school, but a decided unwillingness to talk to parents about it. In all three groups, they found

that "victory" for the young male consisted of "overcoming the largest possible number of inaccessible girls," and that "contraception was overwhelmingly declined by males only slightly more than females." (The sex instruction received in Washington, D. C., resulted in the black youths knowing "just what it is they habitually decline to use.") This finding suggests that as premarital coital patterns converge between classes, the occurrence of intercourse with or without contraception might serve as a good indicator of the relative importance of coitus-as-pair-bond-formation and coitus-as-achieving-immediate-reproductive-success. Hammond and Ladner (1969) studied a group of about 75 Negro adolescents in a St. Louis housing project and found that "Only a few boys and fewer girls ever consider protection. At least half of the adolescent females in our sample had adequate knowledge of the various types of contraceptives and ways in which they could be used. Indeed, one fourth of the girls could describe in sophisticated language how each of the contraceptives we listed was to be used. Despite this knowledge, the majority of girls do not use them." LeMasters (1975) studied a group of relatively successful blue-collar workers in the construction trades. He reported the continued existence of the good girl/bad girl dichotomy (p. 95), segregated CRR's (p. 89), and early end to virginity in both sexes, but especially males (pp. 93-95), the absence of love from sex (p. 96), the higher status acquired by seducing a "good"

woman than a promiscuous woman or prostitute (p. 97), and the belief that most wives are uninterested in sex (p. 43). LeMasters felt his sample was biased towards those men with more segregated CRR's (p. 89), but this is irrelevant here since a precise class comparison is not made. Whyte's (1943) classic study of young men in an Italian slum in an east-coast American city found the good girl/bad girl dichotomy, men believing that their health depended on coitus at certain intervals, male sexual behavior after marriage a continuation of that before marriage, and women wanting to marry up the socioeconomic scale. Fried (1973:135-136) studied a random sample of working-class Boston residents and found high rates of extramarital intercourse among the men and low rates among the women, a low appreciation of female sexuality, and separate social activities for men and women. Spinley (1953:57-62) interviewed London slum residents and found separate sets of same-sex friends for the men and women (among both parents and adolescents), that "sex is considered purely an outlet for the man" and was not pleasant for the woman, that no sex information came from the parents, and that boys changed jobs often. Staples (1973:62) found that upper socioeconomic status blacks engage more in oral-genital relations than working-class blacks. Shah et al. (1975) found that when unwed American teenaged mothers were asked to explain their nonuse of contraceptives, poorly-educated girls and blacks were more likely to reply that they wanted a baby; among those not pregnant,

whites and those more highly educated were more likely to have always used contraception. Likewise, Leppo et al. (1974) found that lower-class Finnish men and women were more likely to have never used contraception or to have used only withdrawal.

On the upper-class side, there are virtually no studies. There is one source, however, on what are apparently upper-class mores in 16th-century Italy (Aretino 1536). Pomeroy (1972:470) said that this work "outlined exactly the same differences" as the Kinsey group found in the 1948 volume. This is almost the case; Aretino's work described upper-class men (upper-class enough to have servants) as enjoying sexual acts including deep kissing, naked coitus, breast fondling, clitoral manipulation, many different coital positions, manual manipulation of the penis, elaborate foreplay, and oral-breast contact. (A nobleman adds love bites to this list.) Working-class preferences were not described in detail; there was, however, one reference to "young louts" who are "unstable" and must pay prostitutes in advance; they were said to "fall in love and then out of love as fast as they meet new women to love." In the absence of carefully controlled sociologic studies, a fictional source such as Aretino's is probably the best that can be expected; the dangers of using fiction to infer fact are acknowledged. (The portrait of Stanley and Stella Kowalski in A Streetcar Named Desire, by Tennessee Williams, for example, shows the working-class

couple with a highly segregated CRR in daily life but a highly joint relationship in the sexual sphere.) The probability of this source's portrait of upper-level sexuality being correct is incrased by the fact that it was addressed to Aretino's patrons, themselves upper-class. Its description of upper-level acts might thus be expected to reflect upper-level fantasies, while its description of lower-class characteristics might be expected to reflect upper-level prejudices.

In theory, anthropological studies might provide large amounts of material for testing the theories proposed in this paper. However, most studies have not turned out to be useful, perhaps because the investigators were more interested in reporting the cultural norm, instead of what actually occurs--rather like trying to infer class differences in American marriage patterns from reading books about bridal etiquitte. One study does seem worthwhile to report, however: Newcomb (1961:301) found that among the lower socioeconomic strata of the Caddo Indians, divorce and remarriage occurs on the "flimsiest of grounds."

It is clear that the parameter "social class," or income unpredictability, has many consequences that reverberate in a multiplier effect (Wilson 1975:11). Behavioral dimorphism is indeed more widespread among working-class people (Rainwater 1965; LeMasters 1975; and many others). Such conventions need not have any rational connection to biological

function of the sexes, although if such rational connections exist they would tend to strengthen the tendency. Those attempting to understand sexual dimorphism patterns in employment, fashion, and other fields should note that although the particular conventions may indeed be culturally determined, the tendency to follow or ignore those conventions may in addition be influenced by factors best understood in a biological light.

THE DEVELOPMENT OF SEXUAL PATTERNS IN INDIVIDUALS

It has already been shown that one is most likely to show the sexual pattern of the class one moves into rather than the class one's parents started one off in. At first glance, this might indicate the effectiveness of sexual socializing agents in the acquired class, but the data indicate a more subtle situation exists. The Kinsey group found (1948: ch. 11; 1953:297) that not only do those who move from one class to another (between childhood and early adulthood) show the pattern of their acquired class, they start doing so long before they change class! One of Kinsey's collaborators (Pomeroy 1972:469) believed as recently as 1972 that this is a phenomenon that deserves to be reinvestigated today. More recently, Pomeroy felt (personal communication) that recent decreases in social class differences make the point "much less clear-cut." In any case, the earlier data remain to be explained.

I can conceive of several explanations for such a result.

First, one might hypothesize that people differ innately (whether genetically or through very early, irreversible childhood socialization) in their sexual habits, and the class one ends up in is causally related to those habits. That is, those sexually unsuited for a certain class are excluded from it by life events. Certainly the genetic half of this hypothesis seems unlikely. There is so much interclass

migration in the U.S. (Blau and Duncan 1967; Kinsey et al. 1948:328) that genetic differences should be few.

Second, it may be argued that "Families that train their children for eventual mobility, . . . through a process of anticipatory socialization, also teach them the mores, including the sexual codes, thought to be appropriate for 'higher' social positions" (Lindenfeld 1960). (Lindenfeld confirmed for a college group the finding that those upwardly mobile are slightly more coitally restrained than those whose parents started them off at upper levels.) While this may indeed be the case in certain individuals (Kinsey et al. 1948:440-441), the Kinsey group rejected this as a general explanation. The very fact that people were surprised to learn of class differences in sexual behavior indicates that such behavior patterns are not well known--and are even greatly distorted--outside the class they occur in. Moreover, "Some of the most fundamental distinctions between the social levels are already discernible in pre-adolescents as young as 3 and 4" (1948:441). This explanation also fails to explain certain exceptions to the general principle--individuals whose lives are directed at being class A, unexpectedly end up in class B, and show class A's sexual behavior pattern. There is an age limit to this occurrence; it is much more common among those whose unexpected move occurs after the late teens (1948:436ff). Accommodation to the mores of a new

group should, according to this hypothesis, be possible at any age. A biologically oriented theory, in contrast, can accommodate this finding with ease, just as one explains, say, degenerative diseases of aging (see below).

The third theory is the one advocated throughout this paper. It proposes that the predictability of one's resource stream has varied over the short term for evolutionarily significant periods of time. It then proposes a built-in genetic mechanism which gives the developing organism a sensitivity to the unpredictability it can expect to find itself in as an adult, and produces the necessary fine tuning of reproductive strategy according to what its sensors "guess" about the future. It predicts correlations with class and racial status not because of any inherent differences in those groups, but because of the empirical correlation of income unpredictability with them. If this mechanism is correct, then it should be less precisely adjusted the less evolutionarily common a given situation is. Sudden, unexpected changes in class status, like very aged people, are indeed rare events, and it is not surprising that a genetic mechanism is not able to cope with them with complete effectiveness. Note that this genetic mechanism is quite different from the one proposed as the first explanation above. This third theory postulates same genes, different effects in different environments, and different results; theory one above postulates different genes and different effects regardless of environment.

The fourth theory is not completely inconsistent with the third, but it is also the strongest competitor. It proposes that precisely those differences in behavior that seem to presage the group one will move into are the behaviors that cause the movement into the group. For example, a girl who is highly promiscuous in the absence of contraceptive use will probably have an early pregnancy, resulting in an early age at marriage and little chance for a college education. Likewise, the boy who resists coitus and masturbates a lot is, as a direct result, less likely to have to get married early and more likely to be able to go to school longer and get a better job. This theory has three difficulties with it. First, it cannot explain racial differences in sexual behavior. Second, it does not explain why a whole group of activities seem to vary together--why working-class couples are most likely to have coitus with their clothes on, why the husband is more likely to go to prostitutes, why the woman finds sex distasteful while her better-educated sister enjoys it more but has less of it. It is conceivable that a set of ad hoc explanations could be the cause of these united consequences, but it seems unlikely. Third, this theory is evolutionarily naïve. If early marriage, say, is a cause of entry into the lower-class status groups, then natural selection begins to select against those who are susceptible to the cause of the "mistake." The assumption that man's high learning and socialization capabilities make

him resistant to such genetic influences in these matters, while often made, is certainly unproven and probably not true (Alcock 1975). Even a total acceptance of the third (biological) hypothesis would not, however, make it impossible for "mistakes" to be made. The point is that it is evolutionarily much more believable to reason that "mistakes" made by millions of people are not mistakes. (It is also more palatable to some to conclude that working-class behavior has a certain dignity and validity of its own, being more than a puppet's reaction to conditions imposed from the outside.) These actions may be better understood as positive adaptations made by the persons involved (with the help of the brain their genes gave them) to the conditions their society has placed them in.

Perhaps one final example will clarify the issues. Masters and Johnson (1970) considered the development and treatment of premature ejaculation, a pattern that we would expect to be more common at the lower socioeconomic levels because it is consistent with the marital pattern of much of that group. (A premature ejaculator is defined as a man who "cannot control his ejaculatory process for a sufficient length of time during intravaginal containment to satisfy his partner in at least 50 percent of their coital connections.") Clearly, it would also be of advantage in pursuing a more opportunistic reproductive strategy. Masters and Johnson noted that the sexual histories of premature ejaculators

have "a consistently familiar pattern," involving their being imprinted on early sexual contacts requiring speed in ejaculatory release--prostitutes, furtive teenage petting, and withdrawal just before orgasm. The human male is apparently susceptible to being imprinted on such a quick-release pattern, but not on many other patterns. For example, many teenagers have their first several sexual experiences in the back seats of automobiles, yet I know of no report of a syndrome in which a person is unable to attain sexual satisfaction without fantasizing about vinyl, or automobile seats, or drive-in movies. The biological theory proposed here would explain why human males are more susceptible to premature ejaculation, but not to vinyl-and-drive-in-movie fetishes--or why women are susceptible to frigidity rather than reaching orgasm too soon.

Clearly, a resolution between these various theories will not be achieved until a properly controlled longitudinal study is done, if only to rule out the possibility of retrospective distortion. What I hope to have established is that the biological theory is an extremely viable one--perhaps even the most likely one--and that it deserves to be tested further.

SUMMARY

Social class and racial differences in family size, marital patterns, and heterosexual behavior can be considered adaptive from an evolutionary perspective. The expected unpredictability of one's future income stream is an important parameter influencing these variables, according to theoretical considerations. The literature is reviewed relevant to the prediction that those facing more predictable income streams should have a higher investment per offspring (and thus fewer offspring), a stronger marital pair bond, and premarital sexual activities more likely to lead to a strong pair bond, all other things being equal. It is shown that those with high education or high occupational status do indeed have more predictable income streams, and show the predicted consequences of that fact. Middle-class blacks have less predictable income streams relative to middle-class whites, but working-class blacks and whites do not differ in income predictability; the few studies of racial differences in the predicted variables support the theory. In the extremely few cases (three) which permitted it, it was found that a correlate of income unpredictability was more important in determining the dependent variables than either race or class, as expected. Alternative explanations of the data were briefly examined and found wanting, especially with respect to explaining the patterns of individuals whose

parental class was different from their own; the dependent variables agreed much better with the subject's class than with parental class.

ACKNOWLEDGMENTS

For much discussion of versions of this paper and much encouragement throughout I think my advisor Robert Trivers. I thank Carl Bajema, Joel Cohen, Mary Corn, Irven DeVore, Don Hickey, Bert Hölldobler, Russell Lande, and Lee Rainwater for comments and suggestions on earlier drafts. J. Ruben (Playboy Press) and W. C. Wilson kindly provided access to some unpublished data. For help with translations I thank Peter Tscherning (Danish and Swedish), Helen Weinrich (Dutch), Pirjo d'Agostino (Finnish), and Edward Pollock (Russian). The Harvard University biology department supported me on a trip to the Summer Course in Human Sexuality and Sex Education presented by the Institute for Sex Research, Bloomington, Indiana, in June 1974. Joan Brewer of that Institute provided some helpful references. Much of the research for this paper was done while I was supported by a National Science Foundation pre-doctoral fellowship.

TABLE 1

PERCENT OF MEN IN EACH OCCUPATION GROUP WITH VARIOUS SORTS OF WORK EXPERIENCE, BY RACE, 1973

(Calculated from U.S. Department of Labor, 1973, Table A-5)

	Whites				Non-Whites			
	Percent distribution of those with work experience at full-time jobs			Percent with part-time jobs, of all with work experience	Percent distribution of those with work experience at full-time jobs			Percent with part-time jobs, of all with work experience
	50-52 weeks	27-49 weeks	1-26 weeks		50-52 weeks	27-49 weeks	1-26 weeks	
Professional, technical, and kindred workers	87%	8%	5%	7.7%	83%	10%	7%	9.0%
Managers and administrators, except farm	90	7	3	4.3	79	15	6	5.0
Sales workers	82	13	6		70	20	10	22.8
Clerical and kindred workers	81	9	10	12.9	79	9	12	6.5
Craft and kindred workers	77	16	7	5.7	73	20	7	5.1
Operatives, except transport	70	17	13	9.8	70	16	14	6.2
Transport operatives	75	17	8	9.3	76	14	10	8.0
Laborers, except farm	52	22	26	27.1	51	26	23	22.4
Service workers, except private household	74	12	14	29.1	74	9	17	22.1

TABLE 2

Correlation of fertility with husband's income for white wives aged 45-54, broken down by husband's occupation and education and wife's age at marriage. Fertility is children ever born per 1000 white women married once with husband present, in urbanized areas, 1960. "+" = positive correlation; "-" = negative correlation; "?" = uncertain.

Husband's occupation and education, 1959	Wife married age 14-21	Wife married age 22+
Professional, technical, and kindred		
College 1+	+?	+
High school 1-4	-	+
No high school	-?	+?
Managers, officials, and proprietors		
College 1+	-?	+
High school 1-4	-	+
No high school	-	+
Clerical, sales, and kindred		
College 1+	+?	+
High school 1-4	+?	+
No high school	-	+
Craftsmen, foremen, and kindred		
College 1+	-?	+
High school 1-4	-	+
No high school	-	+?
Operatives and kindred		
College 1+	+?	+
High school 1-4	-	+
No high school	-	-?
Laborers, except mines		
High school 1-4	-	-
No high school	-	-?

Each entry in table is based on 2, 3, 4, or 5 fertility figures for an equal number of income brackets. Direction + or - was determined by comparing fertilities of highest and lowest income brackets. A "?" was added if there were only 2 data points to judge; if there were 3 or 4 data points and one exception to monotonic progression from low to high fertility; or if there were 5 data points and two exceptions to monotonicity. (Calculated from Kiser et al. 1968, Table 11.3.)

TABLE 3

SOCIAL CLASS AND CONJUGAL RELATIONSHIPS

Class	C.R.R.'s			(N)
	Joint	Intermediate	Segregated	
Upper-middle	88%	12%	0%	(32)
Lower-middle	42	58	0	(31)
Upper-lower				
whites	19	58	23	(26)
negroes	12	52	36	(25)
Lower-lower				
whites	4	24	72	(25)
negroes	0	28	72	(29)

From Rainwater (1965), Table 2-1. Chi-square P less than .005, with races combined for test.

TABLE 4

SOCIAL CLASS AND FAMILY PROBLEMS

Men	Whites				Negroes	
	Upper middle	Lower middle	Upper lower	Lower lower	Upper lower	Lower lower
Money and job instability	26%	46%	63%	76%	59%	83%
Other problems	74	54	37	24	41	17
Those with problems as percent of total	77	87	92	87	92	71

Calculated from Rainwater (1965), Table A-8. No chi-square reported.

TABLE 5

STUDIES OF SEXUAL BEHAVIOR BETWEEN SOCIAL CLASSES AND RACES

source	country	year data gathered	number M	number F	data-gathering method	remarks
Kinsey et al. (1948)	U.S.A.	1938-1946	5300	0	I	whites; all ages
Kinsey et al. (1953)	U.S.A.	1938-1949	0	5900	I	whites; all ages
Gebhard et al. (1958)	U.S.A.	1939-1956	0	9585	I	blacks & whites; all ages
Bell (1968)	U.S.A.	1942-1949	496	498	I	blacks; all ages
Bell (1969)	U.S.A.	1938-1949	6000	0	I	whites; all ages
Maccoby & Gibbs (1953) / Sears et al. (1957)	U.S.A.	1951-1952	0	379	I	mothers' reports
Kanin (1960)	U.S.A.	c. 1957	0	177	Q	married whites
Rainwater (1960, 1965)	U.S.A.	c. 1959	202	207	I	blacks & whites; married
Christensen (1960)	U.S.A.	1905-1941	4222	4222	RL	Utah, Indiana, Ohio
Christensen (1963)	US+Denmark	1905-1941	7787	7787	RL	same + Copenhagen
Reiss (1965)	U.S.A.	1959	500	500	Q	blacks & whites; random sample from selected high schools & colleges
Bumpass & Sweet (1972)	U.S.A.	1970	0	5442	I	national random sample of ever married white women under 45
Kantner & Zelnik (1972)	U.S.A.	1971	0	4611	I	blacks & whites; national random sample of teenage girls
Vener et al. (1972)	U.S.A.	1969	2131	2089	Q	white high school students
Hall & Wagner (1972)	U.S.A.	c. 1971	109	120	Q	college students in human sexuality course
Hunt (1974)	U.S.A.	1972	982	1044	Q	blacks & whites; all adult ages
Wilson (1975)	U.S.A.	1970	911	1370	Q	blacks & whites; national random sample of adults
Udry et al. (1975)	U.S.A.	1969-1974	0	6000	I	blacks & whites; random area sample of low-income urban neighborhoods
Levin (1975)	U.S.A.	1974	0	18349	Q	national magazine questionnaire
Mann (1967)	Canada	1965	80	40	Q	random sample of one university
Schofield (1965)	England	c. 1963	934	939	I	random sample of adolescents
von Friedeburg (1953)	Germany	1949	493	517	I	quota sample of Germans over 20 years
Schmidt & Sigusch (1971)	Germany	1966-1969	545	362	I,Q	university students and same-aged workers
Simon et al. (1972)	France	1970	1250	1375	Q	representative national quota sample of those 20 years and above
Jonsson (1951)	Sweden	1942-1943	968	728	Q	M: compul. mil. serv., 20 & 40 yrs.; F: lecture attendees + various
Zetterberg (1969)	Sweden	1967	1011	989	I,Q	stratified probability sample of 18-60-year-olds
Israel et al. (1970) / Eliasson (1971)	Sweden	1966	663	634	I	probability sample of Stockholm adolescents
Auken (1953)	Denmark	1944-1947	0	315	I	non-chronic hospital patients
Hertoft (1968, 1969, 1970)	Denmark	1963-1965	2532	0	I,Q	random sample of 18-19-year-olds at compulsory military exam
Olsen (1974)	Greenland	1967-1968	244	255	I	random sample of 15-19-year old eskimos from S. Greenland
Leppo, Sievers et al. (1974)	Finland	1971	912	1490	I,Q	national random sample
Deggeller et al. (1969)	Holland	1968	585	699	Q	stratified probability sample of 21-64-year-olds
Hart (1975)	Australia	1970	670	0	Q	random sample of Vietnam soldiers + those at V.D. clinic
Malhotra & Wig (1975)	India	c.1973	107	0	I	stratified random sample of 30-50-year-olds in N. India town
Asayama (1975)	Japan	1950-1956	248	c900	I,Q	adults & students; summary of earlier studies

I Interview Q Questionnaire RL Record Linkage

{studies in brackets refer to essentially the same data base}

TABLE 6

SEXUAL BEHAVIOR WITHIN MARRIAGE

source	long foreplay	intercourse with female above	wife has regular orgasm	fellatio and cunnilingus	masturb. after marriage	wife has + attitudes tow. sex	equal enjoy't of sex	other
Rainwater (1965) (M, F)						US (T 3-1) B?? (T 3-2)	US (T 3-5) B? (T 3-6)	LS: wife agrees sex is woman's duty (T 3-8) LS: husband says wife likes sex more than she says (T 3-8)
Kinsey et al. (1948) (M)		UE (T 95)		UE (T 93)	UE,UJ (p 341)			LE: marital coitus as % of total, ages 26-ff (T 97) UE?: marital coitus as % of total, ages 16-25 (T 97) UE: nudity in marital coitus (T 95)
Kinsey et al. (1953) (F)	UE? (p365)		UE,0PJ (Fg 66)	UE?? (T 100)	UE,0PJ (p 148ff)			UE: nudity in marital coitus (T 101)
Bell (1968) (M, F)								W: nudity in sleep (p 9)
Bumpass & Sweet (1972) (M, F)								LE: first marriage more unstable; (M*) (F§)
Hunt (1974) (M, F)	0E (p 201)	0E? (p 202)	0E,0J (p 214)	UE (T 32) W (p 198)				
Sievers et al. (1974) (M, F)	UE (p 335)	LE? (T 6:27)						UE?: wife had orgasm last coitus (T 6:28) UE?: last coitus pleasant (T 6:33) LE?: high current coital frequency (T6:24)
Asayama (1975) (M, F)	US (p 104)	US (p 104)						LE: first marriage more unstable (T 6:5)
Hart (1975) (M)				UE (p 218)				
Deggeller et al. (1969) (M, F)								US: agree masturbation can be normal after marriage (p 25) U3(F): "fully satisfied" at last coitus (p 73) LS: don't know how satisfied spouse was at last coitus (p 77)

L: occurs more in lower
U: occurs more in upper
W: occurs more among whites
B: occurs more among blacks
0: does not significantly differ by
blank: difference unreported

PJ: paternal job status level
PE: paternal educational level
S: own socioeconomic level
J: own job status level
E: own educational level

* difference somewhat reduced with control for wife's age at marriage

§ difference strongly reduced with control for wife's age at marriage

?: difference is small or shows minor exceptions to trend
??: important differences occur in opposite direction among some groups

F: females reported in this study
M: males reported in this study
F+M: male and female figures added in this study

The source for each entry appears in parentheses underneath the reported correlation.
T: Table of source p: Page of source Fg: Figure of source

TABLE 7

EXTRAMARITAL INTERCOURSE

source	active incidence, early ages	active incidence, later ages	ever, early ages	ever, later ages	other
Kinsey et al. (1948) (M)	LE* (T 86)	OE?* (T 86)			LE: with prostitutes, early & late ages (T 87) J breakdowns similar (p 355)
Kinsey et al. (1953) (F)	OE* (Fg 77)	UE* (Fg 77)			PJ breakdown similar (Fg 77)
Hunt (1974) (M) (F unreported)	LE (p 259)	OE? (p 259)			
Levin (1975) (F)			LE	UE	
Zetterberg (1969) (M+F)	LE (T II:11)	UE (T II:11)			
Simon et al. (1972) (M, F)			LE (M) OE (F) (p 694)	UE (M) OE (F) (p 694)	
von Friedeburg (1953) (M, F)					OE: ever extramarital (p 69)
Sievers et al. (1974) (M, F)					OE: ever extramarital (T 6:39)
Deggeller et al. (1969) (M)					US??: ever extramarital (p 194) middle S??: never with prostitute (p 123)

* coitus with companions

Other symbols as in Table 6

TABLE 8

PREMARITAL SEXUALITY
(UNITED STATES)

source	low age first masturbation	high masturbation frequency	low age first coitus	high coitus frequency	high petting active incidence	elaborate petting techniques	other
Kinsey et al. (1948) (M)	OE (T 82)	UE (T 82) UJ (p 341) OPJ (T 108)	LE (T 85)	LE (T 85) LJ (p 351) OPJ (T 111)	UE* (T 84) UJ* (p 347) OPJ (T 110)	UE (p 540)	LE, LJ, OPJ: coitus with prostitutes (T 87, p 601, T 113) OE, UJ, OPJ: petting to orgasm freq., of those active (T 84, 110) LE: high number of coital partners (p 557) LE: ever premarital coitus (T 85)
Kinsey et al. (1953) (F)	UE (Fg 13) OPJ (T 28)	UE (Fg 14) OPJ (T 29)	LE§ (Fg 46) LPJ§ (Fg 49)	OE (p 296)	LE*§ (p 239) OPJ* (p 242)	UE (p 252-9)	OE*, OPJ*: high petting frequency (p 241-242) UE§: ever premarital coitus (p 293)
Gebhard et al. (1958) (F)			LE (T 17) B (T 63)				
Bell (1968) (M, F)			B (p 11)	B (p 11)		W (p 11)	B: more orgasm in coitus (p 11) B(M): coitus source of first orgasm (p 11)
Kanin (1960) (M, F)							LPJ(F), OPJ(M): coitus with spouse before marriage
Christensen (1960, 1963) (M, F)							LJ: high percentage of first births premaritally conceived (1960) LJ: parenthood early in marriage (incl. premar. conc.) (1963)
Reiss (1965) (M, F)							OPJ: ever premarital coitus (footnote 25)
Vener et al. (1972) (M, F)			LPJ¶ (T 5,6)				
Kantner & Zelnik (1972) (F)			B (p 12)				L-poverty-status, LP-income, LPE (among B): more premar. coitus among W: same trend??
Hall & Wagner (1972) (M, F)			LPE?? (T 1)				
Hunt (1974) (M, F)	OE,OJ (p 86)	OE,OJ (p 86)	LE(M) B(F) (p 149)				LE(M): coitus with prostitutes (p 144) B(M): coitus with prostitutes (p 145)
Wilson (1975) (M, F)	UE (T 3)		LE† (T 3)				LE(M): never masturbated (T 3)
Udry et al. (1975) (F)							B, LE, OPS: ever premarital coitus

* petting to orgasm

¶ here, PJ is average job level of school community

§ difference disappears almost completely when age at marriage is controlled

† male relationship curvilinear, with high-school-educated most experienced. See text.

All other symbols as in Table 6

TABLE 9

PREMARITAL SEXUALITY
(FOREIGN STUDIES)

source	low age first masturbation	high masturbation active incidence	low age first coitus	high coitus active incidence	high in petting	elaborate petting techniques	other
Schmidt & Sigusch (1971) (M, F)	UE(M) OE(F) (T 2)	UE** (T 4)	LE (T 3)	LE (T 4)		UE† (T 5)	UE(M): high masturbation freq. (T 4) (F too few to tell) LE(M): high # of partners, of those coitally active (T 4) UE(F): orgasm regularity, with ** control (p 98-9) UE(F), OE(M): high median coital freq., active groups (T 4)
v. Friedeburg (1953) (M, F)							OE: ever premarital coitus (p 69)
Deggeller et al. (1969) (M, F)					US (p 192)		LS(M), OS(F): ever premarital coitus (p 192) LS: high coitus/petting ratio (p 192) LS(M): first coitus with mere acquaintance (p 193)
Schofield (1965) (M, F)			LPJ?? (p 43-7) OPJ (p 141) LE (T 9.1)		UE§ (T 9.1) UPJ§ (p 47,141)	UPJ* (p 26)	UE(older): earlier petting (p 49)
Mann (1967) (p 54) (M only?)				LP-income UPJ	UP-income¶ UPJ		

Simon (1972) (M, F)		UE†† (p 263)	LE? (p 202)				UE: ever masturbation (p 263); ? ever premarital coitus (p 224)
							??: first coitus with mere acquaintance (p208), # premarital partners
							LE(M): first coitus with friend known 1 year or more (p 208)

Hertoft (1968, 1969) (M)			LE,LJ,LPJ (T 2/VIII)	LJ,LE (T 3/XI)	UE,UJ (T 5/VIII)		UJ: first coitus with long-time friend (T 6/IX) LE, LJ, LPJ: coitus with prostitute (T 1/XIV)
Hertoft (1970) (M)							LJ?: short time between meeting girl and first coitus (T 15)
Jonsson (1951) (M, F)			LE(M) (T 1) LPJ(F) (p 197)				
Zetterberg (1969) (M+F)			LE,LJ,LPJ (T III:3)				OE, OPJ: length of acquaintance before & after first coitus (T III:5)
Israel et al. (1970) (M, F)			LE (T7, T 16, Fg 4) LPJ? (T 15)				
Eliasson (1971) (M, F)			LE LPS(F) (p 7)				UE, UJ: % with some masturbation (T 5:1) UPJ: no premarital coitus (T 5:4, T 5:3) UE, UJ?: never had coitus (T 7:5) LPJ: first coitus with mere acq. (T 5:11) LE, LJ: fiancée pregnant at marriage (T 5:18) } all Sievers et al.
Sievers et al. (1974) (M, F)			LE?,LPJ (T 5:9)				
Olsen (1974) (M, F)			LE,LPJ (T 65)				LE, LPJ: more than 10 coital partners (T 65)
Asayama (1975) (M, F)			LE (p 103)				

* deep kissing ** difference persists after control for coital experience
† manual-genital, fellatio, cunnilingus, nudity in coitus †† except older males
¶ text ambiguous; may be active incidence or frequency
§ those who stop at petting, not going on to coitus
Other symbols as in Table 6

TABLE 10

MISCELLANEOUS SEX-RELATED ACTS

source	forbid children's masturb.	accept nudity in home	dreams about sex	use of erotica	open disc'n of sex in home	learned of coitus early	other
Kinsey et al. (1948) (M)	LE (p 375)	UE (p 366)	UE,UJ,OPJ* (T 83,111)				incest: too few cases (p 558)
Kinsey et al. (1953) (F)			OE,OPJ (p 201)	UE(M)** (p 667)			UE(M): arousal from hearing erotic stories (p 670)
Bell (1968) (M, F)		W(F) (p 9)		W (p 9,11)		B(M) (p 11)	W: learn early about fertiliz., menst., and preg. (p 9) W: arousal by biting (p 9)
Bell (1969) (M)		UPJ (p 105)					
Hunt (1974) (M, F)							LE: agree "Masturbation is wrong" (p 75) UE: ever incest (p 347)
Wilson (1975) (M, F)	LE (T 2)		UE (T 5)				UE: ever imagined coital partner to be someone else (T 5) LE(M?,F): agree "When it comes to sex, there is a great difference between what most people do and what they would like to do" (T 1)
Mann (1967) (M only?)				UP-income UPJ (p 54)			
v. Friedeburg (1953) (M, F)							UE: agree children should be taught about sex (p 67)
Simon (1972) (M, F)		UE§ (p 266)		UE (p 842)	UE(M?,F) (p 544-7)		OE: sex in presence of a third person (p 260) UE: ever or in last year read sex education books (p 840) UE: should teach children about sex at early ages (p 560-3) UE: should teach children about contraception (p 566)
Deggeller et al. (1969) (M, F)					US (T 37, p 184)		
Hertoft (1968) (M)							UE: knew about & troubled by first noctural emission (p 111)
Hertoft (1968, 1969) (M)					UPJ,UPE (T 8/VI)		
Zetterberg (1969) (M+F)				UE (T V:5)		UE,UPS (T V:5)	UE, UPS: learned early of fertilization (T V:6)
Eliasson (1971) (M, F)		UPE§§ (p 3)					
Malhotra & Wig (1975) (M)					US (p 521)		LS: consider nocturnal emissions "abnormal" or "symptom of disease" (T I, II)

* dreams with orgasm ** in masturbation

§ saw parents naked §§ ever orgasm in sleep (? for young F)

All other symbols as in Table 6

Figure 1 -- The optimal amount of investment per offspring from the parents' point of view is P*. The dashed line is the line of greatest slope through the origin tangent to the curve relating parental investment (PI) to reproductive success (RS). Higher slopes increase the ratio of reproductive success obtained per unit investment in offspring. Since T lies on the line of highest possible slope intersecting the curve, its abscissa P* is the value of PI per offspring the parents should select to maximize their own total RS. From Smith and Fretwell (1974).

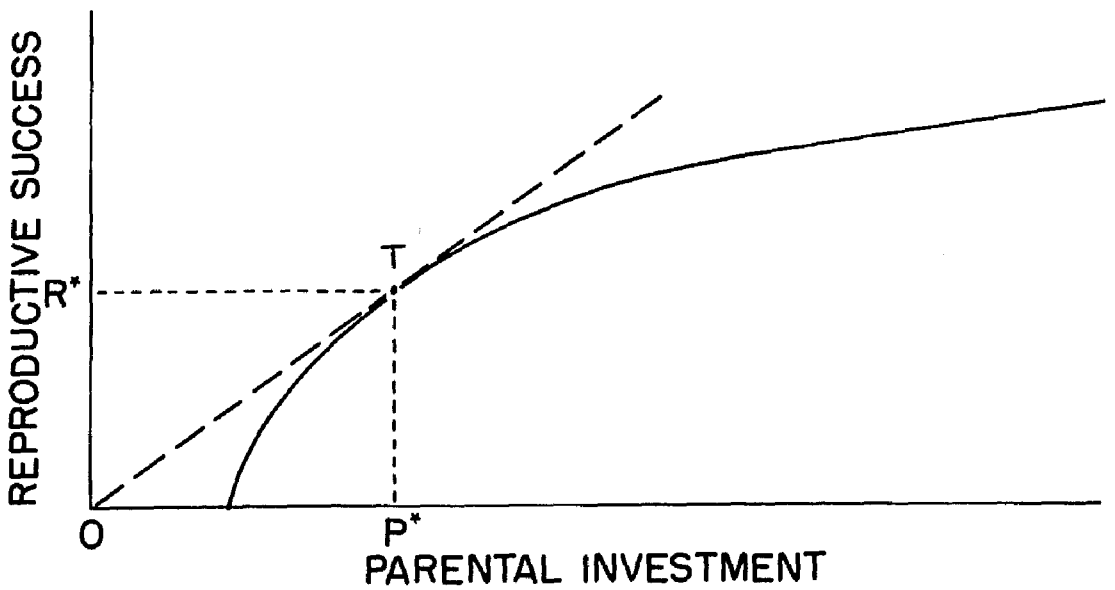

REPRODUCTIVE SUCCESS
R*
T
O
P*
PARENTAL INVESTMENT

Figure 2 -- The allocation of parental investment (PI) between two offspring. (A) is the curve of Figure 1, reversed around a vertical axis so the origin is the value of total PI available to the parents (Q); values of PI increase to the left. It represents the RS obtained by the second offspring when s units of PI are allocated to the first offspring (and Q - s are allocated to the second). (B) superimposes Figures 1 and 2A. The dashed line is the point-by-point sum of the two solid curves, and represents the total reproductive success (RS) of the parents for any given allocation of Q into s and Q - s. (C) is the same as Figure 2B, except the dashed line is half as high as the dashed line in Figure 2B, and is thus the average RS attained by the parents for a given allocation; this is easier to see without making careful curve measurements. (Clearly, maximizations in Figures 2B and 2C achieve the same result.) Here, maximum parental RS is attained at an equal allocation of PI between the offspring. (D) shows the result under harsher conditions, with a smaller Q. Although equal investment is still a local maximum, the overall maximum is attained by shifting all PI to a single child. If the curves in Figures 1 and 2 were to have inflection points (rather than running directly into the abscissa), the overall results would be the same; however, the local maximum at equal allocation in 2D could have been a local minimum.

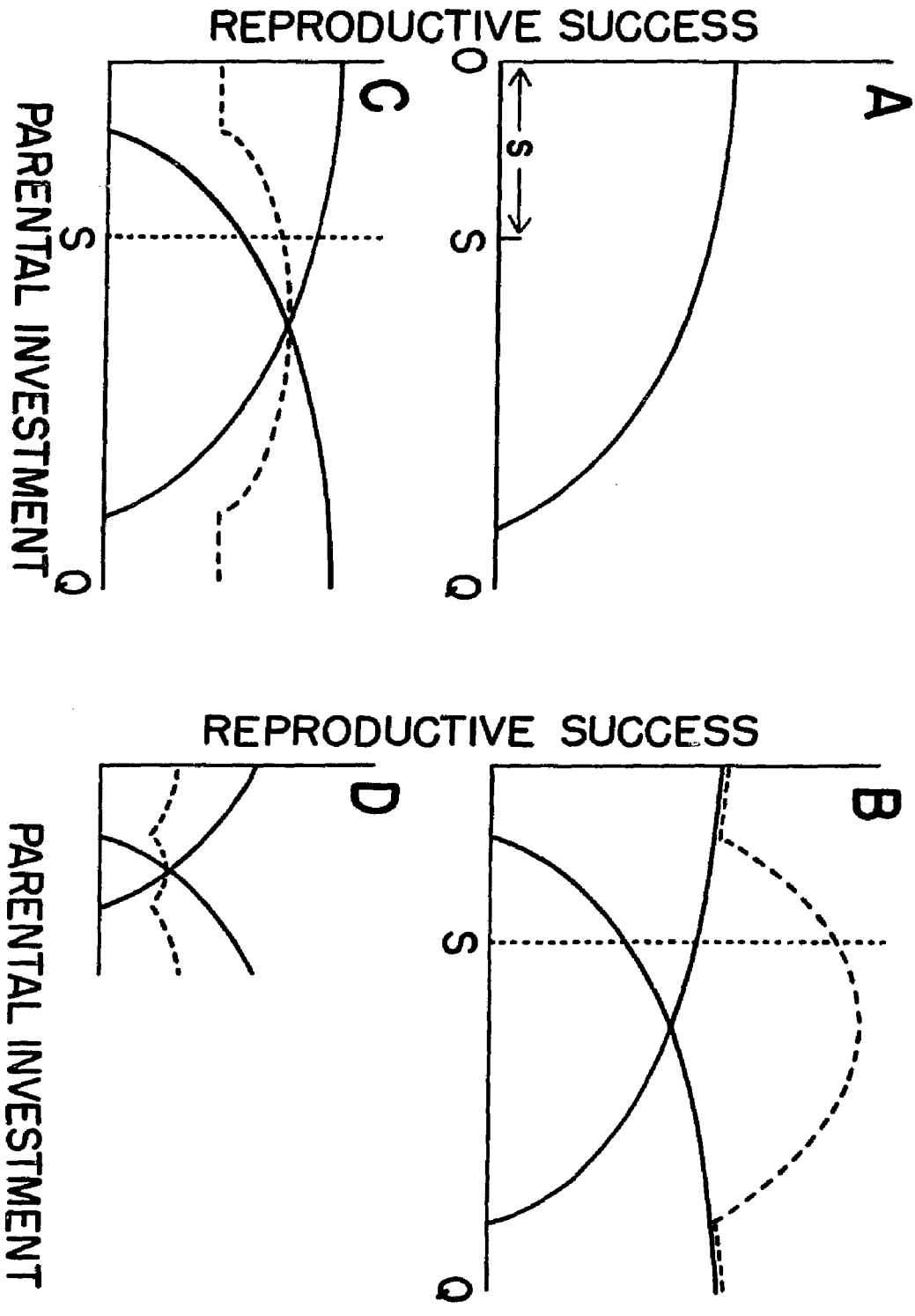
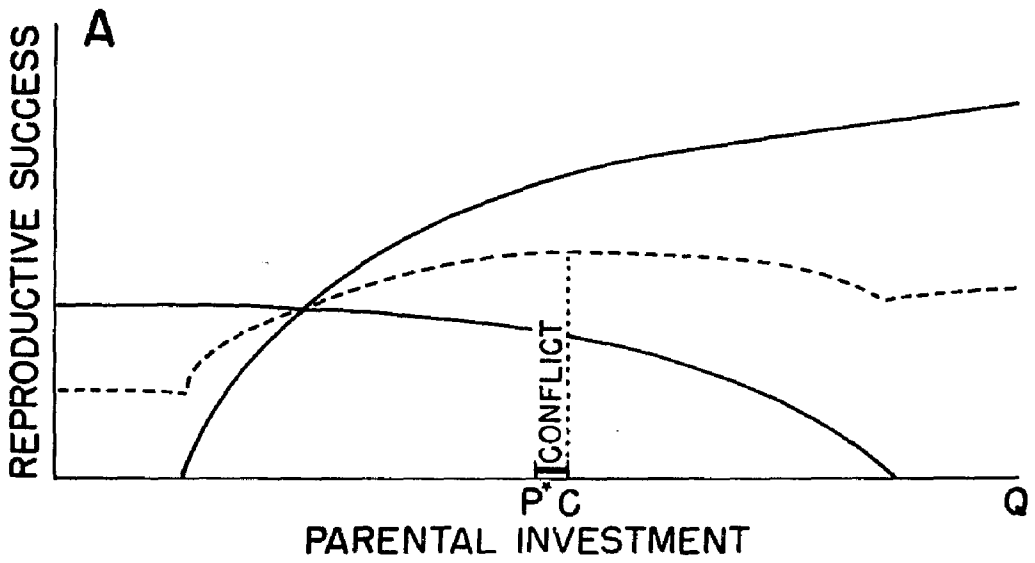

REPRODUCTIVE SUCCESS
PARENTAL INVESTMENT
C
A
S
O
S
Q
Q
REPRODUCTIVE SUCCESS
PARENTAL INVESTMENT
D
B
S
Q

Figure 3 -- Expected conflict between relatives, concerning resources. (A) Total resources (Q) are plentiful. The curve rising to the right is the first offspring's, as in Figure 1. The curve rising to the left is its nestmate's, shown here devalued by its degree of relatedness (1/2) to the first. The first offspring should act to maximize its own inclusive fitness, which is proportional to the dashed line. The parents' RS is maximized at equal investments (P*), the offspring's at C. Conflict between the nestmates is over a small amount of PI, about twice the value C - P*. Conflict should be confined to allocation of small amounts of food. (B) Total resources are small. The dashed curve indicating the first offspring's inclusive fitness is maximized at a point requiring the death of the nestmate. Conflict between nestmates should involve attempts to push each other out of the nest, in addition to fights over food.


A
REPRODUCTIVE SUCCESS
CONFLICT
P* C
Q
PARENTAL INVESTMENT

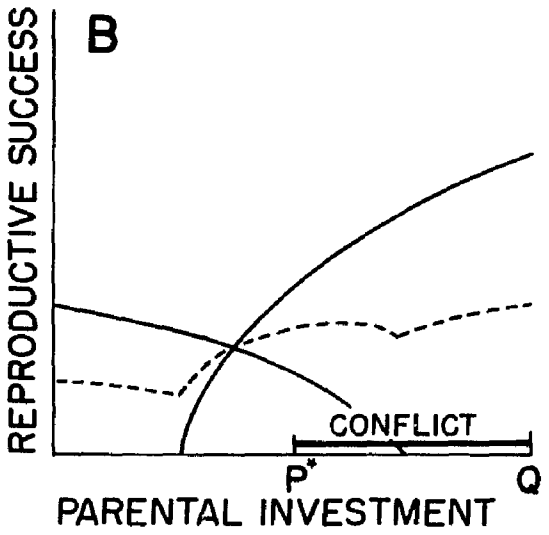

B
REPRODUCTIVE SUCCESS
CONFLICT
P*
Q
PARENTAL INVESTMENT

Figure 4 -- The decision to produce an extra young when the food supply is highly unpredictable, even at an expected cost in average years. Let b, a, and g be the reproductive successes attained in bad, average, and good years if clutch size is adjusted to the overall average food availability. If extra young are squeezed in by reducing per-offspring investment, this will reduce reproductive success in an average year (by ε), and also in a bad year (by δ), but increase it by a large amount L in a good year. A predictable food supply means bad and good years are rare, and usually ε is lost by squeezing in extra young. An unpredictable food supply means, if L is large enough, that parental reproductive success is maximized by producing extra young.

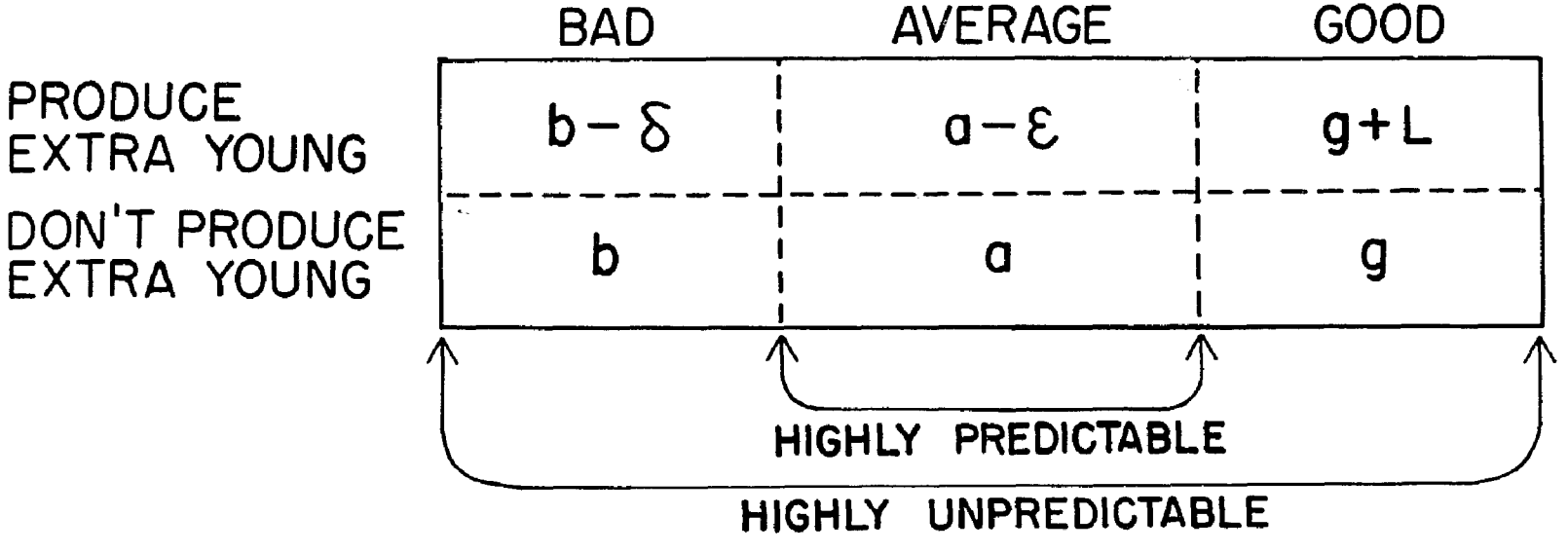

BAD
AVERAGE
GOOD
PRODUCE EXTRA YOUNG
DON'T PRODUCE EXTRA YOUNG
b − δ
a − ε
g + L
b
a
g
HIGHLY PREDICTABLE
HIGHLY UNPREDICTABLE

Figure 5 -- Optimal investment per child (curved line) and total investment allocated to reproduction (straight line) as a function of total parental resources available (income). The first must approach an asymptote P* (defined in Figure 1) as parental resources become large; to the left, it might approach the x-axis slowly (dashed portion) or abruptly (solid portion). The total resources allocated for reproduction is drawn assuming a certain amount i is allocated for subsistence and the rest for reproduction. It is probably more accurate to show this line curving towards the origin (dotted portion), reflecting a higher proportion of available resources being devoted to reproduction in these circumstances. Conversely, the right-hand portion of this line may not rise as quickly as the linear form shown; this does not affect the prediction of Figure 6 (see text), so it is not shown. At point m, the tangent to the curve (not shown) has the same slope as the line.

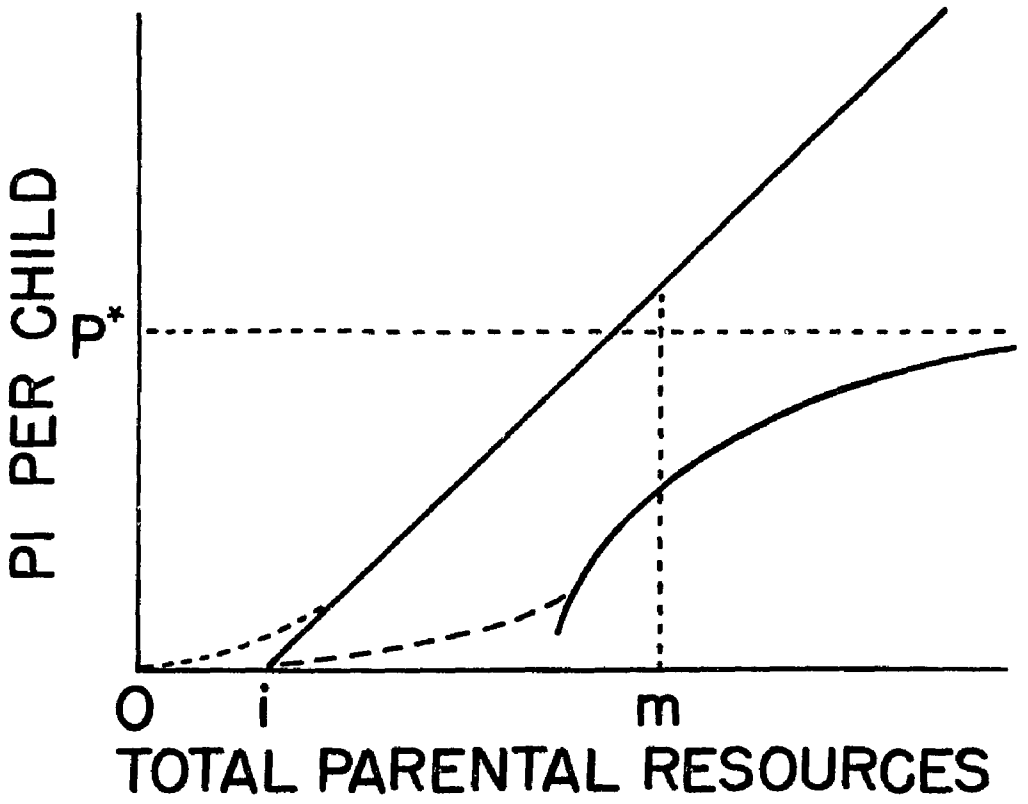

PI PER CHILD
P*
O
i
m
TOTAL PARENTAL RESOURCES

Figure 6 -- Family size as a function of total parental resources. The solid curve is obtained from the solid lines of Figure 5, dividing the investment per child into the investment allocated to reproduction for each level of parental income. The dashed portion shows the result of the dashed portion of Figure 5; this effect is somewhat reduced or eliminated if the dotted portion of Figure 5 is correct.

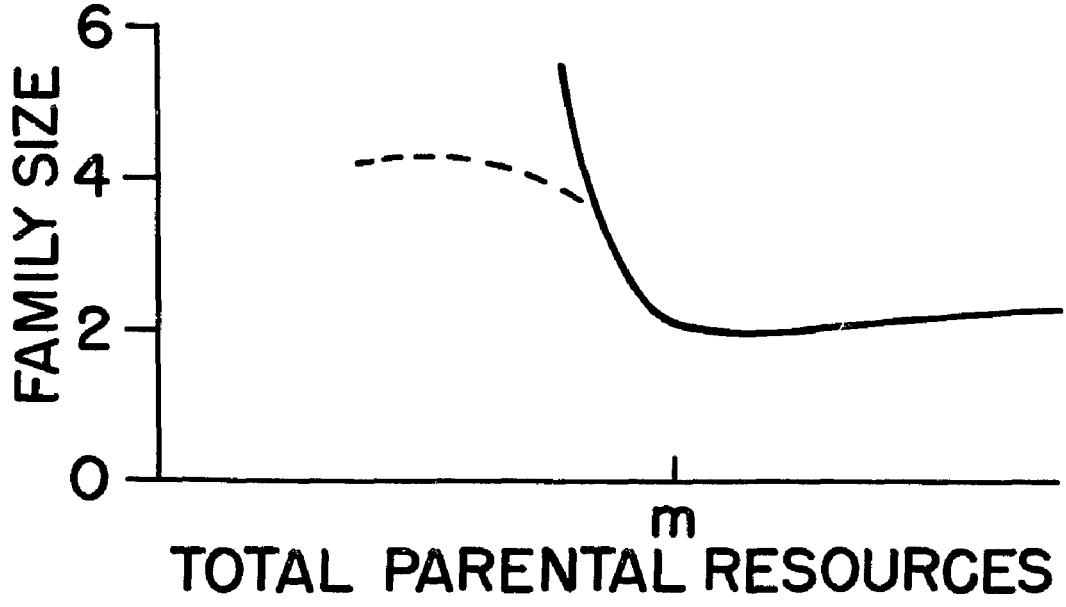
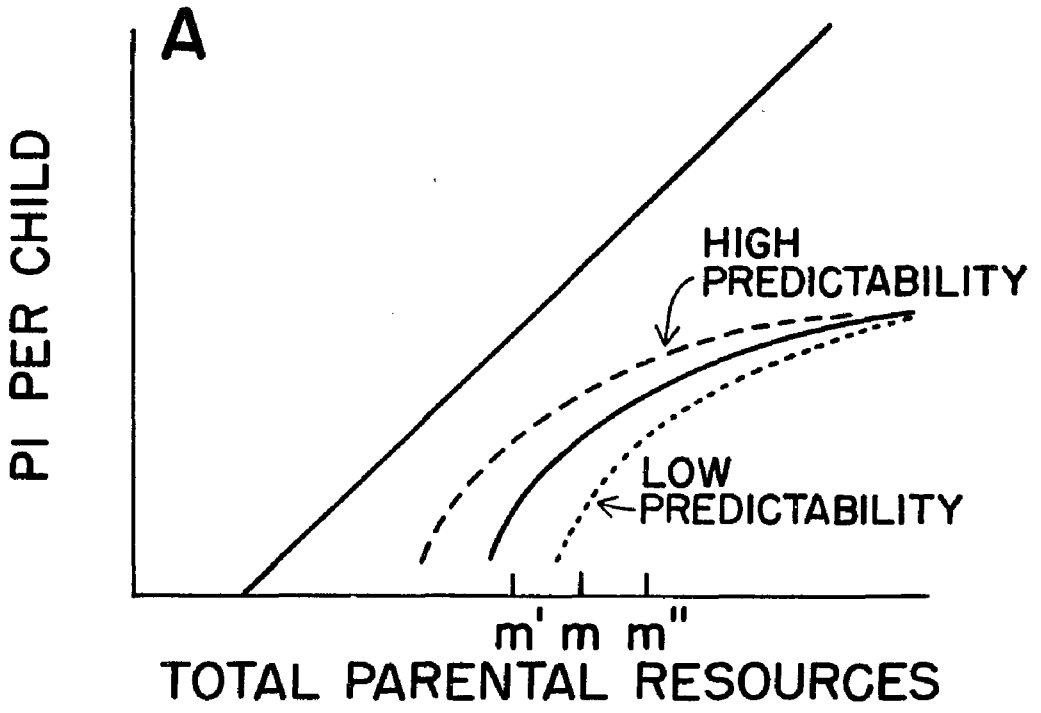

FAMILY SIZE
6
4
2
0
m
TOTAL PARENTAL RESOURCES

Figure 7 -- The effect of a partial control for income unpredictability independent of income level. (A) An increase in unpredictability lowers the optimal investment per child less at the right than at the left; the effect is similar to a shift of the curve to the right. (B) With increased unpredictability of income, family size increases at every income level, much more so at lower levels. The point of minimum family size (m, m') shifts to the right.


A
PI PER CHILD
HIGH
PREDICTABILITY
LOW
PREDICTABILITY
m' m m"
TOTAL PARENTAL RESOURCES

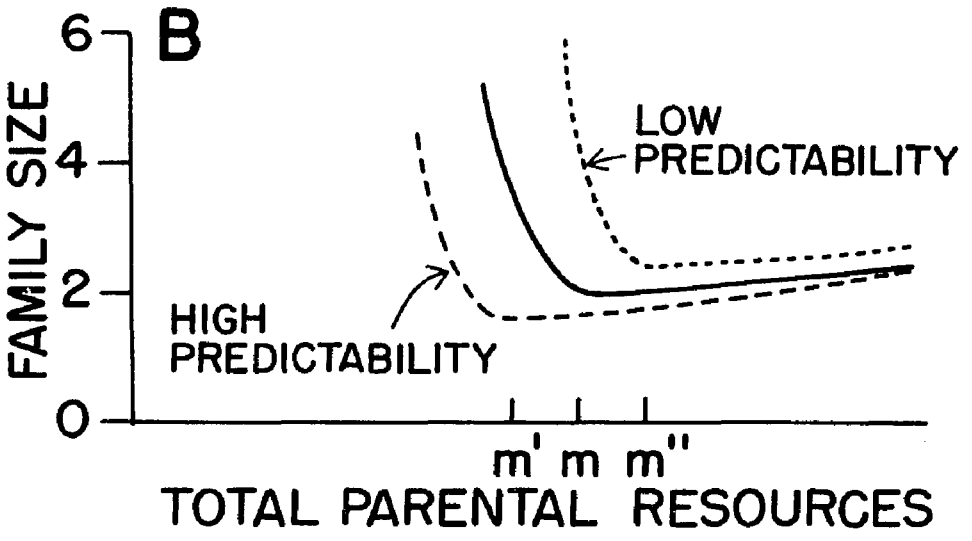
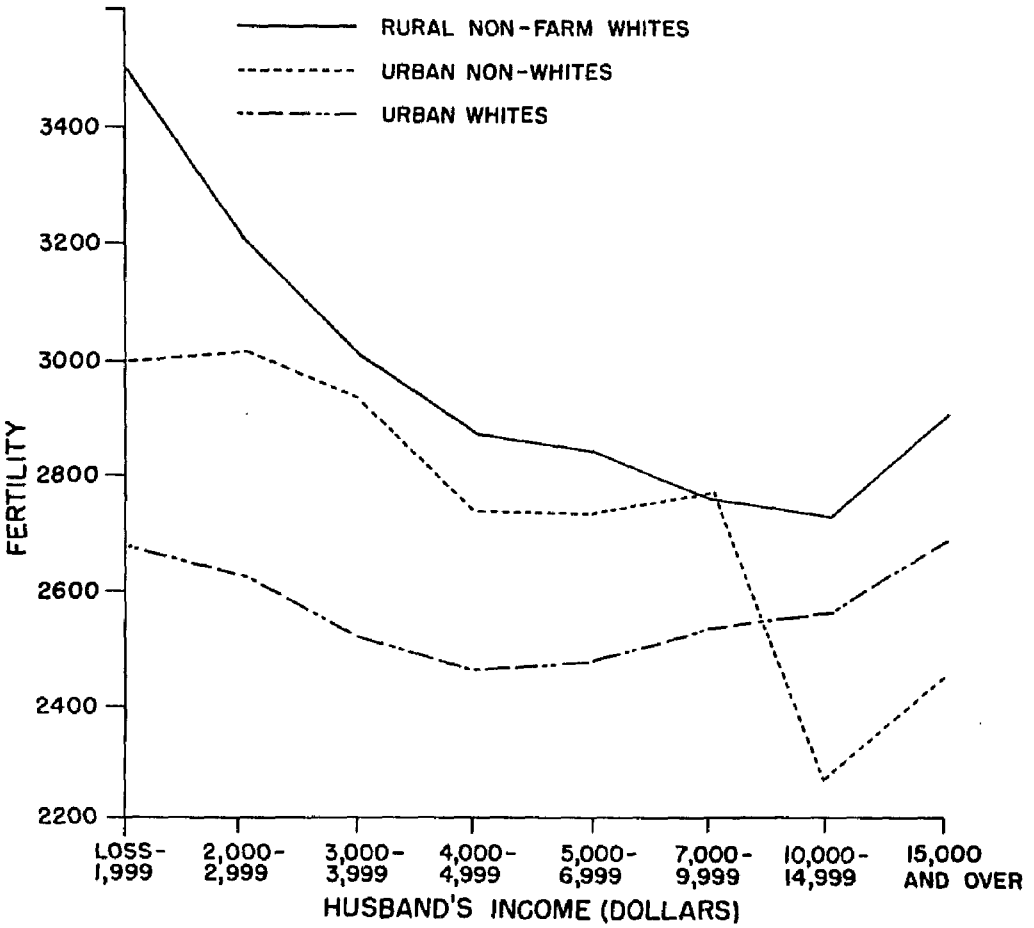

B
6
4
2
0
FAMILY SIZE
LOW
PREDICTABILITY
HIGH
PREDICTABILITY
m' m m"
TOTAL PARENTAL RESOURCES

Figure 8 -- The observed effect of income on fertility. Fertility is children ever born per 1000 wives aged 35-39 (past childbearing) with husband present. (Husband-absent wives are expected to face significantly less predictable income streams.) Income is per year. From U.S. Bureau of the Census 1960 census, Table 37.


RURAL NON-FARM WHITES
URBAN NON-WHITES
URBAN WHITES
FERTILITY
3400
3200
3000
2800
2600
2400
2200
LOSS-
1,999
2,000-
2,999
3,000-
3,999
4,000-
4,999
5,000-
6,999
7,000-
9,999
10,000-
14,999
15,000
AND OVER
HUSBAND'S INCOME (DOLLARS)

LITERATURE CITED

Alcock, J. 1975. Animal behavior: An evolutionary approach. Sinauer Associates, Sunderland, Mass.

Andrews, R., and A. S. Rand. 1974. Reproductive effort in anoline lizards. Ecology 55:1317-1327.

Aretino, P. 1536. The first day of Messer Pietro Aretino's conversation, in which Nanna teaches her daughter Pippa the art of being a whore. In R. Rosenthal (trans.). 1971. Aretino's dialogues. Stein and Day, New York.

Asayama, S. 1975. Adolescent sex development and adult sex behavior in Japan. J. Sex Res. 11:91-112.

Athanasiou, R. 1972. French and American sexuality. Psychol. Today 6(2):54-ff.

Auken, K. 1953. Undersøgelser over unge kvinders sexuelle adfaerd. Rosenkilde and Bagger, Copenhagen.

Ballinger, R. E. 1973. Comparative demography of two viviparous iguanid lizards (Sceloporus jarrovi and Sceloporus poinsetti). Ecology 54:269-283.

Barash, M. 1926. Sex life of the workers of Moscow. J. Soc. Hygiene 12:274-288.

Bauman, K. E., and J. R. Udry. 1972. Powerlessness and regularity of contraception in an urban Negro male sample: A research note. J. Marr. Fam. 34:112-114.

_____, and R. R. Wilson. 1974a. Sexual behavior of unmarried university students in 1968 and 1972. J. Sex Res. 10:327-333.

_____, and _____. 1974b. Contraceptive practices of white unmarried university students: The significance of four years at one university. Amer. J. Obstet. Gynecol. 118:190-194.

Bell, A. P. 1968. Black sexuality: Fact and fancy. Talk presented at "Focus: Black America" series, Indiana University, 14 October (mimeographed).

_____. 1969. Attitudes towards nudity by social class. Med. Asp. Human Sexual. 3(9):101-110.

Bell, R. R., and J. B. Chaskes. 1970. Premarital sexual experience among coeds, 1958 and 1968. J. Marr. Fam. 32:81-84.

Ben-Porath, Y. 1973. Economic analysis of fertility in Israel: Point and counterpoint. J. Polit. Econ. 81:S202-S233.

Berent, J. 1970. Causes of fertility decline in eastern Europe and the Soviet Union II. Economic and social factors. Pop. Studies 24:247-278.

Bergström-Walan, M.-B., R.-M. Eliasson, I. Fredriksson, N. Gustavsson, P. Hertoft, J. Israel, G. Lindberg, and A. Nelson (eds.). 1970. Modenfall Skandinavien? Sexualpolitik in Dänemark und Schweden. Rowohlt, Reinbeck.

Blake, J. 1968. Are babies consumer durables? A critique of the economic theory of reproductive motivation. Pop. Studies 22:5-25.

Blau, P. M., and O. D. Duncan. 1967. The American occupational structure. Wiley, New York.

Bott, E. 1957. Family and social network. Tavistock Pubs., London.

Brockelman, W. Y. 1975. Competition, the fitness of offspring, and optimal clutch size. Amer. Natur. 109:677-699.

Bumpass, L. L., and J. A. Sweet. 1972. Differentials in marital instability: 1970. Amer. Sociol. Rev. 37:754-766.

Cannon, K. L., and R. Long. 1971. Premarital sexual behavior in the sixties. J. Marr. Fam. 33:36-49.

Charlesworth, D. 1971. Selection in density-regulated populations. Ecology 52:469-474.

Christensen, H. T. 1960. Cultural relativism and premarital sex norms. Amer. Sociol. Rev. 25:31-39.

_____, and G. R. Carpenter. 1962. Value-behavior discrepancies regarding premarital coitus in three western cultures. Amer. Sociol. Rev. 27:66-74.

_____. 1963. Child spacing analysis via record linkage: New data plus a summing up from earlier reports. Marr. Fam. Living 25:272-280.

_____, and C. F. Gregg. 1970. Changing sex norms in America and Scandinavia. J. Marr. Fam. 32:616-627.

Cochran, W. G., F. Mosteller, and J. W. Tukey. 1954. Statistical problems of the Kinsey report. Amer. Statis. Assoc., Washington, D. C.

Cody, M. L. 1966. A general theory of clutch size. Evolution 20:174-184.

Colwell, R. K. 1974. Predictability, constancy, and contingency of periodic phenomena. Ecology 55:1148-1153.

Deggeller, E., P. J. F. Dupuis, G. J. Kloosterman, G. A. Kooy, J. D. Noordhoff, C. J. Straver, B. S. Witte, and M. Zeldenrust-Noordanus. 1969. Sex in Nederland. Het Spectrum, Utrecht.

DeTray, D. N. 1972. The interaction between parent investment in children and family size: An economic analysis. RAND Report R-1003-RF.

_____. 1973. Child quality and the demand for children. J. Polit. Econ. 81:S70-S95.

Dumond, D. E. 1975. The limitation of human population: A natural history. Science 187:713-721.

Eliasson, R. 1971. Könsdifferenser i sexuellt beteende och attityden till sexualitet. Sociologiska Institutionen, Lunds Universitet, Lund, Sweden. [Mimeographed copy on file at the Institute for Sex Research, Bloomington, Indiana.]

Farley, R. 1970. Growth of the black population. Markham, Chicago.

Fisher, R. A. 1958. The genetical theory of natural selection. Dover, New York.

Fried, M. 1973. The world of the urban working class. Harvard University Press, Cambridge, Mass.

Friedeburg, L. von. 1953. Die Umfrage in der Intimsphäre. Beiträge zur Sexualforschung 4:1-95.

Fryer, G., and T. D. Iles. 1969. Alternative routes to evolutionary success as exhibited by African cichlid fishes of the genus Tilapia and the species flocks of the great lakes. Evolution 23:359-369.

Gadgil, M., and W. H. Bossert. 1970. Life historical consequences of natural selection. Amer. Natur. 104:1-24.

Gadgil, M., and O. T. Solbrig. 1972. The concept of r- and K-selection: Evidence from wild flowers and some theoretical considerations. Amer. Natur. 106:14-31.

Garcia, J., B. K. McGowan, F. R. Ervin, and R. A. Koelling. 1968. Cues: Their relative effectiveness as a function of the reinforcer. Science 160:794-795.

Gardner, B. 1973. Economics of the size of North Carolina rural families. J. Polit. Econ. 81:S99-S122.

Gebhard, P. H., W. B. Pomeroy, C. E. Martin, and C. V. Christenson. 1958. Pregnancy, birth and abortion. Harper-Hoeber, New York.

Groat, H. T., and A. G. Neal. 1967. Social psychological correlates of urban fertility. Amer. Sociol. Rev. 32:945-959.

Hall, P. L., and N. N. Wagner. 1972. Initial heterosexual experience in Sweden and the United States: A cross-cultural survey. Proc. 80th Ann. Conv. Amer. Psychol. Assoc., pp. 293-294.

Hammond, B. E., and J. A. Ladner. 1969. Socialization into sexual behavior in a Negro slum ghetto. In C. B. Broderick and J. Bernard (eds.). The individual, sex, and society. Johns Hopkins Univ. Press, Baltimore.

Harman, A. J. 1970. Fertility and economic behavior of families in the Philippines. RAND Report RM-6385-AID.

Harper, J. L., P. H. Lovell, and K. G. Moore. 1970. The shapes and sizes of seeds. Ann. Rev. Ecol. Syst. 1:327-356.

Hart, G. 1975. Sexual behavior in a war environment. J. Sex Res. 11:218-226.

Hertoft, P. 1968. Undersøgelser over unge mænds seksuelle adfaerd, viden og holdning. Akademisk Forlag, Copenhagen.

_____. 1969. Investigation into the sexual behaviour of young men. Danish Med. Bull. 16, suppl. I.

_____. 1970. Das sexuelle Verhalten junger Dänen. In M.-B. Bergström-Walan et al. (eds.), op. cit.

Hobart, C. W. 1972. Sexual permissiveness in young English and French Canadians. J. Marr. Fam. 34:292-303.

Hunt, M. 1974. Sexual behavior in the 1970s. Playboy Press, Chicago.

Imaizumi, Y., M. Nei, and T. Furusho. 1970. Variability and heritability of human fertility. Ann. Hum. Genet. 33:251-259.

Israel, J., N. Gustavsson, R.-M. Eliasson, and G. Lindberg. 1970. Sexuelle Verhaltensformen der schwedischen Großstadtjugend. In M.-B. Bergström-Walan et al. (eds.), op. cit.

Jonsson, G. 1951. Sexualvanor hos svensk ungdom. Statens Offentliga Utredningar 1951 (41): 160-213.

Kanin, E. J. 1960. Premarital sex adjustments, social class, and associated behaviors. Marr. Fam. Living 22:258-262.

Kantner, J. F., and M. Zelnik. 1972. Sexual experience of young unmarried women in the United States. Fam. Plan. Persp. 4(4):9-18.

Kawai, M. 1965. On the system of social ranks in a natural troop of Japanese monkeys (I) Basic rank and dependent rank. In S. A. Altmann (ed.), Japanese monkeys: A

collection of translations. Yerkes Regional Primate Center, Atlanta, Georgia.

King, C. E., and W. W. Anderson. 1971. Age-specific selection. II. The interaction between r and K during population growth. Amer. Natur. 105:137-156.

Kinsey, A. C., W. B. Pomeroy, and C. E. Martin. 1948. Sexual behavior in the human male. Saunders, Philadelphia.

_____, _____, _____, and P. H. Gebhard. 1953. Sexual behavior in the human female. Saunders, Philadelphia.

Kiser, C. V. 1933. Trends in the fertility of social classes from 1900 to 1910. Human Biol. 5:256-273.

_____, W. H. Grabill, and A. A. Campbell. 1968. Trends and variations in fertility in the United States. Harvard Univ. Press, Cambridge, Mass.

Kramer, J. 1976. Profiles--the invandrare. The New Yorker 52(5):43-84.

Lack, D. 1954. The natural regulation of animal numbers. Oxford Univ. Press, Oxford.

_____. 1966. Population studies of birds. Oxford Univ. Press, Oxford.

_____. 1968. Ecological adaptations for breeding in birds. Methuen, London.

Landahl, J. T., and R. B. Root. 1969. Differences in the life tables of tropical and temperate milkweed bugs, genus Oncopeltus (Hemiptera: Lygaeidae). Ecology 50: 734-737.

Langer, W. L. 1974a. Infanticide: A historical survey. Hist. Childhood Q. 1:353-365.

_____. 1974b. Further notes on the history of infanticide. Hist. Childhood Q. 2:129-134.

LeMasters, E. E. 1975. Blue-collar aristocrats. Univ. Wisconsin Press, Madison.

Leppo, K., O. Koskelainen, and K. Sievers. 1974. Contraceptive practices in Finland in 1971. Yearbook of Population Research in Finland 13:47-60.

Levin, R. J. 1975. The Redbook report on premarital and extramarital sex: The end of the double standard? Redbook 145(6):38-ff.

Levins, R. 1968. Evolution in changing environments. Princeton Univ. Press, Princeton, N. J.

Levison, A. 1974. The working-class majority. Coward, McCann, and Geoghegan, New York.

Lewis, O. 1951. Life in a Mexican village: Tepoztlán revisited. Univ. Illinois Press, Urbana.

Lindenfeld, F. 1960. A note on social mobility, religiosity, and students' attitudes towards premarital sexual relations. Amer. Sociol. Rev. 25:81-84.

Lockie, J. D. 1955. The breeding and feeding of jackdaws and rooks with notes on carrion crows and other Corvidae. Ibis 97:341-369.

MacArthur, R. H. 1962. Some generalized theorems of natural selection. Proc. Nat. Acad. Sci. U.S.A. 48:1893-1897.

MacArthur, R. H., and E. O. Wilson. 1967. The theory of island biogeography. Princeton Univ. Press, Princeton.

Maccoby, E. E., and P. K. Gibbs. 1953. Child-rearing practices: Social classes compared. Laboratory of Human Development (Harvard University), Cambridge, Mass. (Mimeographed, Hilles Library call number 392.3.M12.)

Malhotra, H. K., and N. N. Wig. 1975. Dhat syndrome: A culture-bound sex neurosis of the Orient. Arch. Sex. Behav. 4:519-528.

Mann, W. E. 1967. Canadian trends in premarital behaviour. Bull. Council Soc. Serv. 198. Anglican Church of Canada, Toronto.

Masters, W. H., and V. E. Johnson. 1970. Human sexual inadequacy. Little, Brown, Boston.

Matushkin, E. L. 1927. Experimental observations on the sex life of a military detachment. Omskii Meditsinskii Zhurnal 2/3:191-204.

Merritt, C. G., J. E. Gerstl, and L. A. LoSciuto. 1975. Age and perceived effects of erotica-pornography: A national sample study. Arch. Sex. Behav. 4:605-621.

Murphy, G. I. 1968. Pattern in life history and the environment. Amer. Natur. 102:391-403.

Newcomb, W. W. 1961. The indians of Texas: From prehistoric to modern times. Univ. Texas Press, Austin.

Olsen, G. A. 1974. Seksuel adfaerd blandt ungdom i Grønland--I socialmedicinsk belysning. Publikation 4 of the Institut for Social Medicin, Københavns Universitet, Copenhagen.

Orians, G. H. 1969. On the evolution of mating systems in birds and mammals. Amer. Natur. 103:589-603.

Pianka, E. R. 1970. On r- and K-selection. Amer. Natur. 104:592-597.

Pitelka, F. A., R. T. Holmes, and S. F. MacLean, Jr. 1974. Ecology and evolution of social organization in arctic sandpipers. Amer. Zool. 14:185-204.

Pomeroy, W. B. 1972. Dr. Kinsey and the Institute for Sex Research. Harper and Row, New York.

Rainwater, L. 1960. And the poor get children. Quadrangle, Chicago.

_____. 1964. Marital sexuality in four cultures of poverty. J. Marr. Fam. 26:457-466.

_____. 1965. Family design. Aldine, Chicago.

Randolph, P. A. 1973. Influence of environmental variability on land snail population properties. Ecology 54:933-955.

Reiss, I. L. 1965. Social class and premarital sexual permissiveness: A re-examination. Amer. Sociol. Rev. 30:747-756.

Ricklefs, R. E. 1965. Brood reduction in the curve-billed thrasher. Condor 67:505-510.

Robinson, I. E., K. King, C. J. Dudley, and F. J. Clune. 1968. Change in sexual behavior and attitudes of college students. Fam. Coord. 18:119-123.

_____, _____, and J. O. Balswick. 1972. The premarital sexual revolution among college females. Fam. Coord. 22:189-194.

Rosenberg, B., and J. Bensman. 1968. Sexual patterns in three ethnic subcultures of an American underclass. Ann. Amer. Acad. Polit. Soc. Sci. 376:61-75.

Roughgarden, J. 1971. Density-dependent natural selection. Ecology 52:453-468.

Schaffer, W. M., and R. H. Tamarin. 1973. Changing reproductive rates and population cycles in lemmings and voles. Evolution 27:111-124.

_____. 1974. Optimal reproductive effort in fluctuating environments. Amer. Natur. 108:783-790.

Schmidt, G., and V. Sigusch. 1971. Patterns of sexual behavior in West German workers and students. J. Sex Res. 7:89-106.

_____, and _____. 1972. Changes in sexual behavior among young males and females between 1960-1970. Arch. Sex. Behav. 2:27-45.

Schofield, M. 1965. The sexual behaviour of young people. Little, Brown, Boston.

Schüz, E. 1957. Das Verschlingen eigener Junger ("Kronismus") bei Vögeln und seine Bedeutung. Die Vogelwarte 19:1-15.

Sears, R. R., E. E. Maccoby, and H. Levin. 1957. Patterns of child rearing. Row, Peterson; Evanston, Illinois.

Shah, F., M. Zelnik, and J. F. Kantner. 1975. Unprotected intercourse among unwed teenagers. Fam. Plan. Persp. 7(1):39-44.

Shorter, E. 1971. Illegitimacy, sexual revolution, and social change in modern Europe. J. Interdiscipl. Hist. 2:237-272.

Sievers, K., O. Koskelainen, and K. Leppo. 1974. Suomalaisten sukupuolielämä (Sexual life of Finns). Werner Söderström, Porvoo and Helsinki.

Sigusch, V., and G. Schmidt. 1971. Lower-class sexuality: Some emotional and social aspects in West German males and females. Arch. Sex. Behav. 1:29-44.

Simon, J. L. 1974. The effects of income on fertility. Carolina Population Center monograph 19, Chapel Hill, N.C.

Simon, P., J. Gondonneau, L. Mironer, and A.-M. Dourlen-Rollier. 1972. Rapport sur le comportement sexuel des Français. René Julliard/Pierre Charron, Paris.

Slater, E., and M. Woodside. 1951. Patterns of marriage. Cassell, London.

Smith, C. C., and S.D. Fretwell. 1974. The optimal balance between size and number of offspring. Amer. Natur. 108:499-506.

Spinley, B. M. 1953. The deprived and the privileged. Routledge & Kegan Paul, London.

Staples, R. 1973. The black woman in America. Nelson-Hall, Chicago.

Steffan, W. A. 1973. Polymorphism in Plastosciara perniciosa. Science 182:1265-1266.

_____. 1975. Morphological and behavioral polymorphism in Plastosciara perniciosa (Diptera: Sciaridae). Proc. Entomol. Soc. Wash. 77:1-14.

Stycos, J. M. 1955. Family and fertility in Puerto Rico. Columbia Univ. Press, New York.

Tilley, S. G. 1973. Life histories and natural selection in populations of the salamander Desmognathus ochrophaeus. Ecology 54:3-17.

Tinkle, D. W., and R. E. Ballinger. 1972. Sceloporus undulatus: A study of the intraspecific comparative demography of a lizard. Ecology 53:570-584.

_____, and N. F. Hadley. 1975. Lizard reproductive effort: Caloric estimates and comments on its evolution. Ecology 56:427-434.

Trivers, R. L. 1972. Parental investment and sexual selection. In B. Campbell (ed.), Sexual selection and the descent of man. Aldine, Chicago.

_____, and D. E. Willard. 1973. Natural selection of parental ability to vary the sex ratio of offspring. Science 179:90-92.

_____. 1974. Parent-offspring conflict. Amer. Zool. 14:249-264.

Udry, J. R., N. M. Morris, K. E. Bauman, and C. L. Chase. 1970. Social class, social mobility, and prematurity: A test of the childhood environment hypothesis for Negro women. J. Health Soc. Behav. 11:190-195.

_____, K. E. Bauman, and N. M. Morris. 1975. Changes in premarital coital experience of recent decade-of-birth cohorts of urban American women. J. Marr. Fam. 37:783-787.

U.S. Bureau of the Census. U.S. census of population: 1960. Women by number of children ever born. Final report PC(2) - 3A, Table 37.

U.S. Department of Labor, Bureau of Labor Statistics. 1975. Work experience of the population, 1973. Special Labor Force Report 171.

Vance, R. R. 1973a. On reproductive strategies in marine benthic invertebrates. Amer. Natur. 107:339-352.

_____. 1973b. More on reproductive strategies in marine benthic invertebrates. Amer. Natur. 107:353-361.

Vener, A. M., C. S. Stewart, and D. L. Hager. 1972. The sexual behavior of adolescents in middle America: Generational and American-British comparisons. J. Marr. Fam. 34:696-705.

_____, and _____. 1974. Adolescent sexual behavior in middle America revisited: 1970-1973. J. Marr. Fam. 36:728-735.

Verner, J. 1965. Breeding biology of the long-billed marsh wren. Condor 67:6-30.

Whyte, W. F. 1943. A slum sex code. Amer. J. Sociol. 49:24-31.

Willis, R. J. 1973. A new approach to the economic theory of fertility behavior. J. Polit. Econ. 81:S14-S64.

Wilson, E. O. 1975. Sociobiology: The new synthesis. Belknap Press of Harvard Univ. Press, Cambridge, Mass.

Wilson, W. C. 1975. The distribution of selected sexual attitudes and behaviors among the adult population of the United States. J. Sex. Res. 11:46-64.

Young, A. M., and K. Michelotti. 1971. Work experience of the population in 1970. Monthly Labor Rev. 94(12):35-44.

_____. 1974. Work experience of the population, 1973. Monthly Labor Rev. 97(12):49-53.

Zetterberg, H. L. 1969. Om sexuallivet i Sverige. Statens Offentliga Utredningar 1969(2).

PART II

HOMOSEXUALITY AND NON-REPRODUCTION:

SOME EVOLUTIONARY MODELS

ABSTRACT

The theory of kin selection cannot be ignored in attempts to understand non-reproductive behavior in humans. Homosexual behavior, whether interfering with reproduction or not, is examined in the light of hypotheses of its evolution by natural selection, the more non-reproductive cases being considered in the light of kin selection. Models derived from these evolutionary arguments are elaborated and compared with anthropological evidence concerning the institution of the berdache and other phenomena; earlier models are examined both in the light of intrinsic scientific merit and from the view of evolutionary theory. It is concluded that certain features of homosexuality (and other phenomena such as transvestism and transsexualism) are inconsistent with simple learning-theory explanations, and are quite consistent with kin selection. Ways to test this consistency further are proposed.

INTRODUCTION

The nature-nurture controversy is an old one, rapidly losing favor as a legitimate dichotomy. One recent work noted:

> "In the theory of psychosexual differentiation, it is now outmoded to juxtapose nature versus nurture, the genetic versus the environmental, the innate versus the acquired, the biological versus the psychological, or the instinctive versus the learned. Modern genetic theory avoids these antiquated dichotomies, and postulates a genetic norm of reaction which, for its proper expression, requires phyletically prescribed environmental boundaries. If these boundaries are either too constricted, or too diffuse, then the environment is lethal, and the genetic code cannot express itself, for the cells carrying it are nonviable.
>
> "The basic proposition should be not a dichotomization of genetics and environment, but their interaction." (Money and Ehrhardt 1972:1)

Even this more modern view is at one point too restrictive, and at another misses an important distinction. By postulating a "genetic norm of reaction" this theory ignores the question of how one determines that it is in fact the norm. Equally evolutionarily possible are developmental switches or alternate paths of development not at all the result of a clash with inflexible environmental boundaries. And the interaction between genetics and environment does not merely exist--it works in evolutionarily sensible ways, according to the principles of natural selection (Lockard 1971, Alcock 1975).

Thus, even if a behavior pattern is learned, it can be easier to learn some things than others (e.g., Garcia et al. 1968). Simple Skinnerian learning theory is no longer adequate

to account for many learned phenomena in humans (Seligman 1976) and animals (Breland and Breland 1961).

Indeed, many of the deviations from classical-conditioning rules follow patterns. Seligman (1976) has shown that certain phobias in humans are a non-random subset of all those conceivable, that they are acquired much more quickly than Skinnerian theory would predict, that they are robust and difficult to extinguish with negative reinforcement, that rational arguments and reasoning capabilities have little effect on their retention or acquisition, and that this pattern of facts makes evolutionary sense. Seligman (personal communication) has independently concluded that this pattern also applies to certain atypical human sexual behaviors, a thesis I will defend here. Elsewhere (Weinrich 1976) I have argued that many "normal" variations in human sexual behavior are comprehensible from the point of view of natural selection. I also argued that some heterosexual "dysfunctions" exist for evolutionarily sensible reasons.

In this paper, I will review the evidence that human homosexuality and non-reproduction show patterns that are consistent with Darwinian (or more precisely, Hamiltonian) natural selection. Beginning with a review of the most prominent current theories of the correlates and causes of homosexuality, I will examine the connection (which is not invariable) between homosexuality and non-reproduction--since it is only when homosexuality interferes with reproduction

that it is biologically "mysterious." (In contrast, a psychological view considers homosexual behavior "mysterious" whenever it occurs in a culture that socializes its members against it.) Next I consider what sorts of evolutionary models are permissible for a species whose environment has changed so overwhelmingly in the recent evolutionary past, and elaborate the ways homosexuality and non-reproduction can interact. Following Seligman, I then show that many features of atypical gender role differentiation do not fit the usual Skinnerian learning pattern, although these behaviors are (for the most part) undoubtedly learned. The specific models are then applied to the actual accounts in the anthropological literature (especially of berdaches and certain bond-forming patterns) and more recent data from sex researchers. Finally, I re-evaluate the earlier theories of homosexuality solely in terms of their evolutionary plausibility in the light of the theories proposed in this paper, and make a few suggestions for future research.

I also occasionally indicate where I think these theories can be easily misunderstood as recommendations for moral principles, and why I think such applications are unwarranted. Although I claim no qualifications as a moralist, I feel that certain possible misapplications are minimizable if they are squarely faced in advance of the misuse. Science and morality are two separate areas of inquiry, and bridges should be built between the two only with extreme care. Throughout, I attempt

to make my own biases clear, and point out where I think the research of other investigators could have been more farily conceived and executed. This is a field in which one's emotions can often intrude. A careful development of logic leading from theory to empirical test, rather than the reverse, can be of assistance in reaching an understanding a little bit closer to truth.

PREVIOUS MODELS OF HOMOSEXUALITY

The first group of models of homosexuality are models of "congenital maladaptation." These models all assert that there is a genetic factor inherited in the usual Mendelian fashion, or hormonal variability uncorrelated with genetic mechanisms, which exercises some degree of deterministic control over sexual object choice. Almost all of these models also admit a considerable environmental component. Gley (1884) proposed, and Hirschfeld (1912) and others elaborated, the early theory of constitutional bisexuality, which gained favor after embryological studies showed that fetuses contain the precursors of the internal reproductive organs of both sexes; the existence of biological intersexes thus became conceivable. At the time it was proposed, this theory received little verification, and left unspecified the exact mechanism. More recently, Dörner's group (1975 and references therein) proposed that in males, "androgen deficiency during a critical hypothalamic organizational period" can "give rise to a predominantly female-differentiated brain, homosexual behavior, and a . . . positive estrogen feedback effect," and reported just such a feedback effect in a group of homosexual men (as compared to a group of heterosexual and bisexual men). A parallel syndrome is hypothesized for women (as yet untested), involving abnormally high androgen levels in utero. Other investigators have left the

direction of causation unspecified, and have simply looked for hormonal correlates of homosexuality. Kolodny et al. (1971) reported significantly lower serum testosterone levels in a group of predominantly or exclusively homosexual men as compared with heterosexual controls, and (1972) higher levels of plasma luteinizing hormone among the same subjects. Margolese (1970) and Margolese and Janiger (1973) reported higher ratios of urinary androsterone to urinary etiocholanolone in homosexual and heterosexual men. Parallel studies of lesbians remain virtually unperformed; Loraine et al. (1970) found high levels of testosterone and luteinizing hormone, and low levels of estrogen in urine samples from 4 homosexual women. The only large (N = 42) hormonal study ever done reported no abnormality in urinary estrogen and did not test for luteinizing hormone (Griffiths et al. 1974). Urinary testosterone and epitestosterone showed suggestions of elevation in 10 subjects, although here some technical problems cast doubt on the significance of those levels.

Most of these models have not fared well in subsequent testing, except for the results of Dörner et al., which have not been repeated by other investigators. However, study of genetic males with androgen insensitivity (Money and Ogunro 1974) casts doubt on this mechanism; if the brain tissues were also androgen insensitive they should have differentiated in the female pattern, producing homosexual object choice--which did not occur. The Margolese results (like the

preliminary report by Loraine et al. (1970), which reported on 3 men) are considered less relevant than studies of blood plasma. Replications have been attempted; one confirmed the difference (Evans 1972) while another failed to find any statistically significant difference (Tourney et al. 1973, 1975). Although there was one confirmation on the question of plasma testosterone (Raboch et al. 1975), six other studies found no significant difference (Tourney and Hatfield 1973, Birk et al. 1973, Doerr et al. 1973, Pillard et al. 1974, Parks et al. 1974, Barlow et al. 1974), one found a marginally significant difference in the opposite direction ($\underline{P} < 0.1$, Tourney et al. 1975), and one found a highly significant difference in the opposite direction ($\underline{P} < 0.01$, Brodie et al. 1974). Regarding plasma luteinizing hormone, the two attempted replications (Parks et al. 1974, Tourney et al. 1975) found no significant differences, although the accuracy in one study was poor and the number of subjects in the other was small. Finally, Srivastava et al. (1974) found no differences in the Y chromatin fluorescence patterns of homosexual and heterosexual men, a finding of doubtful relevance to any etiological theory since the fluorescing portions are those hypothesized to be genetically inert. In the absence of explanations of the conflicting results (Weinrich 1974, Tourney et al. 1975), these theories must be regarded as highly speculative. Hormone levels are known to vary widely from day to day (Parks et al. 1974) and even from minute to

minute (Smith et al. 1974), so perhaps the positive findings are artifactual.

The second sub-group of "congenital maladaptation" models do not attempt to specify anything about the mechanism responsible for the homosexuality. Slater (1962) found a higher than expected age at term for the mothers of homosexual men, while Abe and Moran (1969) reanalyzed this data and concluded that it was father's age that explained the differences. Birtchnell (1972), however, showed that Slater's finding was a statistical artifact. Moreover, an extensive review of other studies of male and female homosexuality and parental age found much disagreement between different investigators (Siegelman 1973). Kallmann's classic studies (1952, 1953) of monozygotic and dizygotic male twins found perfect concordance for sexual object choice among the monozygotes but only a 12% concordance rate in the dizygotes. Although the 100% value is certainly too high (Kallmann 1960, Rainer et al. 1960, Mesnikoff et al. 1963), the true rate was almost certainly higher than the 12% comparison. Heston and Shields (1968) reviewed many earlier twin studies and reported on their own unselected twin series, finding a "tendency . . . for concordance and discordance to occur about equally frequently in monozygotic pairs, given that one of them is homosexual, while concordance is less frequent in dizygotic pairs." They also found no higher incidence of homosexuality among monozygotic twins than among dizygotic (an important

methodological question left unsettled by Kallmann), and reported on two monozygotic twin pairs in a single family, in which a genetic predisposition was strongly suggested. "These twins were not only concordant for homosexuality, but the members of each pair had developed modes of sexual behavior strikingly similar to each other. Furthermore, they did this while ignorant of their co-twin's homosexuality and, for [one pair], while widely separated geographically." The evidence from such twin studies, while not iron-clad, is extremely suggestive. Those wishing to discount any genetic predispositions must now attribute Kallmann's quantitative results to biased case selection, Heston and Shields' to statistical fluctuations, and both sets of case histories of similar behavior under separate circumstances to coincidence. Interestingly enough, there are apparently only two cases of female homosexuality in monozygotic twins reported in the literature (Perkins 1973), a striking example of investigative bias. I will consider this question further in a later section.

The third sort of congenital maladaptation model is that of Hutchinson (1959), who was apparently the first to realize that the statistics on homosexuality gathered by Kinsey et al. (1948, 1953) required a reconciliation with natural selection. He assumed that homosexuality resulted in lowered reproduction, cited Kallmann's work mentioned in the previous paragraph, and successively ruled out two possible explanations.

It seemed unlikely that the incidence of homosexuality was decreasing as a result of selection, since this merely raised the question of how it got to be so high. Next, the frequency found by the Kinsey group was too high to be a result of a mutational equilibrium, as might be possible in the cases of the "homosexual" male (Gill 1963) and female (Cook 1975) Drosophila. So he endorsed the third possibility, that "selection in favor of heterozygotes, or some other form of balanced polymorphism, may occur." He did not propose any specific character for the heterozygote advantage, except to note that the psychoanalytic sort of explanation (summarized below) was consistent with "a great deal of modern embryological genetics, in which the genetic control of rates of various processes rather than the control of the mere existence or non-existence of the processes is usual."

A fourth sort of congenital maladaptation model has been proposed by Evans (1972), who studied a group of homosexual men obtained from a gay social organization, and a group of heterosexual volunteers obtained "through a number of sources." He found that the homosexuals as a statistical ensemble "had less subcutaneous fat and smaller muscle/bone development and were longer in proportion to bulk. Their shoulders were narrower in relation to pelvic width, and their muscle strength was less." Although some of these characteristics might reasonably be suspected to be the result of the social nature of the group from which the homosexuals were drawn, it

is at least conceivable that Evans' conclusion is correct: that "inheritance of a particular physique influences personality development" in a way that leads to more homosexuality among those who lose out in preadolescent competitive interactions. This model is conspicuous in its relatively careful specification of the ways the genetic factors are mediated by environmental ones. Other investigators have not repeated Evans' measurements for men, although Griffiths et al. (1974) found that their group of lesbian women was taller in stature than heterosexual controls--the difference being about one tenth the average difference between women and men.

Next to be considered is a large group of models which I will call the "acquired maladaptation" models. These models reject the relevance of genetic differences between individuals as part of the causation of differences in sexual object choice. Most prominent among these are the psychoanalytic models, for example those of Bieber et al. (1962), Socarides (1968), and Hatterer (1970). Psychoanalytic models have tended to focus on parental relationships--both between mother and father and between parents and pre-homosexual child. What follows will be a very abbreviated consideration of some of the most prominent hypotheses. This is not merely a result of the fact that I am not a psychoanalyst; some of the lists of possible etiologies are staggeringly long (Hatterer 1970, Romm 1965).

The literature regarding psychoanalytic studies of female homosexuality has been characterized as "extremely complicated, diffuse and at times difficult to follow," with even the "pillars of the freudian case" not having "stood the test of time," according to one recent review (Kenyon 1974:90). Even those psychoanalytic theories that confine the etiology to parental relationships have produced findings that are "inconsistent and contradictory" (Siegelman 1974b:14). One author found "the homosexual pattern . . . associated with specific types of family constellation, the commonest of which probably includes a domineering, hostile, antiheterosexual mother and a weak, unassertive, detached, and pallid father" (Wilbur 1965:280). In contrast, Gundlach and Riess (1968:222) found a "lack of clear-cut patterns distinguishing the total Lesbian and non-Lesbian groups," although some small differences were found. Siegelman (1974b) reviewed the data on parental relationships and found that much of the contradiction is a result of the failure to use well-verified psychological scales in assessing parental relationships, the failure to distinguish between the parents' actual behavior and the daughter's reactions to that behavior, and the fact that some of the findings of certain studies may be due more to the degree of neuroticism of the subject than to her homosexuality.

To the extent that a consensus exists among psychoanalysts as to the etiology of male homosexuality, it concerns a

"close-binding, intimate, seductive" mother and a "detached, hostile" father as causative agents (Bieber 1965). This generalization has caused enormous controversy. Although it was obtained in a study that utilized homosexual men undergoing psychotherapy, it had a similarly disturbed heterosexual control group; however, data were obtained by questioning the psychotherapist and not the patient (Bieber et al. 1962). Certain aspects of this theory are verified when non-patient groups are used (Evans 1969, Stephan 1973, Saghir and Robins 1973), but the picture becomes much more confused when other possibilities are taken into account. Hooker (1969) noted that the parental relationships can be the effect and not the cause of the homosexuality, given that some homosexual identifications can form at very early ages (especially in more feminine boys). If a father "used to pick at me all the time . . . He called me sissy, and girls' names" (Saghir and Robins 1973:147), is it not conceivable that the son would later recall him as hostile, or that his mother would move in to comfort him? Such an etiology would view the disturbed relationship as a result of the father's own reaction to the boy's atypical sexuality. Bell (1974) noted that the report on homosexuality currently being prepared by the Institute for Sex Research has found that it will be possible "to delineate those [interview subjects] who have read the literature [on etiology] and those who haven't, and the ways they have been affected by

their reading of the literature and the kinds of reconstruction of their autobiographies that they give," casting doubt on the entire corpus of subjectively recalled material.

To my knowledge, two sorts of attempts have been made to separate out cause from effect in this matter. The less direct method was used by Freund and Pinkava (1961), who used different measures of paternal absence which varied in their susceptibility to retrospective distortion. Comparing hospitalized homosexuals, neurotics, and non-psychiatric patients, they found that although homosexual men did recall a weaker father and a closer mother than the other two groups they did not have any higher incidence of parental loss or deprivation. They concluded that it was likely that "the defects in these [parental] relations are rather secondary in relation to homosexuality than its cause." This picture is complicated by a later study by Freund et al. (1974), which found that homosexual men from a homosexuals' club did indeed have a higher incidence of unreplaced loss of father, and of being raised by relatives or foster parents. Without further study, these results are inconclusive.

The more direct way to separate cause from effect is to evaluate the parental relationships of boys who will become homosexual at the time they are still boys. For at least one subgroup of the population, this is not as impossible as it may seem. Boys showing pronounced feminine identification and behavior exist and are reliably distinguishable

from boys showing what the culture defines as a more typical masculine pattern (Zuger and Taylor 1969). Such boys are also known to have a very high probability of homosexuality in adulthood (Zuger 1966, Bakwin 1968, Lebovitz 1972, Green and Money 1961), although it should be pointed out that many other boys (perhaps many more than the feminine group) become homosexual without showing this group of feminine behaviors (Zuger 1966). Members of Lebovitz's group were interviewed mostly after the age of 18 years, and described their fathers in stereotypically negative terms, their mothers in more positive ways. Zuger's and Bakwin's groups were seen in childhood, and the parental relationships were directly observed. Bakwin (1968:621) found no family pathology in any of 9 cases, plus 1 case where the mother had wanted a girl to be born instead of a boy. Zuger (1970) matched his cases with non-feminine controls and investigated parental relationships in great detail, finding no significant differences in the satisfaction the parents expressed in their marriage, in who was the dominant parent, in the parents' desire for a child and sex preference, in the parents' affection for the child, or in the sex of the child's nearest sibling. He also found that both groups of boys were equal in closeness to their mothers, although

> "the closeness of the effeminate and noneffeminate boys to their mothers was different qualitatively. The noneffeminate boy solicited his mother's attention and sympathy in regard to his own concerns and occupations; the effeminate boy aligned himself with

> those of his mother--her domestic duties, her dress, appearance, etc. These preferences later extended to other females as well, such as teachers, neighbors, and television stars.
>
> "On the other hand, the effeminate boy had no interest in the activities of his father. This gradually led to separation from him . . . Many fathers mentioned making frequent unsuccessful efforts to get their sons to participate in their activities. Thus a father whose earlier relationship with his son was described by the mother as 'practically inseparable,' said, 'I don't get involved any more, the mother takes care of that . . . I have just thrown up my hands.'" (Zuger 1970:1169)

A completely independent set of cases (Bates et al. 1975) required a similar explanation:

> "In numerous instances these fathers had made sincere efforts to relate to their sons. However, the boy usually had responded with cold rejection of his father's interest, which eventually extinguished the father's efforts. This indicated to us that the assumption of paternal indifference producing gender abnormality is inadequate as a sole explanation of the boys' behavior difficulties." (Bates et al. 1975:154-155)

In short, the two studies that observe the parent-child relations most simply and directly force the conclusion that retrospective reports in adulthood are of unproven reliability, even when obtained with the aid of sophisticated psychiatric techniques allegedly designed to minimize the effects of conscious or unconscious distortion and repression. Similar reports confirm that these same sorts of boys later in life will indeed report the canonical weak-father, close-binding-intimate-mother pattern.

Other studies indicate that the parental patterns of homosexuals and heterosexuals may differ in much more

complicated ways, especially when those lower in femininity are included. Hooker (1969) cited many studies of non-clinical samples that do not conform to the canonical Bieber et al. (1962) pattern. Likewise, Siegelman (1974a), using psychometric scales that are more reliable than almost all previous studies, found a quite different pattern of parental relationships distinguishing homosexual and heterosexual groups. He found, moreover, that virtually all these differences disappeared when homosexual and heterosexual groups low in neuroticism were compared, and that feminine homosexuals showed different patterns than non-feminine ones. This study could reasonably be interpreted as consistent with the existence of a mechanism whereby the classic parental constellation is the result of a pattern that produces more neurotic homosexuality, which in turn results in more such individuals being seen by psychotherapists. It is known for at least one study that homosexuals who volunteer for scientific investigation are more neurotic than those who do not (Burdick and Stewart 1974). Or, recalling Bell's observation, it may be that such individuals consider themselves "sicker" after reading about themselves in the psychoanalytic literature and consult psychoanalysts about their "syndrome." The question of femininity as a factor causing more neuroticism through the intermediary of societal disapproval deserves investigation; if important, it could help to explain why homosexual women seek treatment less

often, usually for problems not directly related to their lesbianism.

The main theory competing with the psychoanalytic ones within the "acquired maladaptation" school is that proposed in various slightly differing forms by Ford and Beach (1951), Kinsey et al. (1949), and Tripp (1975). (All these authors would probably object to my use of the word "maladaptation" to describe their theory of homosexuality. I use the term in this paper only in its evolutionary sense: something lowering one's reproductive success.) Briefly, these authors propose that the course of mammalian evolution is characterized by "a progressive evolutionary trend" with sexual performance "rather rigidly dependent upon gonadal hormones" among the non-primate mammals, but progressing to primates and man where "erotic responsiveness is, within wide limits, independent of sexual physiology" (Beach 1949). It is then argued that homosexuality is an unavoidable side effect of this liberation from strict hormonal control (Tripp 1975:16).

This view has not fared well in recent studies, not so much because environmental effects are considered less important, but rather because it has been recognized that the pattern of sexual learning itself should remain adaptive. Thus, it will <u>indeed</u> be asked here "why 'nature' should have been so 'careless' as not to have retained a few directional controls over sex instead of allowing the whole matter of procreation to fall into the loose and chancy

hands of learning" (Tripp 1975:16). At least one clear exception to Beach's rule has been found (Nadler 1975), and the entire comparative-psychological paradigm has been severely challenged (Lockard 1971). What is needed is an evolutionary view that makes sense of the sexual patterns of different species, taking count of the different mechanisms operating in each case (Wilson 1975).

It is the central task of this paper to show how such an evolutionary view can be applied to cases of human homosexuality and non-reproduction. These models are the "adaptive" ones: they require the phenomena in question to benefit some members of the society in a reproductive sense.

The first such reproductively adaptive model involves the mechanism of kin selection. First worked out by Hamilton (1962), this mechanism notes that an individual need not maximize its number of offspring ("reproductive success") in order to have its genes spread in the population; under certain theoretically well-defined conditions, genes can spread by indirect descent through relatives. What is maximized is "inclusive fitness," which includes both one's own offspring and the offspring of relatives, devalued by one's degree of relatedness (r, below) to them. Non-reproduction is then seen as a reproductively altruistic act, wherein one's own personal reproductive success is lowered at a cost C, conferring a benefit B on a set of relatives. If r is the value of one's degree of relatedness to such a

relative (defined as the proportion of genes identical by descent shared with that relative), then Hamilton's theory notes that genes promoting the expression of the reproductively altruistic trait will increase in the population if C is less than rB. To the extent that homosexuality interferes with reproduction, this reasoning can be applied to it; early versions of this application are summarized in Wilson (1975:343,555).

The second reproductively adaptive model involves the mechanism of group selection (summarized by Wilson 1975:311, 555). Here an individual's non-reproduction is seen as giving a B to the group as a whole (at a C to its own reproductive success). If the B to the group does not increase the non-reproductive's inclusive fitness, then certain difficult theoretical problems arise in explaining the behavior (Wilson 1975, ch. 5).

The third adaptive model focuses on the conflict between parents and their offspring concerning the adult reproductive role of the offspring (Trivers 1974:261). Trivers showed that if one's non-reproduction as an adult gives a B to one's siblings at a C to oneself, then conflict over whether one should be non-reproductive is expected whenever $C < B < 2C$. In this case, the parents' inclusive fitness is maximized when the child becomes non-reproductive, but the child's is maximized by going ahead and reproducing. Trivers reasoned that if the child ever "loses" in this interaction,

then there should be two sorts of non-reproductives: those for whom $\underline{B} > 2\underline{C}$ (in which case parent and child both have their inclusive fitnesses maximized by the child's non-reproduction, as in the paragraph before last), and those for whom $\underline{C} < \underline{B} < 2\underline{C}$. As Trivers put it (1974:261):

> "The first kind is expected to be as happy and content as living creatures ever are, but the second is expected to show internal conflict over its adult role and to express ambivalence over the past, particularly over the behavior and influence of its parents."

Here we have a particularly clear case of how natural selection need not produce eternal harmony, cooperation, and the greatest good for the greatest number.

The last adaptive model is adaptive only in a special sense. The model of Hutchinson (1959), mentioned above under the category of congenital maladaptations, can also be seen as adaptive for the parents if one adopts as a given the assumption of heterozygote advantage. In order to gain the increased reproductive success postulated by this heterozygote advantage, it is necessary to suffer a certain genetic load of less-than-fully-"fit", non-reproductive homozygotes. It would, of course, be more adaptive to "find" a genetic mechanism that would produce the phenotype of the heterozygote without having to waste investment of the non-reproductives, but in the evolutionary short run this could conceivably be impossible. Again, it should be clear that this scheme is not adaptive for the homozygote.

THE RELATIONSHIP BETWEEN HOMOSEXUALITY AND NON-REPRODUCTION

The concepts of homosexuality, transsexualism, transvestism, and homosexual behavior are often confused. Here I will define each and briefly indicate its relevance to biological questions.

Transvestism. The practice of dressing in the clothes defined by the culture as appropriate for the opposite sex, in order to achieve erotic arousal. A person who does not thus achieve erotic arousal is a cross dresser, not a transvestite, in the terminology currently most in use by sex researchers. In humans, most researchers agree that most transvestites are heterosexual (Kinsey et al. 1953:680, Beigel 1969), although homosexual transvestites and cross dressers do exist. A reasonable extension of the definition to the rest of the animal kingdom would be as follows; note that it is not a precise parallel of the human definition. An animal is said to show a transvestitic pattern when it displays a physical or behavioral pattern, normally sexually dimorphic, that causes it to be treated as a member of the opposite sex by a conspecific. Most of the examples of such transvestism I have found among animals are attempts to gain a fairly obvious advantage from the "deception." Captive males of one South American leaf fish can adopt the coloration and behavior of a female ready to spawn, and thus apparently attempt to steal a fertilization from the

territory-holding male (Barlow 1967). The same is true for the ten-spined stickleback (Morris 1952), with the additional possibility of attempting to eat the eggs instead. (Morris' interpretation of this behavior as an unadaptive side effect of sexual frustration is unconvincing.) Two other examples in fishes are briefly summarized by Geist (1975:99). Thornhill (1976) has observed many instances in the wild where a male scorpion fly (Bittacus apicalis) attempts to steal the food offered by a courting male, by adopting the female's wing-drooping invitation pattern but then bending his own genitalia away from those of the courting male as he starts to eat the food. In mountain sheep (Geist 1975:98ff), subordinate males mimic the behavior pattern of females and are treated sexually as females by the dominant males, avoiding severe clashes as a result. Robert L. Trivers (personal communication) has seen many homosexual copulations in the wild in the lizard Anolis garmani, involving a male territory-holder treating a smaller male (maintaining his own smaller territory within the boundaries of the larger's) as a female. By this device the smaller male has access to females also living within the same large territory, until he grows larger than most females do, at which point he is excluded by the dominant male. Noble and Bradley (1933) report similar behavior in the laboratory for Anolis carolinensis and Ameiva chrysolaema, apparently mistaking it for simple dominance display.

It is probably not fortuitous that all the above examples involve males masquerading as females. The argument of Trivers (1972) is easily extended to explain this phenomenon, and likewise predicts that the so-called "sex-reversed" species of birds are just where one should look to find females masquerading as males.

In humans, the distinction between transvestism and cross dressing makes the situation more complex; one must ask about the biological significance of the sexual arousal that distinguishes the two. For humans, sexual activity is often a bond-forming mechanism, and one reasonable supposition is that cross dressing aims at motivating behavior from the public at large, while transvestism aims at obtaining certain behaviors from one's spouse. No large-scale studies of transvestites have been made, so this suggestion is best construed as a hypothesis for future research. However, many case reports are quite suggestive. Thus, in western cultures dependency is a trait considered appropriate more for females, while males are considered to be the providers; Beigel (1969) mentions one man who would exhibit the strongest sort of dependency needs while cross dressing, putting great strain on his wife. If this sort of explanation is correct, then many predictions can be made. For example, transvestism should be more common the more one partner provides a disproportionate share of the couple's support. Many researchers familiar with the subject (e.g., Green 1974b) have stated

that although there are indeed female cross dressers, no one has ever described a female transvestite. The incidence of cross dressing by sex requires an analysis of patterns of sexual dimorphism at different social levels, which is beyond the scope of this paper.

One other similarity is worthy of note, although its significance is unclear, and may be coincidental. Beach (1949) observed captive male rats which accepted sexual advances by other males by showing the typical behavioral pattern of a sexually receptive female; he found that such receptive males "invariably prove to be unusually vigorous copulators when they are placed with a receptive female." Pomeroy's survey (1975:220) found that human male transvestites "were more heterosexual than a comparable group of males taken at random" (emphasis in original).

Transsexualism. The condition of having one's innermost feelings of gender identity be inconsistent with one's sex of rearing, manifested in a desire to dress, act, and in every way "pass" as a member of the opposite sex, and usually including a desire for sex change surgery. Early writings on homosexuality often stated that homosexuality involved some degree of identification with the opposite sex, and claimed that homosexuals could usefully be divided into categories depending on the degree of the cross-gender identification. Recently, most writers have separated out the most extreme cross-gender identification and called it

transsexualism, since most transsexuals feel uncomfortable in homosexual milieux, and consider themselves heterosexual (living in the wrong body). Although I endorse this distinction, it will become clear that the evolutionary significance of transsexualism is as a non-reproductive extreme of homosexuality. There are other respects in which transsexualism is "more extreme" than homosexuality. For example, many more male-to-female transsexuals cross-dressed in childhood than did male homosexuals, and of those who did cross dress the transsexuals started earlier (Green 1974a, Saghir and Robins 1973). Likewise, although transsexualism is known to be highly resistant to treatment in any respect except the surgical one (Benjamin 1967), many homosexuals do change their behavior temporarily in the heterosexual direction as a result of therapy (Freund 1960, McConaghy and Barr 1973). But even closely related questions of fact are controversial--e.g., whether cases exist of complete change from homosexual to heterosexual (or the reverse) as a result of therapy (Tripp 1975:251-253, Laws 1974, Socarides 1970).

Homosexual behavior. Behavior between two members of the same sex which utilizes the mechanisms of sexual arousal. Clearly, an individual can participate in homosexual acts and still reproduce at other times; two prominent examples follow.

Mounting behavior in many species serves not only the ends of reproduction, but is also used as a ritualized way

of displaying dominance and submission. (Whether such behavior is "really homosexual" is simply a matter of definition; I have included it in the definition above since sexual arousal seems the intuitively simplest distinction to make.) Hrdy (1975) found that langur females often mount estrous females in the wild, accompanied by "highly realistic thrusting" (Hrdy, personal communication), and that this is a good correlate of displacement rank. Geist (1971, 1975:98) found homosexual mounting to be ubiquitous in wild mountian sheep as an indication of dominance in aggressive encounters; such mounting was accompanied by erection of the penis of the mounting male (Geist, personal communication). (It is my impression from personal communications that most male-male dominance mounting is accompanied by erection, pelvic thrusting, and occasionally anal penetration, although when written this is often called "considerable sexual excitement" or is not mentioned at all.) Similar behavior has been reported for free-ranging or wild individuals in many other species (Hamadryas baboons, Zuckerman 1932:230, 287; rhesus monkeys, Carpenter 1942:149-152 and Altmann 1962:395, "monkeys," Hamilton 1914:306-308; giraffes, Innis 1958:259-260), and probably exists in many more. (For caged populations, see Craig 1908:92 (pigeons), McBride and Hebb 1948:114-115 (dolphins), and Kempf 1917 (rhesus monkeys).) Much of the human homosexual behavior that occurs in prisons is strikingly similar to this sort of dominance/submission display, and

many human cultures have viewed homosexuality in this way (Bullough 1973). Ovesey (1969) has argued that this behavior should be called "pseudohomosexual." Although his distinction is a real one, I prefer the linguistically more imperialistic usage as long as it is made clear that the term "homosexual behavior" covers many distinct phenomena, not all of them identical with "homosexuality" (defined below). Incidentally, Geist (1975:98) recounted a good example of how societal attitudes can influence one's observations of wild animals. He once felt that the behavior pattern he observed between male mountain sheep should be called "aggressosexual" and not "homosexual," but has now dropped the former term. He feels he used it because "to state that the males had evolved a homosexual society was emotionally beyond me. To conceive of those magnificent beasts as 'queers'--Oh God!" Such candor is rare; many other investigators continue to maintain that dominance mounting should be considered aggressive and nothing else.

Some instances of homosexual behavior can correctly be interpreted as practice for or instruction in heterosexuality. Much of the homosexual activity that occurs in ultimately heterosexual human beings constitutes such practice. Many non-western cultures approve of adult involvement, so that the practice includes a certain amount of teaching (Ford and Beach 1951:131-133). Some other species show homosexual behavior that is at least superficially

similar to these possibilities (Carpenter 1942:151, Innis 1958:260, Hamilton 1914:306), including homosexual behavior in play (Meyer-Holzapfel 1961), even in the wild (Altmann 1962:395). There are also suggestions that homosexual relations among some animals can be a bond-forming or -reestablishing device (Hamilton 1914:307-308, Carpenter 1942:151-152, Ford and Beach 1951:135-138.) Meyer-Holzapfel (1961) argued that some of this behavior might be called "prostitution" since it helped in the attainment of social advantage, although the term seems extreme.

There is much other homosexual behavior reported in non-human animals that is not so easily classifiable; further investigation is needed to determine its adaptive significance. In the wild, Karsch (1900) carefully documented 10 cases of male-male copulation in Mayflies (Melolontha vulgaris); Struhsaker (1967) observed male homosexual play (or possibly dominance interactions) in vervet monkeys; and Organ (1958:256) broke up a courtship between two male salamanders exactly like others which had proceeded to spermatophore deposition in the laboratory. In captivity, homosexual behavior of an unusual sort in both males and females (but never between the sexes) was reported for two species of macaques by Kaufman and Rosenblum (1966); it consisted of the two partners presenting to each other, then backing towards each other until each could reach the genitalia of the other through their legs. Kaufmann (1965:71-72) noted homosexual behavior in tree

shrews, mostly associated with agonistic encounters. Chevalier-Skolnikoff (1974) reported a very wide variety of homosexual acts for both sexes of stumptail macaques in capativity; some resembled closely the behavior reported for the other two macaque species mentioned above. Finally, Erwin and Maple (1976) reported a case of "ambisexual behavior" including much preferential homosexual activity in a pair of captive rhesus monkeys, including anal penetration but perhaps not ejaculation; simple dominance as an explanation was convincingly ruled out. In all the cases in captivity the relevance to the wild situation is uncertain. However, the best rule of thumb is that if a behavior occurs in captivity it will occur in the wild, although often the context or frequency will be very different. Adaptive explanations should only be attempted after observations in as natural a state as possible. Nevertheless, it is clear (as Meyer-Holzapfel 1961 has also noted) that most cases of homosexual behavior in animals are relatively well understood from an evolutionary view. Such behavior is not merely a result of sexual segregation or nature's inability to perfect heterosexual adaptations; it has its own evolutionary causes.

Homosexuality. The sustained preference, in fantasy or behavior, for sexual relations with members of one's own sex. Note that "homosexuality" is not just a question of "homosexual behavior." A person can engage in much homosexual behavior

and yet not exhibit homosexuality or be "a homosexual." Conversely, it makes little sense to call a person "heterosexual" if his or her behavior is heterosexual (as the result of the desire to have children) or celibate (due to societal pressure), although his or her wishes in the absence of such pressures are homosexual. Adult homosexuals have often had times in their lives when they realized conscious homosexual attraction without acting on those attractions (Saghir and Robins 1973:33-35, 204-206), and exclusively heterosexual adults have often had incidental homosexual experience of no lasting significance (Kinsey et al. 1948, ch. 21; 1953, ch. 11). Moreover, at least for males the concept of a sexual identity separate from one's behavior can be placed on a firm, objective basis by the use of penile plethysmography (Freund 1974:32 and elsewhere). Even if one's preferences are entirely homosexual, it is still possible to marry and in certain cultures this was the commonest pattern--at least among males (Boswell 1977, Taylor 1965, Fisher 1965), and probably also among females (although historical documentation is much rarer). As noted above, transsexualism is a more extreme commitment to non-reproduction than many cases of homosexuality (although a few transsexuals do reproduce). We can thus visualize a continuum. At one end, we have homosexualities that interfere little or not at all with reproduction; at the other are homosexualities and transsexualities that interfere completely with reproduction.

The rest of this paper will examine how homosexual behavior and non-reproduction can act, separately and together, to help maximize one's inclusive fitness.

ON THE NATURE OF EVOLUTIONARY MODELS

Among the social insects, non-reproductives form a morphologically recognizable caste, with non-functioning gonads and a whole series of behavioral adaptations clearly "designed" to maximize the inclusive fitness of the individuals which show them (Trivers and Hare 1976). Individuals destined to be non-reproductive carry the same sorts of genes as those which will reproduce, and it is the actions of the brood-tending workers (creation of queen cells, etc.) which determine which set of genes will be expressed.

Among humans, lesbians continue to menstruate and be fecund; male homosexuals continue to produce viable sperm. Similar statements can be made for transsexuals of both sexes. With one exception (a finding of Masters and Johnson, concerning anal lubrication, reported second-hand by Sherfey 1972:110), I know of no morphological feature which could reasonably be interpreted as a special adaptation for non-reproduction among homosexuals.

Thus any selection for non-reproduction in humans has not gone as far as in the social insects. It is certainly conceivable that this is the result of the absence of selection for non-reproduction, and the inapplicability of the models to be proposed in this paper. It might instead be the result of insufficient time for natural selection to go to work on the genetic variability at hand. Or it

could result from the existence of selection pressures to keep open the option of reproduction in case one's circumstances change and reproduction becomes advantageous. Although I favor the last two alternatives, there is not yet more than circumstantial evidence in their favor, since most investigators have not been aware that there is a question to be asked in this regard. What sort of correspondence do we expect between evolutionary models and the "real world"?

Humans apparently spent most of their time differentiating from other primates as hunter-gatherers, and most adaptive explanations must be geared to this state. Although many details of the earlier evolution of hunter-gatherers must remain speculative, some details are well enough established to be of use here, and current hunter-gatherers not too long influenced by outside investigators may still be available.

It is also conceivable that some adaptations have arisen only under conditions existing in more modern societies. Such adaptations must have arisen from pre-existing genetic variability of the traits concerned, and be simply enough inherited or linked that selection can be expected to work over relatively few generations, making the establishment of elaborate new linkages unnecessary. These conditions are stringent, but perhaps not insurmountable.

Finally, if one makes an adaptive interpretation of a behavior in terms of a hunter-gatherer society, it can also be of intellectual interest to know if the behavior is still

adaptive today, when environments are so different. A priori, it is often impossible to say, although shrewd guesses can be made; in the last analysis, one must go out and measure reproductive success (or inclusive fitness) and see. If it were to turn out that the behavior in question is no longer adaptive for the individual (or for the society's other members, often a separate question), then one faces the political and moral question of what should be done about it. Scientists have little to offer as scientists to this debate, except to point out other instances of situations with underlying similar causes.

Our society treats many such behaviors in different ways. Women menstruate much more often now than they did in hunter-gatherer days (Frisch 1975 and references therein), yet the medical profession regards regular menstruation as normal and desirable, and a significant group even regards pregnancy as an "abnormal" physiological state. (This is not to imply that pregnancy is the only natural state, of course.) Michael et al. (1974 and references therein) have found that women produce, cyclically in the menstrual cycle, volatile fatty acids that in other primates function as sex pheromones. McClintock (1971) found that women who spend much time with each other tend to synchronize their menstrual cycles. These formerly functional relationsips are now counteracted or ignored by our culture. There is an extensive literature on the evolutionary relationships between birth, breast feeding,

and sexual responsiveness (reviewed by Newton 1973). Our society has often ignored or disrupted these relationships using techniques of hospital birth and early weaning.

So if the current-adaptiveness question is investigated, biologists must be careful with a world whose members may wish to use the apparent current maladaptiveness of a trait as a way to make the mode the only permissible alternative. Our culture approves of shaving and disapproves of homosexuality, but it should not be allowed to forget that perhaps the wrong one is called a "crime against nature."

The whole question of the naturalness or unnaturalness of homosexuality has a curious history (Boswell 1977). One common modern view is that homosexuality is unnatural because it is non-reproductive and because animals do not engage in it; reproductive behavior is seen as a higher, more human goal. On the other hand, many ancient Greeks who idealized homosexuality used precisely the same two "facts" to argue that homosexual behavior is the higher goal (pseudo-Lucian 1967:205,207)--heterosexual behavior was seen as the embodiment of base, animalistic reproductive urges. Now that the existence of homosexual behavior in animals has been proven, there has emerged a fall-back position: that "Homosexual behavior has never been the main choice, or even a customary minor part of the sexual pattern, of any mammal living in the free state" (Hunt 1974:299), or that homosexual behavior occurs only in the absence of the opposite sex, or consists

only of dominance interactions, or occurs mostly among juveniles. On the other hand, Kinsey et al. (1953:448-451) considered human homosexuality to be the result of fundamental mammalian patterns of sexual arousal, as modified somewhat by the human ability to be influenced by experience, a viewpoint which ignores the adaptive significance of the behaviors in question and the possibility that different selection pressures in humans might have selected for novel forms of homosexual behavior. Yet again, many people who feel homosexual behavior is unnatural because it cannot result in offspring endorse contraception and non-coital sexual techniques as being completely natural since the couples who use them have it "within their power to be fertile or not, as they choose" (Hunt 1974:299)--although this last author feels sado-masochistic relations are abnormal even between heterosexual spouses and seems to have been recently ambivalent about anal intercourse (p. 36). To be sure, some individuals maintain completely consistent opposition to homosexual behavior and contraception, although the justification in "natural law" is completely without scientific foundation (Wickler 1973).

As the homosexual behavior of animals becomes better known, I suspect that it is only a matter of time before arguments are heard that humans should not let animal behavior dictate what is believed to be right and wrong, that homosexual behavior is an expression of animal lust that must be

refined into proper heterosexual expression. Likewise, I would expect the ghosts of Socrates and pseudo-Lucian to decide that the homosexual behavior seen in animals is of a completely different character from that seen in humans. As a scientist, it is my duty to point out these distortions, but I find it difficult to get too worked up over them, since they occur in every conceivable combination and are singularly removed from logic. Human homosexuality is a phenomenon that overlaps homosexual behavior in animals somewhat, but not completely. There is probably no case of animal homosexuality that is precisely like some human forms in every detail; but then again I know of no non-human species whose heterosexual behavior is characterized by socioeconomic differences in reproductive strategy (Kinsey et al. 1948, ch. 10; Weinrich 1976); or that combines large amounts of investment in offspring by the father with significant amounts of extramarital behavior and sexual arousal mediated by large numbers of touch receptors rather than stereotyped fixed action patterns. The value of animal studies lies in the discovery that when homosexual behavior occurs, it usually makes evolutionary sense for the unique environment the animal finds itself in. This generalization makes it worth seeking adaptive explanations for the human cases as well.

ELABORATION OF THE EVOLUTIONARY MODELS

What follows is for the splitters, not the lumpers. I will enumerate six ways being a homosexual (exhibiting homosexuality, with or without homosexual behavior) can interfere with reproduction, and the theoretical ways it can be explained by evolutionary logic. I will confine myself for the moment to simple kin selection models and work out the required evolutionary consequences for self and kin. In each case, of course, the partner(s) for any homosexual acts must also receive some benefit.

Case 1. Marriage and children early in life, then homosexuality interferes to halt reproduction; spouse raises children. Abandoning one's spouse and children is a reproductively spiteful act (in the absence of child support), hurting their reproductive success and thus one's own. Evolutionary theory predicts that for such behavior to be adaptive for the abandoner, there must be a return benefit. If one is homosexual to the point of ending reproduction, this benefit cannot be to oneself; it must be to one's kin. (For heterosexuals who remarry, of course, the return B can take the form of further children by another spouse.) If the (newly) homosexual spouse pays an equivalent of child support, then the C to the children and one's own reproductive success is lowered, perhaps eliminated; this case falls under case 3.

Case 2. Marriage and children early in life, then homosexuality interferes to halt reproduction; ego raises children. In some cases this does not imply much of a marginal cost to one's reproductive success. For example, if the spouse dies, is severely sick, or is a cruel parent, deserting the spouse as a result of one's nascent homosexuality may even generate a net benefit--although one should of course prefer a well-functioning spouse. If one settles down with a homosexual partner, theory predicts that one must get some benefit from this association (for example, by having a second person around to help with child-rearing in times of one's own stress); sexual relations can function as a bond-forming device.

Case 3. Marriage, children, and homosexuality coexist. We have seen how sometimes homosexuality does not interfere with reproduction. Evolutionary theory need only predict in such cases that some benefit is gained for one's own offspring as a result of any homosexual behavior (by forming alliances with other individuals on the hunt, for example). If, however, the homosexuality inflicts a cost on one's offspring, then the theoretical situation is the same as in case 2; one's kin must benefit.

Case 4. Homosexuality which interferes with reproduction, followed by marriage and children. Here, theory predicts that a homosexual person engaging in homosexual behavior does so with an ultimate desire for marriage and children, and that

an advantage is gained from the homosexual behavior. Regardless of the existence of actual behavior, a benefit for one's ultimate reproduction must also be expected as a result of the postponement of reproduction. Some homosexuality can persist into the marriage only under the conditions of case 3.

Case 5. Lifelong homosexuality interfering with reproduction, due to unfortunate circumstances. This is an undesired outcome of case 4. "Unfortunate circumstances" refers to events beyond the control of the individual which either never change to make reproduction favorable, or which cause the expected return benefit not to materialize, the reproduction having been postponed beyond the point where any significant benefit can be attained. In this case, the individual should feel some remorse at not having children, express unhappiness with the events that prevented this, and so on.

Case 6. Lifelong homosexuality interfering with reproduction, not due to the failure of case 4. Here the theoretical predictions are simple: a benefit must accrue to one's kin as a result of any homosexual behavior, and a benefit must accrue due to the non-reproduction.

Now for the lumpers. Most of these six cases involve a cost to one's own reproductive success, and a benefit to one's kin. These costs and benefits cannot be arbitrary values; one must have $B > rC$ as explained earlier. This should occur most often when the B is unusually large, the C is unusually small, the r is unusually high, or some combination

of these. It has now been convincingly demonstrated that the evolution of non-reproduction in the Hymenoptera (social ants, bees, and wasps) is due to the high-r pathway (Hamilton 1972; Trivers and Hare 1976). The B > rC relationship has two other variables, however, and it follows that non-reproduction as a result of large B or small C must be seriously considered as an evolutionary mechanism. (For example, in termites, where the r's are no higher than in humans, non-reproductive castes have evolved, and must eventually be explained in these terms.) It is emphatically not the case that "the one fact we know [about human sexual object choice] . . . is that male and female are programmed to mate with the opposite sex, and this is the story of 2 1/2 billion years of evolution . . ." (Socarides 1974; see also 1970), or that "homosexuality is biologically absurd . . ." (Swanson 1974:108). Far from being obvious consequences of evolutionary logic, such statements are premature. They cannot be accepted until it is shown that homosexuality actually does lower inclusive fitness for those who exhibit it in hunter-gatherer societies. A later section will show that this is unlikely.

THE LEARNING OF TYPICAL AND ATYPICAL SEX ROLES

Along the lines of the introduction to this paper, I will now argue that the learning of gender role behavior differs in sensible ways from simple classical conditioning and Skinnerian theory. This job has essentially been done by the extremely comprehensive review of the literature by Maccoby and Jacklin (1974). They concluded that although "the processes of direct reinforcement and simple imitation are clearly involved in the acquisition of sex-typed behavior, . . . they are not sufficient to account for the developmental changes that occur in sex typing" (p. 365). Another component is required, since "children seem to adopt sex-typed patterns of play and interests for which they have never been reinforced, and avoid sex-inappropriate activites for which they have never been punished" (p. 362) and "children have not been shown to resemble closely the same-sex parent in their behavior" (p. 363). Although a few sex-typed differences seem to be almost deterministically influenced by the sex chromosomes, a more comprehensive explanation is required for behaviors that differ in cross-cultural perspective. A reasonable conclusion to be drawn from this review is that children are "designed" to discover--seemingly effortlessly--the rules of sex-typed behavior deemed appropriate by the culture they find themsleves in. (The similarities to the language acquisition process are clear.) But in contrast to

the deterministic statement of this position, an evolutionary approach must note that some individuals will find themselves in situations where it is not to their advantage to follow the usual roles; and in some of those cases, even extreme deviations from the typical roles may be advantageous. In such cases, it would be worthwhile to have developmental switches built in to the sex-role-deduction process, producing atypical behavior in atypical circumstances. Following Seligman's (1976) criteria, one can ask whether these behaviors are a non-random subset of all those conceivable, acquired without seeming effort by certain individuals; whether they are robust and difficult to extinguish, little influenced by rational arguments about what girls and boys should and should not do, and whether they make evolutionary sense.

Sex-role "deviations" do indeed show patterns that are non-random, although many are poorly understood. As noted above, male transvestites exist but female ones do not (Green 1974b). In contrast, both male-to-female and female-to-male transsexuals exist, the former being more common than the latter (Hoenig and Kenna 1974, but see Wålinder 1968). Most studies show male homosexuality to be more common than lesbianism (Kinsey et al. 1953:487). Among those who are not completely heterosexual, however, bisexuality is apparently more common among women than men (Bell 1974). Allowing for a certain amount of uncertainty in all these studies, it is

nevertheless clear that the female/male ratio of transvestites, transsexuals, homosexuals, and bisexuals differ strikingly from each other. There are many other non-random patterns of sexual atypicalities that could be cited here.

Without the assistance of evolutionary logic, the acquisition of the atypical gender role behavior seems magical. Green (1974a) cited many case histories of boys and girls who show the sex-role patterns usually associated with the opposite sex, and one is impressed on reading them with how effortlessly this occurred for those individuals. If one asks homosexuals why they grew up feeling attractions to their own sex, one will get many answers, but overshadowing their specific responses is the observation that the persons in question don't logically know; it just happened that way (Kahney 1976). Similar observations can easily be made with transvestites: the desire to cross-dress seemingly just began. Most (perhaps all) "primitive" cultures that have cross-gender institutions endorse the belief that the inspiration for the "berdache" [cross-gender] role is super-natural: that the individual is compelled to take up the role by forces outside his or her control.

The difficulty of extinguishing transsexual and homosexual feelings has already been remarked upon in an earlier section. Although the efficacy of psychotherapy in the treatment of homosexuality is still extremely controversial, simple Skinnerian or behavior-therapy techniques seem ineffective,

even according to investigators who earlier reported progress along these lines (Freund et al. 1959, Freund 1960, Laws 1974, Tripp 1975:ch. 11), and certain Skinnerian-inspired techniques do no better than those difficult to explain in Skinnerian terms (McConaghy and Barr 1973). Likewise, rational arguments, threats, and discussions concerning a child's atypical gender role behavior do not seem to have much effect. Zuger (1970:1170) reported that his group of effeminate boys "initiated the feminine behavior and even insisted on these practices in spite of prohibition and punishment." This observation is confirmed for both sexes in many of the case histories extant (e.g., Green 1974a,b).

Thus, four of Seligman's five criteria are satisfied in the case of atypical gender roles. The fifth criterion is that of evolutionary sensibility. In the next section, I will match up specific sets of instances of atypical gender role behavior with the specific evolutionary explanations listed in the previous section.

APPLICATION OF THE MODELS

Berdaches and transformed shamans. Many so-called "primitive" cultures (most of them hunter-gatherers) had these cross-gender institutions established to varying degrees. The parallels between the transvestitic or homosexual aspects of these institutions and the more recent manifestations are extensive and quite specific. Consider the following descriptions:

> "[The subject] had dressed like a girl, played like a girl, and fantasized about 'really' being a girl. [The] mother and grandmother collaborated in this . . . childhood playmates were girls, and [this person] had no interest in boys' games like 'ball or bat or dumb marbles.'" (Sabalis et al. 1974:907)

> "The more common symptoms are . . . the wearing of articles of women's dress, . . . a preference for playing with girls, asserting a desire to be a girl or a woman, feminine gesturing, playing with dolls, and exhibiting a lack of interest in or outright dislike of boys' games and sports." (Zuger 1966:1099)

> ". . . when they are children, [such people] discover an effeminate disposition. They are clothed very early in feminine attire . . ." (Falkner 1774:117)

> "[Such a child] cannot be brought to join in any of the work or play of the boys, but on the contrary associates entirely with girls . . [and] acquires all the habits of a girl . . . [Later] the parents clothe him in a girl's dress . . ." (Denig 1961:187)

> "[Such people] pick up dolls and toy with metates just as girls do. They refuse to play with the toys of their own sex. Nor will they wear a breech-clout. They ask for skirts instead. They will watch a woman's gambling game . . . [and] try to participate in the game whenever they see it . . . Their parents will eventually notice this strange behavior and comment upon it." (Devereux 1937:502).

The first quotation concerns a pre-operative male-to-female transsexual. The second describes a group of feminine-acting boys in a group that had an unusually high incidence of male homosexuality in adulthood. The last three describe male-to-female berdaches among the Araucans, Crow, and Mohave, respectively. Precisely similar quotations could be found for female-to-male institutions. Bleibtreu-Ehrenberg (1970:213) and Giese (1962:325) have noted the striking similarities between modern accounts of male transvestism and transvestitic institutions among "primitive" cultures--for example, the variable strength of the transvestitic urge over time, often peaking when there is an audience, or when the transvestite is subjected to external pressures.

Tables 1 and 2 summarize the information gathered from anthropological observations concerning institutions with some degree of cross-gender identification. (Excluded are observations of homosexual behavior or homosexuality devoid of cross-gender elements, the most extremely uninformative of the accounts of the early explorers, those in languages I was unable to deal with, and those inaccessible to me. An effort has been made to include every observation of original investigators, although I suspect the list is far from complete. Others who look into this literature should be warned that the terminology for the various cross-gender institutions is extremely variable and sometimes inconsistent--see Angelino and Shedd 1955.)

(Perhaps the most striking feature of Tables 1 and 2 is the absence of so much information; the accounts are common--especially for males--but spread very thin. Only Bogoras (1904-1909), Métraux (1942), and Devereux (1937) provide detailed accounts; in second place by far are Seligmann (1902), Levy (1971), Hill (1935), Hoebel (1960), Kroef (1954), and Parsons (1916), who give good accounts of various specific details.)

With few exceptions, a consistent picture emerges from these tables. Many "primitive" cultures institutionalized a pattern whereby a boy could be raised as a girl, whether he showed such a preference himself or his parents desired it of him; he would be shifted to a female peer-group at varying ages, and would completely take up the occupations and dress of a woman by puberty. With high probability it would be possible for him to marry or be the concubine of a man, engaging in sexual relations with him, and often acquiring shamanistic (witch-doctor) power as a result of his transformation. Many cultures also permitted individuals to stop before going to the extreme, adopting some mixture of male and female dress. The converse set of possibilities for females was also permitted in many cultures. Although probably in many cases a female-to-male institution was overlooked or considered unimportant due to the bias of the male investigator, or the unwillingness of female informants to tell a male investigator of their customs, the conclusion

that female-to-male institutions were less common seems inescapable. One female investigator (Lurie 1953) was able to elicit information about a male Winnebago who had adopted women's work, but was not able to elicit anything about a corresponding female except for one case she described as "doubtful" involving a woman who saved some men in a war, who "laughed aloud like a man." Moreover, some male investigators tried to find information concerning women and failed--Lafitau (1724, I:46) described "Amazons" in western history and myth in great detail, but failed to mention any among the American natives.

The exceptions to this general pattern are few. The female case among the Nuer is perhaps not a cross-gender institution, but only a homosexual one, although same-sex marriage occurs, and one or two cultures do not permit shamans to transform their sex. The most important exception concerns the Sea Dyak, where two investigations confirm that boys are not brought up in a cross-gender role; indeed, one must attain a certain advanced age before one thinks of becoming a manang bali. In this case, one's father must pay a series of increasing fees to initiate the grown son into the role, and all three investigators agreed that the manang bali are invariably rich (often chiefs) as a result of their fees for shamanizing. Since the shamanizing is held to be more effective the more transformed the shaman, it is reported that marriage to another man is an important asset; but the

husband is said to do this only with the aim of inheriting the manang bali's riches. Although one must be wary of post hoc rationalization, it is tempting to interpret the Sea Dyak pattern as a modification of the basic plan, which resulted when the manang bali's role happened to become especially lucrative, as opposed to simply having its own share of compensations.

Historical institutional changes of this magnitude are not unknown--Sea Dyak shamans once all dressed in women's clothes (Roth 1896, I:282); nowadays only certain manangs do. Métraux's excellent paper clearly documents from the historical record changes in the role of the shaman among the Araucans of South America. The earliest reports indicated that all shamans were men who had taken up the role of women, who took "the passive role" in homosexual relations, and who were chosen for the role in childhood, due to their feminine mannerisms or certain physical deformities. Nowadays, however, all Araucan shamans are women. Historical progressions in the opposite direction have also been hypothesized; presumably both transitions have occurred often in history. This should caution us against any oversimplified attempt to interpret a single culture's pattern in evolutionary terms, even if there were not the filter of uninterested or hostile observers between us and the culture itself (e.g., Catlin 1926:244).

Despite this caution, certain cases almost certainly fall into Case 6 or Case 5 of the earlier section, and others

probably do. Again and again, the investigator happens to mention Bs that accrue to individuals or their kin as a result of their non-reproduction; many are listed in the last column of Tables 1 and 2. There are cases where every step can be justified on evolutionary grounds. For example, in a culture with high bride-prices, turning a boy into a girl turns a family's economic liability into an asset; the boy in question often has a "defect" that makes the C to his own reproductive success especially small; the husband who marries the boy-turned-woman has other wives with whom to achieve his own reproductive success and is in effect buying himself a servant to help with the household chores; these chores are often arduous and done especially well by a wife who is not raising "her" own children. Likewise, a Nuer woman who marries another woman is usually barren, and enmeshes herself in the complex system of cattle exchange that being a father or an uncle implies (Evans-Pritchard 1951:108).

Similarly suggestive facts turn up in case after case, in spite of the fact that the investigators were ignorant of kin-selection hypotheses and made no systematic attempt to report such events. The husband of a Sea Dyak manang bali is "generally a widower having a family" (Low 1848:176). Berdaches among the Toradjas adopted nieces and nephews, and took up women's work primarily because of cowardice or some harrowing experience (Kroef 1954:258-259). Male-to-female

berdaches among the Mohave (Devereux 1937:517) were said to be cowards. "As a rule, child-birth among the Paleo-Siberian shamanesses results in either a complete or at least a temporary loss of the shamanistic gift" (Czaplicka 1914:252). Among the Mohave, "No hwamē [female-to-male berdache] ever bore a child after assuming that status" (Devereux 1937:510) and "It was hinted that painful childbirth may not have been foreign to this decision" (p. 515). Many cultures insured or observed that berdaches were unusually powerful shamans (Devereux 1937:516; Bogoras 1904-1909:453, Roth 1896, I:271, Hill 1935:275). In others they excelled in some other way: women's work (Devereux 1937:513, Simms 1903:580, Kroeber 1925:647, Waltrip 1965:6, Hassrick 1964:123, Lurie 1953:708); matchmaking, peacemaking, and advice-giving for important decisions (Reclus 1896:80-81, Métraux 1942:349, Hoebel 1960:78, Shea 1903:37, Hill 1935:274-275, Roth 1896, I:271); or some form of altruism (Simms 1903:580, Lurie 1953:710).

All these cases can reasonably be understood in the light of a low C for non-reproduction, a high B to one's kin, or both. It should be possible in many instances to point to specific events in the life histories of individuals which resulted in the individual's facing a very much lowered C or raised B. In all sources except one, only events of the berdache as an adult are recounted (although Czaplicka 1914:173 reported one case of an apparently non-transformed shaman who took up the shaman role after a severe illness).

This exception is Bogoras (1904-1909:450-455) who described seven shamans in various stages of transformation. Three of these (including the one Bogoras knew best) took up shamanism to cure themselves of a severe childhood disease; two more did not describe their childhoods; one was at the time a sickly child; and the last was a child simply described as "a nimble young fellow and an able herdsman." In accounts of modern male-to-female transsexuals, it is very common to read of some sort of childhood trauma immediately preceding the appearance of femininity (Green 1974a:226 and ch. 14) (small C); and in the case of transsexuals of both sexes, of a dead or severely disabled parent (large B to the family) (Green 1974a:222; Stoller 1972), also pointed out for the Sioux by Hassrick (1964:121). Green (1974a, ch. 14) even reports one pair of monozygotic twins, one of whom began feminine behavior after contracting a disease of the lymph nodes; his unaffected brother is typically masculine. Likewise, Zuger's (1974) group of effeminate boys showed an above-average incidence of certain physical defects. (An occasional myth of sex transformation will cite severe trauma as the reason for the change: Boas 1901:325-326.) The institution of shamanism per se seems to be attractive to individuals who have undergone some trauma, regardless of whether this involves a change of sex (Handelman 1967, Ohnuki-Tierney 1973, Bororas 1904-1909:420-424, Bleibtreu-Ehrenberg 1970:221-222), although there are some exceptions

(Ohnuki-Tierney 1973). Given the fact that this list is far from complete, that Bs and Cs cannot be measured quantitatively in retrospect, and that exceptions to this generalization are sometimes encountered (see above), this interpretation must be regarded as suggestive but not definitive.

So far, the explanations given seem rather severe and negative, involving various sorts of misfortune to oneself or one's family, with especially large effects on the C of non-reproduction--uncomfortably reminiscent for some of the darker sorts of anti-homosexual theorizing. This has been done deliberately, to show how one must guard against the covert creation of a tone of presentation that is unjustly prejudicial. Some investigators have apparently filtered their reports of homosexual behavior to overemphasize its association with misery or cross-gender behavior. To be sure, this filtering might not always be conscious or completely avoidable: public cross-dressing is more likely to be observed than private homosexual behavior, for example. But a proper application of an evolutionary view warns us that rB can be greater than C for both "bad" and "good" reasons, not just for low C but also for high B, and a scientist who wants to be more than naïve has a special responsibility to point this out.

Being a shaman, acquiring a cross-sex identification, and engaging in homosexual relations are also correlated with special ability in the performance of certain rites.

Charles (1953) argued that shamans must be excellent dramatists in their exorcistic performances. Carpenter (1910), in a paper that was well ahead of its time, argued that a cross-sex identification or homosexuality assists in this process, and in the processes of divination and religion. Shamanistic performances often require proficiency in music (or at least drumming), and many berdaches played special roles in tribal ceremonies; Kiefer (1968) argued that cross-sex identification is common among musicians of many cultures, and showed why this may be the case for one culture in the Philippines. Very significant is the report by Green and Money (1966), who reported that effeminate boys are unusually adept at stage-acting and role-taking--at an age long before they could know that the acting profession has an unusually high incidence of homosexuality (as do the arts in general: Gebhard et al. 1965:29). Tripp (1975:276) asserted that "much more than accident is involved when frequency rates [of homosexuality] jump from less than 4 per cent to as much as 90 per cent, and then back again as one crosses professional lines." Perhaps the consideration of the role of the berdache can help explain some of these patterns.

But once again the argument seems to be moving in the direction of stereotypy. Accordingly, I would like to make an effort to suggest other areas for research that might produce more "positive" results.

It is apparently the case that, as a statistical ensemble, homosexuals have higher I.Q.'s than heterosexuals. Table 3 lists every study that I could find that tested a group of homosexuals (or, in one case, a group of women engaging in homosexual behavior) for I.Q.; to the best of my knowledge, such a review of the literature has never before been attempted. Although I.Q. tests have justifiably been attacked for racial, ethnic, and social class bias, homosexuals and heterosexuals live more or less under similar conditions, so these criticisms will not concern me here. Leaving aside the studies of prisoners, the investigations are in complete agreement. Although one must be especially cautious about bias in the selection of subjects in I.Q. studies, there is one extremely well controlled study of both men and women (Liddicoat 1961), and others where any bias, if it exists, is extremely subtle, except for the obvious inattention (once again) to women.

(The results for prisoner populations require more discussion. The report by Norris (1974) must be excluded because the subjects were those who engaged in homosexual behavior in prison, a much more inclusive group than those who were preferentially homosexual "on the outside." The three male prisoner studies are mixed. Since I.Q. is well correlated with educational attainment, we can attain some insight by considering the differences between the incidence of homosexual behavior by education according to the original Kinsey volume (Kinsey et al. 1948:361,376), whose statistics

were significantly contaminated with prisoner histories, and according to the same data base when the prisoner histories are removed (Gebhard 1972:27-28; Gebhard et al. 1965:625). The result is the elimination of educational differences in extensive or exclusive homosexuality among men, with perhaps even a small reversal of the trend (4% of college-educated compared with 3.4% of those with high school or less), although this may be pushing the accuracy of the data too far. Prisoners thus have an atypical distribution of homosexual behavior for their education. If this observation extends from education to I.Q., then Hemphill et al.'s (1958) finding of complete agreement with the uncorrected Kinsey figures constitutes not a disconfirmation of the "belief that homosexuals are above average intelligence" (p. 1318) but a perfect confirmation of the mechanism proposed here.)

The fact that I.Q. tests may measure not so much "intelligence" as the ability to do well in the prevailing culture fits in well with a sociobiological argument of Wilson (1975: 548), worked out in ignorance of the following logic. Wilson hypothesized that man's "mental hypertrophy" evolved as an aid to keep track of and evaluate one's important interactions with scores of other individuals. Moreover,

> "Bonding and the practices of reciprocal altruism are rudimentary in other primates; man has expanded them into great networks where individuals consciously alter roles from hour to hour as if changing masks."

Elsewhere (p. 555), he stated that "The homosexual members of primitive societies, . . . freed from the special obligations

of parental duties, . . . could have operated with special efficiency in assisting close relatives." Putting these two observations together, the data on I.Q. in Table 3 might almost have been predicted. Raising children--although not to be belittled and certainly requiring intelligence for optimum success (Bajema 1963)--is after all an activity that has gone on for millions of years, and one might expect many adaptations to have evolved to aid in the execution of this goal. But if non-reproductives are specialists in the ascertainment and manipulation of societal effects on their kin, and if higher intelligence is needed to keep track of these effects, then we would expect the evolution of modifier genes to increase the intelligence of those forced into non-reproductive roles and to increase the probability of non-reproduction for those especially high in intelligence. (The high I.Q.'s of hypogonadotropic eunuchoids found by Raboch and Sípová (1974) is consistent with this possibility.)

(This is not the way most people are used to thinking of I.Q. Most people in upper socioeconomic strata see "intelligence," at least, as an unqualified advantage, although the incorrect notion that high I.Q. lowers reproductive success is still also prevalent. The idea that I.Q. might sometimes vary as an adaptive function of environmental circumstances is rarely expressed, although it has occurred to others (Layzer 1975:1129). It must, of course, be considered with the most extreme care in order to avoid confusing variability

in I.Q. due to prejudice or test bias with variability due to adaptive developmental plasticity.)

A yet more "positive" line of argument can be made. It is common sense--verified in probably every species on earth --that reproduction requires effort, at a cost to the individual in some other area of its existence. Non-reproductives--even those who are "squandering" a certain proportion of their efforts on members of their own sex--are thus to a degree more able to devote efforts to other pursuits and achieve prominence in them. If this prominance has resulted in benefits to their kin of the right magnitude, then there is no reason why genes allowing such non-reproduction could not have spread. Even in cultures that make things more difficult for homosexuals, this simply alters the quantitative and not the qualitative effects. Boswell (1977) has concluded, after an extensive review of the historical record, that homosexuality (sometimes consummated, sometimes not) has permitted individuals to excel in the particular genius of their age--especially so in the many cases where there were no more strictures placed on homosexual than heterosexual relations (here the evidence is beyond dispute). This analysis recalls Carpenter's views (1910) on the connection between homosexuality and divination. If we take shamanism and witch-doctoring to be the genius of many hunter-gatherer cultures (and the fees paid to most shamans indicate that the people in these cultures considered them to have beneficial,

specialized powers), then this paper has supported the notion that some of these abilities useful to hunter-gatherers have become embedded in the human genome as options, ready to be called into service when individuals take up non-reproductive roles--even though our culture no longer places a high value on talking in tongues. Other, more general-purpose qualities (like I.Q.) continue to be valued by our culture, and should show up especially often in situations where significant threshold effects occur in the relationship between effort expended and increased status received.

If a society is stratified along socioeconomic lines, certain theoretical predictions can be made from this theory which are consistent with the observed patterns of many cultures, although this cannot be considered a particularly strong confirmation since exceptions are not likely to be reported before the theory is proposed. Different incidences of non-reproduction are expected at different class levels, according to a simple argument shown in Figure 1. Since male reproductive success (RS) varies more than female RS (Trivers 1972), male RS is more sensitive to socioeconomic standing than female RS is (Trivers and Willard 1973). Non-reproductive individuals lose the RS associated with their own children, but gain the chance to use the investment to raise their own socioeconomic status, which redounds to the benefit of kin. The key insight is that non-reproductive women and men should be representable on lines of roughly the same slope (in

Figure 1's graph of inclusive fitness versus socioeconomic status)--a line similar in slope to that of the reproductive males. This is so because the sorts of ways non-reproductive individuals can assist relatives--sharing income, using one's job status to open doors and provide opportunities, being ready to help raise a relative's child if the relative becomes incapacitated, etc.--are biologically unrelated to the act of childbearing, which is what gives the reproductive woman's line the lower slope in the first place. The propensity towards non-reproduction should thus increase with high socioeconomic status for women, but not much (if at all) for men. This result can be applied to homosexuality if non-reproductive individuals are homosexual with roughly equal probability at different socioeconomic levels (a hypothesis admittedly deserving more investigation, but not contradicted by any evidence I know of).

This is the case in our own culture, the only one for which reliable data are available. (Kinsey et al. 1953, Fig. 85, gives the statistics for women; the male pattern in the 1948 volume was corrected by Gebhard 1972:27.) It is difficult to decide the extent to which this pattern is repeated in other cultures, since the absence of information could result from the falsity of the hypothesis, the disinterest of the investigator, the small number of cases, or many other factors. Devereux (1937:502) noted that "One female informant, herself a member of a chiefly family, stated

that only persons classified as . . . [a] member of a prominent family . . . became transvestites [berdaches], as a rule." Seligmann (1902:13) reported a single female case; this woman was "a daughter of one of the most influential men of the tribe." This small set of facts, moreover, could not be considered a decisive confirmation of the theory in Figure 1, since most other theoreticians are aware of the facts and have explanations for them--although the fact that both cases involve women in spite of the male bias of the literature is suggestive. It is presented here mostly to emphasize that one cannot assume a priori that the relative incidence of male and female homosexuality or non-reproduction would be about equal; the ratio is expected to vary at least as a function of the degree of accessibility non-reproductive women have to the resources and processes required to aid relatives, and probably with other parameters as well. Kinsey et al. (1953:459), for example, found a clear correlation between female homosexual behavior and education.

Finally, some cases of berdaches who relinquish the role later in life may fit Case 4. Much of the literature mentions how an individual can take up the role, but fails to mention if anyone ever leaves it; I was unable to find any descriptions of individual life histories that would suggest why one would leave the role. The case of LEle'ks (Spier 1930: 52-53,96) is tantalizingly incomplete. "As an adolescent he wore women's dress and performed the appropriate tasks,"

but his people "wanted him to give up women's garb." So they arranged a test while he was sleeping. "They placed a bow and arrow and a punt pole by his side, the latter a symbol of women's work. They stood over him and shouted. As he jumped to his feet he grasped the bow, thus determining his future . . . He left off women's dress and actions . . . He became lucky in every way, acquired wealth, especially in horses, and prestige, and became the foremost chief the Klamath have ever known. His subsequent career seems quite normal unless exception be made of his seven wives!" Missing from this account are any mention of what (if anything) motivated LEle'ks to take up the female role to begin with, and what other important events were happening in his life at the time of the test. If informants who remember this individual are still alive, these predictions could conceivably be confirmed or disproven.

Homosexual behavior as a bond-forming device, coexisting with reproduction. After cross-gender institutions, the most common form of homosexual behavior mentioned in "primitive" cultures is that relating to bond-formation that does not rule out simultaneous reproduction according to the usual customs of the culture. One example which is often proposed concerns homosexual behavior between males on a hunting or warring expedition, to help maintain group solidarity. I have not, however, found a single reported instance of this in the

anthropological literature. The closest approximation involves the berdaches described in the previous section; in some cases, such individuals did help to maintain group cohesion in wartime. Erikson, in a maddeningly ambiguous passage (1945:329-330), stated that among the Yurok or Sioux, a berdache "is not necessarily a homosexual (although warriors before going on the war path are said to have visited such men in order to increase their own ferocity)." Among the Cheyenne (Hoebel 1960:77), members of war parties like to have berdaches come along, "not only for their medical skill, but because they are socially graceful and entertaining"; the berdaches also preside over the victory party (Scalp Dance) afterwards. Among the Illinois and Nadouessi, male berdaches do go to war but are "allowed to use only a club, and not the bow and arrow" (Shea 1903:37), although no details are given as to what else the berdaches do to make themselves useful. However, among the Mohave, berdaches of both sexes did not go to war (Devereux 1937:518). It was fairly common in other tribes for female-to-male berdaches to go to war and fight as men. It is conceivable that the absence of these reports is due to investigator bias or absence from war parties, but the possibility seems weak.

More common are the phenomena of pedophilia (sexual relations between adults and children) and hebephilia (between adults and adolescents). All the descriptions I found were between males; the two phenomena were often hard to distinguish

since the term "boy" is often applied to adolescents. Among the Siwan in Libya, Cline (1936:43) described the way "Prominent men lend their sons [12 to 18 years old] to each other." He had some trouble eliciting information, since "Fear of the Government has lately made sodomy a more secret matter"; however one native source found that 59 of 60 men "had been catamites." Hardman (1888:73-74) noted that men of the Kimberley district (Australia) would be married to 5-10-year-old boys, who have "connexion" but not "Sodomy." Among the Aranda (Strehlow 1913:98), a man commonly marries a 10-12-year-old youth (in this culture, sometimes no longer considered a boy) until he (the older man) marries a woman; the youth is used like a woman (". . . als Weib gebraucht wird."). Ravenscroft (1892:122) found that old Chingalee men "jealously guard" one or two boys, with whom they engage in an unspecified form of sexual behavior. Among the Maragoli and Bagishu there are "passive pederasts" that may also be berdaches (Bryk 1933:228). A situation similar to the Aranda exists in the Big Namba area of Malekula: the older partner is the "guardian" of the younger until initiation. Likewise among the Karaki the initiators practice sodomy with the younger boys for about a year (Hays 1963:406). The Marind initiation ceremony also involves sexual relations between the adult men and young boys, although it is not clear whether a bond is formed beyond the initiation period (Kroef 1954:264).

As usual, information concerning women is less common. The only cases I could find of homosexual relations between women, neither of them a berdache, apparently did not function as bond-forming devices (Róheim 1933:238, Africanus 1492, II: 458-459, Bogoras 1904-1909:455). In this category, it is quite possible that the paucity of female investigators could account for the apparent difference in frequency. Even on the male side, investigators seem to be reluctant to tell much about what goes on, perhaps because the behaviors in question are more private than cross-dressing.

Regarding human males, Freund et al. (1972) have made an extremely interesting observation. Using the direct measurement technique of penile plethysmography, they found that "nondeviant" men (adult men whose erotic preferences are for adult women) can be relatively highly aroused by observing slides of "the buttocks of the pubescent boy" (12-14 years), compared to viewing slides of other body parts of pre-pubescent boys and girls, adult males, and landscapes. Although I do not know of any attempted replications by other investigators, this finding is not a statistical artifact since it was replicated by Freund et al. in two different groups of men, and was apparently unexpected. Given a moment of unbridled speculation, there are two interpretations which come to mind. It is conceivable that this response, if replicable, reflects a releasing effect of the presentation of buttocks as an indication of submission;

this seems unlikely since adult male buttocks and children's buttocks did not produce any effect. Perhaps more likely is the notion that it represents a mild releaser for anal intercourse with adolescents at the age of puberty initiation rites. The correlation with age is thus quite comprehensible. If this interpretation is correct, then it should be easily demonstrable in cultures where anal intercourse is indeed common between men and pubescent boys, and should be enhanced the more the picture's subject is placed in a position suggesting readiness for anal intercourse. Further research should be able to test these predictions.

Theoretically, it is clear that the above examples fall into Case 3, in the typology of a previous section. The results of Freund et al. (1972) are obviously consistent with the hypothesis that such bonds could be formed in our own society if our culture approved of them. Homosexual men who run afoul of the law are significantly more likely to be aroused by both sexes ("bisexual") if they prefer children or adolescents as sex partners (Gebhard et al. 1965:285,312, Freund 1974:44). Thus, the combination of reproduction with a side attraction to younger men seems to be a common cross-cultural possibility. (See in addition the account of the Makassarese dance--Kroef (1954:263)--involving "sexual incitement, emanating from . . . the young boys half dressed as women.") The extent to which this

combination actually occurs, of course, depends on the particular culture.

Many other examples from more recent cultures also fit into Case 3. Symonds (1897:189) and Boswell (1977) have noted that at Thebes in ancient Greece, a special warrior unit was formed, composed of pairs of lovers, each member being pushed to heroic efforts because he would not want to be dishonored in front of his beloved. Since the Greeks at these historical periods idealized homosexuality, it was used to maintain bonds between men of the same or differing ages, and at all social levels (Symonds 1897, Boswell 1977, Fisher 1965, Taylor 1965). The situation among women is apparently unrecorded.

In every major U.S. city today, there are counseling groups for lesbian mothers, many of whom live with another lesbian (sometimes herself a mother) and for whom sexual relations function (among other things) as a bond-forming mechanism. Such a situation clearly falls under Case 2. It would be extremely interesting to know the extent to which similar situations occurred in other cultures; I do not know of any examples.

The adolescents who receive the sexual attentions of older individuals can at times benefit from the experience, thus themselves coming under Case 4. It is well known among sex researchers (Money 1975, Gebhard 1974) that male pedophiles and hebephiles are sometimes of great benefit to the

heterosexuality of the males they bond with; it is not uncommon to hear of such a "big brother" helping the younger one to get ready for heterosexual dating, to fall in love, get married, and eventually survive the difficulties of learning to relate to a wife. This pattern is clearly reminiscent of the situation described above in many hunter-gatherer cultures. It is also analogous to Hamilton's observation (1914) of homosexual relations between older and younger male macaques, resulting in protection for the younger.

Homosexual behavior as dominance/submission behavior. This possibility, completely compatible with reproduction and thus falling under Case 3, has been covered in a previous section.

Homosexuality as a mechanism for polygamy. Some forms of homosexuality have been said to accompany polygamy, bonding individuals of the same sex together in a consortship with a single member of the opposite sex. Unfortunately, the more poorly documented case--that of harem women--is also more often mentioned. One doesn't know whether to attribute this situation to men's historical lack of interest in accurately describing female sexual behavior, or men's great interest in fantacizing about it, or some combination. Baumann (1899: 669) is perhaps typical; he exhibits a double-ended artificial penis used by women in Zanzibar, and asserts that such devices were also used by Arab harem women.

Konrad Lorenz (quoted by Evans 1974:84) reported that two male geese can form a pair bond, and "rise very high in the rank order of a goose colony,because the fighting potential of two males is superior to that of a heterosexual pair." Then an unassociated female can insert herself between the two males and get her eggs fertilized, which are then guarded by both males and the offspring raised to adulthood--a clear if unusual example of Case 3. This amounts to a case of polyandry, certain aspects of which are well understood; the difficulty from an evolutionary viewpoint is to understand why both males help raise the offspring when only one is the father. If chick survival is increased twofold or more, there is no evolutionary problem (assuming equal probability of insemination), but we lack data to show that either is the case. Likewise, there is no problem if the female lays enough extra eggs, the two males each father one clutch's worth, and they manage to raise as many young. These homosexual bonds are well-known in captivity in a great many goose species. However, Lorenz was apparently mistaken when he said that "Peter Scott has shown a large incidence of such triangular marriages among the wild, pink-footed geese of Iceland." Scott (personal communication) says that the pairs in his study were not sexed, and male and female are extremely difficult to tell apart without close examination. If Lorenz's report is correct about wild pairs, he must have been referring to another investigator or species. Further

investigation of this point is certainly warranted, even though an exact human analogue is unreported. Those species most likely to show homosexual pair bonds must have heterosexual pair bonds as evolutionary raw material; but these species are precisely the ones in which sexual dimorphism is likely to be small (Wilson 1975:334), so casual field observations are unlikely to detect homosexual pairs if they exist.

RECONCILIATION WITH EARLIER MODELS

This paper's evolutionary viewpoint is quite compatible with certain earlier approaches, and not compatible with others. Often, the evolutionary view agrees with the data but disagrees with their interpretation. What follows is an attempt to evaluate these models solely from an evolutionary perspective.

Models of congenital maladaptation. Natural selection produces individuals that reproduce well more often than individuals that reproduce poorly. Why should low testosterone, say, cause homosexuality in males when the evolution of higher testosterone levels should be so simple? Any model that simple-mindedly attributes many cases of homosexuality to simple hormonal causes is, on theoretical grounds alone, unlikely to survive attempted verifications. If simple hormonal correlates are found, they should be effects and not causes of the homosexual orientation, and one should be able to find logical evolutionary reasons for them to exist. (For example, if high serum testosterone levels turn out to cause competition for wives, then male homosexuals could reasonably be expected to use this hormonal pathway less often.) In the unlikely event that causal mechanisms are found, it would be difficult for the sociobiological approach of this paper to deal with them. Such a mechanism is conceivable for the production of a certain proportion of non-reproductive

individuals, but then why should maternal stress (Ward 1972) or maternal hormones (Dörner et al. 1975) be the proximate cause? The cause does not make sense for the effect.

The twin studies, in contrast, are easier to interpret. Studies of monozygotic male twins not concordant for homosexuality (Rainer et al. 1960, Mesnikoff et al. 1963) show that certain environmental factors must play a role--especially since the offsprings' genes are identical and their parents' outlook on reproductive altruism should coincide with their own (a simple extension of Trivers 1974). But other studies have suggested that some genetic factors are also important. One evolutionarily sensible set of such factors are those of physique (proposed for men by Evans 1972). Physique is known to be important in some competitive interactions for reproductive success; even in human societies it may be dangerous for weak women or men to bear children or go to war. This sets up a coevolutionary interaction (an evolutionary race); it should not be surprising to find that some individuals lose out in such circumstances due to genetic factors.

Models of acquired maladaptation. One weakness of the psychiatric explanations of homosexuality is the absence of any adaptive significance of the postulated correlations. Weak attempts along these lines can be made: perhaps an uninterested, passive father makes it worthwhile for a son to become

non-reproductive and help raise his brothers and sisters--but then why should the son be likely to develop a cross-gender identity and become in that respect like his mother? (This question is rather mild compared to those which could be asked about some of the other postulated mechanisms such as castration anxiety, oedipal conflicts, or vagina dentata.) The point is not so much to ridicule psychiatric insights as to suggest that the reasons for actions revealed by analysis may be post hoc rationalizations which continue to conceal the built-in developmental switches or other sub-subconscious mechanisms. Freud conceived of his theory as a biological one, and did his best to reconcile it with the biological knowledge of his time (see his position on constitutional bisexuality--Rado 1940). There has not yet been enough time to see what reconciliations will be necessary in the light of sociobiological principles. One recent review (Gadpaille 1972:204) stated:

> ". . . one should not demand obvious and dramatic child-parent traumata in the histories of all homosexuals in order to credit the critical importance of early rearing experiences. The analyst, indeed, all students of human sexuality, must recognize how subtle the conflict may be, how very little conflict it may require to derail psychosexual development (especially in the male), and be alert, both therapeutically and prophylactically, to the almost subclinical quality of the pathogenic influences that may produce homosexuality."

Putting aside the strident (almost ideological) tone of this quotation, Gadpaille practically suggests his own rebuttal, if one is familiar with the arguments of this paper. Gadpaille's analysis rests on what has seemed to be a logical tautology--

that non-reproduction can only be maladaptive. But if homosexuality can, by his own admission, result from events that are "subclinical," and if non-reproduction can be evolutionarily adaptive, then does it not make sense to put these two observations together and conclude that homosexuality can also result from non-"pathogenic" developmental processes?

The other set of acquired-maladaptation models has been dealt with in earlier sections; their basic flaw is their inability to explain why the learning of sexual roles differs so strikingly from other forms of learning.

Hutchinson's model of heterozygote advantage. Assume for the moment that Hutchinson's model (1959) is correct for some homosexual individuals: that they have some combination of genes that deterministically predispose them to homosexuality and lowered reproduction, as an unavoidable consequence of their siblings' having genes that increase reproductive success. From an evolutionary point of view, what should be the parents' view of such a child, and the child's own view? Trivers' (1974) theory of parent-offspring conflict predicts that when the decrement to the child's reproductive success as a result of the postulated homosexuality genes is of the proper magnitude, there should be conflict between parents and offspring concerning the continuation of parental investment in that offspring. In these cases, it would make evolutionary sense for the parent to use the child's

homosexuality as an excuse to end investment--to disown them. (This societal disapproval, at least, is certainly a feature of some modern hunter-gatherers.) Given the end of investment, however, the parent should welcome the child's attempt to survive on its own, since it could still achieve some measure of reproductive success. Such possibilities would lead to selection for the child to conceal its homosexual feelings, until the amount of investment needed to bring the child to adulthood is smaller than the amount needed to raise another child, taking into account a factor allowing for the new child's higher expected reproductive success.

This entire line of logic, however, depends heavily on the plausibility of Hutchinson's model. The number of other genetic polymorphisms with heterozygote advantage (such as sickle cell anemia) is small, others have noted, presumably because selection acts to find other ways of achieving the heterozygotic phenotype without the associated genetic load. Thus only evolutionarily recent phenomena are likely to select for polymorphisms with strong heterozygote advantage. But shamanism (and apparently also the homosexual behavior that often goes with it) are quite ancient phenomena, going back far beyond the agricultural revolution that some believe expanded the habitat of the malaria mosquito in Africa. It has even been suggested that Neanderthal man buried his dead with ceremonials, and that one such grave shows signs of its occupant having been a shaman--60,000 years ago (Solecki 1975).

The hypotheses of this paper concerning the relationship between homosexuality and shamanism, then, are difficult to reconcile with Hutchinson's model. It seems more likely that the origin of societal disapproval of homosexuality--which follows some predictable patterns (Werner 1975, Boswell 1977)--will be found in more recent developments.

SUGGESTIONS FOR FUTURE RESEARCH

Homosexuality has been subjected to differing selection pressures in different cultures, and at different times in the same culture; the pattern of occurrence is extremely detailed. The arguments earlier in this paper concerning the inapplicability of the usual Skinnerian models to the learning of gender role strongly suggest that some genetic mechanism is affecting the process. Putting these two observations together, it seems inconceivable to me that there would not be some sort of genetic predisposition to homosexual behavior in some individuals in modern societies. Accordingly, more research should be directed towards studies designed to detect broad patterns of genetic involvement. The technique used by Kety (1975) to show unequivocally the existence of some genetic predisposition for schizophrenia should be just as easily applicable to homosexuality. I would recommend looking for genetic factors not just in sexual object choice, but also specific behavior patterns (homosexuality with reproduction, with permanent same-sex lover, with significant cross-sex identification, with preference for older/younger/same-age partners, with oral/anal/masturbatory techniques, etc.).

Research should be directed to discover the extent to which homosexuals reproduce, to measure both personal reproductive success and inclusive fitness. Gebhard et al. (1965:

282,308,338) collected the only data I am aware of on the first point; since their subjects were sex offenders it would be worthwhile to study a somewhat more representative population. (They found that homosexual offenders were less likely to marry than other offenders, more likely to have the marriage break up, and more likely to have a small number of children. Homosexual offenders against children, minors, and adults differed in the degree of their non-reproduction, with the first group most reproductive and the last group least.)

Further details should be recorded concerning homosexuality and the institution of the berdache in other cultures. Data on homosexual behavior outside the berdache role are extremely scanty, and should be gathered with the intention of finding out the extent to which it interferes with reproduction and helps one's kin. Likewise, life history data concerning individual berdaches should be gathered with this paper's hypotheses in mind. Also, more extensive information regarding the historical progression of the role of the berdache and shaman should be undertaken, along the lines of Métraux's study (1942). Likewise, attempts to correlate current knowledge of atypical sexual behavior with the behavior of those in "primitive" cultures should continue.

Finally, the view presented in this paper has certain implications for psychiatric theory, concerning which atypical behaviors are "natural" deviations from the average and which

represent "sickness." Much of the force behind the conviction that homosexual behavior is "abnormal" comes from an application of a very specific model of human socialization: the notion that if one receives negative reinforcement for a behavior or is aware that one would receive such reinforcement if it were performed, then the appearance of such behavior constitutes pathology. We have seen that this Skinnerian paradigm is inadequate; an evolutionary view is a worthwhile replacement. Murphy (1976:1022) quoted an Eskimo woman as saying that "When the shaman is healing he is out of his mind, but he is not crazy" [emphasis in original], and noted that "The distinction [between crazy and not crazy] appears to be the degree to which they [crazy behaviors] are controlled and utilized for a specific social function." Yet there are other behaviors for which societies differ in the extent to which healers believe they can "cure" the atypical behavior (Murphy cited "sexual disorders, excessive use of drugs or alcohol, and a variety of behaviors that primarily cause trouble for other people rather than for the doer"). Murphy pointed out that western psychiatry considers these behaviors symptomatic of illness, while the two native cultures she studied do not. These differences deserve further study in the light of the fact that such behaviors (especially the last category and, according to the present writer's views, probably the first category) are biologically adaptive for the individual who performs them.

ACKNOWLEDGMENTS

I thank Robert Trivers for many helpful discussions, and the inspiration that began my thinking along these lines. I thank John Boswell for providing access to his manuscript in advance of publication, for many suggestions, and for giving me comments on an earlier draft. Help with translations was generously provided by Michael Resler (German) and Ricardo J. Fernandez (Spanish). Support was provided by a pre-doctoral fellowship from the National Science Foundation.

TABLE 1

Female-to-Male Cross-Gender Institutions in "Primitive" Cultures

Culture	Engages in homosexual behavior?	Can be a spouse of same sex?	Can be a spouse of opp. sex?	Takes role of shaman, priest?	Childhood Behavior: play or duties of opp. sex?	Childhood Behavior: noted or encouraged by elders?	Childhood Behavior: dressed as opposite sex?	Indiv'ls seen or or lives described?	Source; other comments
Chukchee	yes	yes	yes	always	.	.	.	described	Bogoras (1904-1909:448-457)
Araucans	.	.	.	.	.	.	.	both	Métraux* (1942:312)
W. Inoits	.	.	.	.	yes	.	.	.	Reclus (1896:68)
Cocopa	"att'd"	yes	.	.	yes	app. yes	.	.	Gifford (1933:294)
Crow	.	yes	.	.	yes	yes	.	both	Denig (1961:196-200) not an institution; 1 non-Crow woman taken hostage reported
Klamath	.	yes	no	.	.	.	.	described	Spier (1930:51-53)
Mohave	yes	yes	.	yes	yes	yes	yes	described	Devereux (1937) especially powerful shamans
Navaho	→	→	→	→	→	.	.	→	Hill (1935) → entries prob. as in male-to-female case
Pima	.	.	.	.	sometimes	sometimes	.	.	Hill (1938)
Quinault	yes	.	.	.	.	.	.	both	Olson (1936:99) 1 of 2 descr'd prob. hermaphroditic
Yuma	.	.	.	.	yes	yes	.	.	Forde (1931:157)
Yuma	.	yes	.	never	yes	yes	.	.	Spier (1933:242-243)
Nuer	.	yes	.	often	.	.	.	.	Evans-Pritchard (1951:108) usually barren
Bulaa	.	.	.	.	yes	.	.	1 seen	Seligmann (1902:13-14)
Tupi	yes	yes	.	.	.	.	.	.	Seligmann* (1902:12-13)
"Brazil"	.	yes						app. seen	Magalhães (1576:89-90)
Zanzibar	yes	.	.	.	.	.	.	app. seen	Baumann (1899:669) cross-dressing only in private

. No information available * Source did not observe culture but reported field work of others.

TABLE 2
Male-to-Female Cross-Gender Institutions in "Primitive" Cultures

Culture	Eng. in homo'l behavior?	Concubine, spouse of same sex?	Concubine, spouse of opp. sex?	Takes role of shaman, priest?	Childhood behavior: play or duties of opp. sex?	Childhood behavior: noted or encouraged by elders?	Childhood behavior: dressed as opposite sex?	Indiv'ls seen or or lives described?	Source; other comments
Aleuts	.	yes	.	.	yes	yes	yes	app. seen	Langsdorff (1814,II:47-48)
Aleuts	.	.	.	.	.	yes	yes	.	Seligmann* (1902:11-12)
W. Inoits	.	yes	.	yes	.	yes	yes	.	Reclus (1896:68-71,81) Advice always followed; arbit.
Chukchee	yes	yes	no¶	always	.	.	.	both	Bogoras (1904-1909:448-457) excel in shamanism; husb. must obey "wife's" ke'lE commands
Koryak	.	yes	.	.	.	.	.	.	Czaplika* (1914:86)
Kamchadal	.	yes	.	yes	.	.	.	.	Czaplika* (1914:251-252)
Araucans	.	.	.	yes	yes	yes	yes	.	Falkner (1774:117)
Araucans	yes	.	.	always	.	yes	yes	.	Métraux (1942:311-313,349) advice required for every important decision
Cocopa	app. no	.	.	no	yes	app. yes	.	.	Gifford (1933:294)
Chippewa	.	.	.	.	.	.	.	seen	Kinietz (1947:155-156)
Cheyenne	.	yes	.	yes	.	.	.	.	Hoebel (1960:77-79) goes to war; matchmaker; supervises scalps and scalp ceremonies
Crow	.	.	.	.	yes	.	yes§	1 seen	Simms (1903:580-581) best cooks, many charitable acts
Crow	yes†	.	.	.	.	yes	.	1 seen	Lowie (1935:48)
Crow	.	.	1 did	.	yes	yes	yes	app. seen	Denig (1961:187)
Illinois & Nadouessi	.	.	never	.	.	.	yes	.	Shea* (1903:36-37; Marq!te) required for all imp. decisions; goes to war without bow and arrow

(table continued)

(continued from p. 203)

Juaneño	.	ambiguous		.	"extremely probable"	"seems inconceiv."	.	.	Kroeber (1925:647) "robust workers"
Klamath	.	.	1 did	1/3 do	.	.	yes	both	Spier (1930:51-53)
Mohave	yes	yes	.	yes	yes	yes	yes	described	Devereux (1937) exceptionally industrious wives
Mohave	yes	.	.	.	.	.	.	both	Waltrip (1965:6) exp. crafts
Navaho	yes	yes	no¶	yes	yes	.	.	both	Hill (1935) wealthy; leaders; mediators; matchmakers; unu. opp. for material advance't
Ojibway	yes	yes	.	.	.	.	.	1 seen	Tanner (1830:105-106)
Osage	.	.	1 did	.	.	.	.	described	Fletcher & La Flesche (1905-6)
Pima	.	.	.	.	sometimes	sometimes	.	.	Hill (1938)
Pomo	yes	.	.	.	yes	.	yes	1 descr.	Gifford (1926:333)
Quniault	often	.	.	no	.	.	.	1 seen	Olson (1936:99)
Sioux & Illinois	.	.	no	yes	.	.	.	.	Lafitau* (1724, I:48)
Sioux	.	.	.	yes	.	.	.	seen	Catlin (1926, II:243-244) "extraordinary privileges"
Sioux/Yurok	see text	.	.	.	.	.	.	.	Erikson (1945:329-330) sexually visited by braves bef. war
Sioux	**	.	.	"could be"	app. yes	app. yes	.	.	Hassrick (1964:121-123) excels in women's work
Sioux	.	.	.	.	.	.	.	1 seen	Lame Deer (1972:149-150)
Teton	some	yes	.	yes	.	.	.	.	Spencer et al. (1965:373)
Winnebago	.	.	.	yes	.	.	.	.	Lurie (1953) excels in women's work
Yuma	.	yes	.	.	.	yes	.	.	Forde (1931:157)
Yuma	.	yes	.	never	yes	yes	.	.	Spier (1933:242-243)
Yurok	.	.	.	yes	.	.	.	.	Kroeber* (1925:46)
Yurok/Sioux	see test	.	.	.	.	.	.	.	Erikson (above) sexually visited by braves before war

(continued)

(continued from p. 204)

Zuñi	no††	some-times	.	.	yes	yes	a bit	seen	Parsons (1916)
"Am. Ind."	.	.	.	.	.	yes	partly	both	Mead (1935:294-295)
Sea Dyak	.	yes	no	yes	.	.	.	seen	Low (1848:175-176) rich; person of great consequence
Sea Dyak	yes	yes	.	yes	"not brought up to it"			.	Roth (1896,I:270-271) rich; peacemaker, "sexually disabled"; often chief
Sea Dyak	.	yes	.	yes	never, as a young man			1 seen	Gomes (1911:179-180) fees much higher than ordinary shaman
Rambree Is.	yes	yes	.	app.yes	.	.	.	seen	Foley (1835:199)
Ngadju	yes	yes	.	yes	.	.	.	.	Schärer* (1946:64-65)
Ngadju	yes	.	.	yes	.	.	.	.	van der Kroef* (1954)
Toradjas	.	.	.	yes	.	.	.	.	van der Kroef* (1954)
Makas-arese	yes	.	.	yes	.	yes	yes	.	van der Kroef* (1954)
Bulaa, Garia, & Milanan	.	.	¶¶	.	.	.	.	.	Seligman (1902:14-15) 1 went on war party
Tahitians	app. yes	.	.	.	.	yes	yes	seen	Turnbull (1813:382-383)
Tahitians	yes§§	.	.	.	.	yes	yes	seen	Levy (1971)
Sakalave	yes	no?	.	spells	yes	yes	yes	seen	Lasnet (1899:494-495)
Zanzibar	yes	yes	.	.	.	.	.	app. seen	Baumann (1899:668-669) involv'd "beischlafähnlichen Handlungen"
Nandi, Badama, Baganda	yes	.	.	.	.	.	.	seen	Bryk (1933:227-228)

* Source did not observe culture in the field but reported work of others. ** A man flirted with one.
† The berdaches "pretend to have sweethearts among the men." †† "not the slightest hint"
§ Only when no longer under parents' control. §§ "not essential" but done "discreetly"
¶ Yes for non-permanent cross-dressers. ¶¶ One was married heterosexually but childlessly.
. No information available.

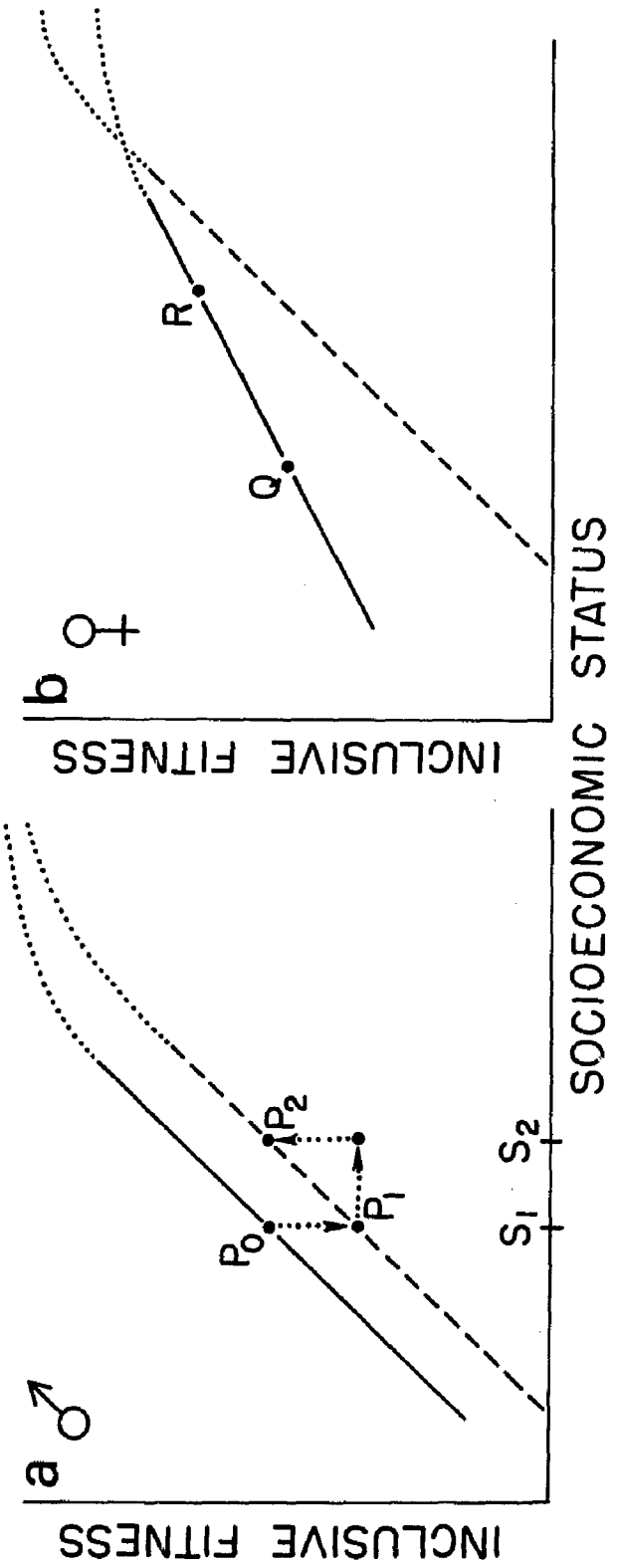
TABLE 3
HOMOSEXUALITY AND I.Q.

Ss	Controls	N (Ss)	Sex	higher I.Q.'s among:	Country	Source
soldiers discharged as sexual psychopaths (93% homosexual)	Regular Army statistics	270	M	Ss	U.S.A.	Loeser 1945
neurotic homosexual soldiers	neurotic hetero'l soldiers	100	M	Ss	England	Lambert 1949
prisoners with homosexual offenses on record	heterosexual prisoners	64	M	no diff.	England	Hemphill et al. 1958
non-institutionalized homosexuals, contacted through friends	married indiv'ls matched from files of national personnel institute	50,50	F,M	Ss	South Africa	Liddicoat 1961
prisoners with homosexual offenses on record	exhibitionistic and pedophilic prisoners	132*	M	Ss	Canada	Spencer 1961
youth offenders with "overt indication of passive homosexual behavior"	youth offenders without indication of homosexual behavior	80	M	controls	U.S.A.	Houston 1965
prisoners observed in homosexual behavior	prisoners never observed in homosexual behavior	196	F	no diff.	U.S.A.	Norris 1974
homosexuals, transsexuals, hypogonadotropic eunuchoids seeking treatment	married men seeking treatment for sterility in marriage	85†	M	Ss§	Czechoslovakia	Raboch & Šípová 1974
homosexuals seeking therapy, and homosexuals in a civil rights group	general population statistics	110	M	Ss¶	England	Turner et al. 1974

* N includes controls + Ss † 41 homosexuals among them ¶ attributed to "sampling bias" of unspecified origin

§ Bar diagrams show similar IQ distributions for all S groups, though individual N's are too small for test.

Figure 1. The relationship between socioeconomic status and inclusive fitness for reproductive (solid lines) and non-reproductive (dashed lines) men (a) and women (b). Some decrease in inclusive fitness is assumed for non-reproductive individuals compared with reproductive ones of similar socio-economic status. An individual on a reproductive line ($\underline{P}_0$) loses inclusive fitness by becoming non-reproductive ($\underline{P}_1$), but gains a quantity of investment sufficient to raise socioeconomic status form $\underline{S}_1$ to $\underline{S}_2$, redounding to the benefit of relatives and moving inclusive fitness to $\underline{P}_2$. Whether $\underline{P}_2$ is higher or lower than $\underline{P}_0$ depends on the slope of the lines and the relative efficiency with which investment is turned into increased status. (The figure happens to show a case where the individual is indifferent as to whether to reproduce.) The curve for reproductive females differs from the others, according to the arguments of Trivers and Willard (1973), the slope being less steep. A female beginning at $\underline{Q}$ is much less likely to find non-reproduction advantageous in terms of inclusive fitness than a female at $\underline{R}$. The dotted portions reflect the possibility that one's own reproductive capacity may be swamped before that of one's relatives, increasing the incidence of non-reproduction at the highest socioeconomic levels among males (an alternative is seeking a second wife).


a ♂
INCLUSIVE FITNESS
SOCIOECONOMIC STATUS
S_1
S_2
P_0
P_1
P_2
b ♀
INCLUSIVE FITNESS
Q
R

BIBLIOGRAPHY

Abe, K., and Moran, P.A.P. (1969). Parental age of homosexuals. British Journal of Psychiatry 115:313-317.

Africanus, L. (1492). The History and Description of Africa and of the Notable Things Therein Contained. The Hakluyt Society, London, 1896.

Alcock, J. (1975). Animal Behavior: An Evolutionary Approach. Sinauer Associates, Sunderland, Massachusetts.

Altmann, S.A. (1962) A field study of the sociobiology of rhesus monkeys, Macaca mulatta. Annals of the New York Academy of Sciences 102:338-435.

Angelino, H., and Shedd, C.L. (1955). A note on berdache. American Anthropologist 57:121-126.

Bajema, C.J. (1963). Estimation of the direction and intensity of natural selection in relation to human intelligence by means of the intrinsic rate of natural increase. Eugenics Quarterly 10: 175-187.

Bakwin, H. (1968). Deviant gender-role behavior in children: Relation to homosexuality. Pediatrics 41:620-629.

Barlow, D. H., Abel, G. G., Blanchard, E. B., and Mavissakalian, M. (1974). Plasma testosterone levels and male homosexuality: A failure to replicate. Archives of Sexual Behavior 3:571-575.

Barlow, G. W. (1967). Social behavior of a South American leaf fish, Polycentrus schomburgkii, with an account of recurring pseudo-

female behavior. The American Midland Naturalist 78:215-234.

Bates, J. E., Skilbeck, W. M., Smith, K. V. R., and Bentler, P. M. (1975). Intervention with families of gender-disturbed boys. American Journal of Orthopsychiatry 45:150-157.

Baumann, O. (1899). Conträre sexual-erscheinungen bei der negerbevölkerung Zanzibars. Verhandlungen der Berliner Gesellschaft für Anthropologie, Ethnologie, und Urgeschichte 31:668-670.

Beach, F. A. (1949). A cross-species survey of mammalian sexual behavior. In Hoch, P. H., and Zubin, J. (eds.), Psychosexual Development in Health and Disease, Grune and Stratton, New York, pp. 52-78.

Beigel, H. G. (1969). A weekend in Alice's wonderland. The Journal of Sex Research 5:108-122.

Bell, A. P. (1974). Homosexuality. Talk given 21 June at the Summer Program in Human Sexuality and Sex Education, Institute for Sex Research, Bloomington, Indiana.

Benjamin, H. (1967). The transsexual phenomenon. Transactions of the New York Academy of Sciences (series II) 29:428-430.

Bieber, I. (1965). Clinical aspects of male homosexuality. In Marmor, J. (ed.), Sexual Inversion: The Multiple Roots of Homosexuality, Basic Books, New York, pp. 248-267.

Bieber, I., Dain, H. J., Dince, P. R., Drellich, M. G., Grand, H. G., Gundlach, R. H., Kremer, M. W., Rifkin, A. H., Wilbur, C. B., and Bieber, T. B. (1962). Homosexuality: A Psychoanalytic Study of Male Homosexuals. Basic Books, New York.

Birk, L., Williams, G. H., Chasin, M., and Rose, L. I. (1973). Serum testosterone levels in homosexual men. New England Journal of Medicine 289:1236-1238.

Birtchnell, J. (1972). Birth order and mental illness: A control study. Social Psychiatry 7:167-179.

Bleibtreu-Ehrenberg, G. (1970). Homosexualität und transvestition im schamanismus. Anthropos 65:190-228.

Boas, F. (1901). The Eskimo of Baffin Land and Hudson Bay. American Museum of Natural History Bulletin 15:1-570.

Bogoras, W. (1904-1909). The Chukchee. Memoirs of the American Museum of Natural History 11:1-732.

Boswell, J. E. (1977). Homosexuality in the Middle Ages. (Tentative title; in preparation).

Breland, K., and Breland, M. (1961). The misbehavior of organisms. American Psychologist 16:681-684.

Brodie, H. K. H., Gartrell, N., Doering, C., and Rhue, T. (1974). Plasma testosterone levels in heterosexual and homosexual men. American Journal of Psychiatry 131 (1):82-83.

Bryk, F. (1933). Voodoo-Eros: Ethnological Studies in the Sex-Life of the African Aborigines. Privately printed, New York.

Bullough, V. L. (1973). Homosexuality as submissive behavior: Example from mythology. Journal of Sex Research 9:283-288.

Burdick, J. A., and Stewart, D. Y. (1974). Differences between "show"

and "no show" volunteers in a homosexual population. The Journal of Social Psychology 92:159-160.

Carpenter, C. R. (1942). Sexual behavior of free ranging rhesus monkeys (Macaca mulatta) II. Periodicity of estrus, homosexual, autoerotic, and non-conformist behavior. Journal of Comparative Psychology 33:143-162.

Carpenter, E. (1910). On the connexion between homosexuality and divination. Revue d'Ethnographie et de Sociologie 1:301-316. Also in Carpenter, E. (1975), Intermediate Types Among Primitive Folk, Arno, New York, Part I.

Catlin, G. (1926). North American Indians. John Grant, Edinburgh.

Charles, L. H. (1953). Drama in shaman exorcism. Journal of American Folklore 66:95-122.

Chevalier-Skolnikoff, S. (1974). Male-female, female-female, and male-male sexual behavior in the stumptail monkey, with special attention to female orgasm. Archives of Sexual Behavior 3:95-116.

Cline, W. B. (1936). Notes on the people of Siwah and El Garah in the Libyan desert. General Series in Anthropology 4:1-64.

Cook, R. (1975). "Lesbian" phenotype of Drosophila melanogaster? Nature 254:241-242.

Craig, W. (1908). The voices of pigeons regarded as a means of social control. The American Journal of Sociology 14:86-100.

Czaplicka, M. A. (1914). Aboriginal Siberia: A Study in Social Anthropology. Oxford University Press, Oxford.

Denig, E. T. (1961). Five Indian Tribes of the Upper Missouri. University of Oklahoma Press, Norman.

Devereux, G. (1937). Institutionalized homosexuality of the Mohave indians. Human Biology 9:498-527.

Doerr, P., Kockott, G., Vogt, H. J., Pirke, K. M., and Dittmar, F. (1973). Plasma testosterone, estradiol, and semen analysis in male homosexuals. Archives of General Psychiatry 29:829-833.

Dörner, G., Rohde, W., Stahl, F., Krell, L., and Masius, W.-G. (1975). A neuroendocrine predisposition for homosexuality in men. Archives of Sexual Behavior 4:1-8.

Erikson, E. H. (1945). Childhood and tradition in two American indian tribes. Psychoanalytic Study of the Child 1:319-350.

Erwin, J., and Maple, T. (1976). Ambisexual behavior with male-male anal penetration in male rhesus monkeys. Archives of Sexual Behavior 5:9-14.

Evans, R. B. (1969). Childhood parental relationships of homosexual men. Journal of Consulting and Clinical Psychology 33:129-135.

Evans, R. B. (1972). Physical and biochemical characteristics of homosexual men. Journal of Consulting and Clinical Psychology 39:140-147.

Evans, R. I. (1974). Lorenz warns: "Man must know that the horse he is riding may be wild and should be bridled." Psychology Today 8(6):82-93.

Evans-Pritchard, E. E. (1951). Kinship and Marriage Among the Nuer. Oxford University Press, Oxford.

Falkner, T. (1774). A Description of Patagonia and the Adjoining Parts of South America. Armann and Armann, Chicago, 1935.

Fisher, S. H. (1965). A note on male homosexuality and the role of women in ancient Greece. In Marmor, J. (ed.), Sexual Inversion: The Multiple Roots of Homosexuality, Basic Books, New York, pp. 165-172.

Fletcher, A. C., and la Flesche, F. (1905-1906). The Omaha tribe. 27th Annual Report of the Bureau of American Ethnology:15-672.

Foley, W. (1835) Journal of a tour through the island of Rambree, on the Arracan coast. Journal of the Asiatic Society of Bengal 4: 199-207.

Ford, C. S. and Beach, F. A. (1951). Patterns of Sexual Behavior. Harper Colophon, New York.

Forde, C. D. (1931). Ethnography of the Yuma indians. University of California Publications in American Archaeology and Ethnology 28: 83-278.

Freund, K.W. (1960). Some problems in the treatment of homosexuality. In Eysenck, H.J. (ed.), Behaviour Therapy and the Neuroses, Pergamon Press, New York, pp. 312-326.

Freund, K. W. (1974). Male homosexuality: An analysis of the pattern. In Loraine, J. A. (ed.), Understanding Homosexuality: Its Biological and Psychological Bases, American Elsevier, New York, pp. 25-81.

Freund, K. W., and Pinkava, V. (1961). Homosexuality in man and its association with parental relationships. Review of Czechoslovak Medicine 7:32-40.

Freund, K. W., Pinkava, V., and Březinová, V. (1959). Zur frage der eheschließung homosexueller männer. Beiträge zur Sexualforschung 16:25-32.

Freund, K. W., McKnight, C. K., Langevin, R., and Cibiri, S. (1972). The female child as a surrogate object. Archives of Sexual Behavior 2:119-133.

Freund, K. W., Langevin, R., Zajac, Y., Steiner, B., and Zajac, A. (1974). Parent-child relations in transsexual and non-transsexual homosexual males. British Journal of Psychiatry 124:22-23.

Frisch, R. E. (1975). Demographic implications of the biological determinants of female fecundity. Social Biology 22:17-22.

Gadpaille, W. J. (1972). Research into the physiology of maleness and femaleness: Its contributions to the etiology and psychodynamics of homosexuality. Archives of General Psychiatry 26:193-206.

Garcia, J., McGowan, B. K., Ervin, F. R., and Koelling, R. A. (1968). Cues: Their relative effectiveness as a function of the reinforcer. Science 160:794-795.

Gebhard, P. H. (1972). Incidence of overt homosexuality in the United States and western Europe. In National Institute of Mental Health Task Force on Homosexuality, Final Report and Background Papers, Government Printing Office, Washington, D. C., pp. 22-29.

Gebhard, P. H. (1974). Paraphilias. Talk given at the Summer Program in Human Sexuality and Sex Education, Institute for Sex Research, Bloomington, Indiana.

Gebhard, P. H., Gagnon, J. H., Pomeroy, W. B., and Christenson, C. V. (1965). Sex Offenders: An Analysis of Types. Harper and Hoeber, New York.

Geist, V. (1971). Mountain Sheep: A Study in Behavior and Evolution. University of Chicago Press, Chicago.

Geist, V. (1975). Mountain Sheep and Man in the Northern Wilds. Cornell University Press, Ithica, New York.

Giese, H. (1962). Abnormes und perverses verhalten. In Giese, H., and von Gebsattel, V. E. (eds.), Psychopathologie der Sexualität, Ferdinand Enke, Stuttgart, pp. 305-470.

Gifford, E. W. (1926). Clear Lake Pomo society. University of California Publications in American Archaeology and Ethnology 18:287-390.

Gifford, E. W. (1933). The Cocopa. University of California Publications in American Archaeology and Ethnology 31:257-334.

Gill, K. S. (1963). A mutation causing abnormal courtship and mating behavior in males of Drosophila melanogaster. The American Zoologist 3:507.

Gley, E. (1884). Les aberrations de l'instinct sexuel, d'après des travaux récents. Revue Philosophique 17:66-92.

Gomes, E. H. (1911). Seventeen Years Among the Sea Dyaks of Borneo. Lippincott, Philadelphia.

Green, R. (1974a). Sexual Identity Conflict in Children and Adults. Basic Books, New York.

Green, R. (1974b). Gender identity development. Talk given 25 June at the Summer Program in Human Sexuality and Sex Education, Institute for Sex Research, Bloomington, Indiana.

Green, R., and Money, J. (1961). Effeminacy in prepubertal boys: Summary of eleven cases and recommendations for case management. Pediatrics 27:286-291.

Green, R., and Money, J. (1966). Stage-acting, role-taking, and effeminate impersonation during boyhood. Archives of General Psychiatry 15:535-538.

Griffiths, P. D., Merry, J., Browning, M. C. K., Eisinger, A. J., Huntsman, R. G., Lord, E. J. A., Polani, P. E., Tanner, J. M., and Whitehouse, R. H. (1974). Homosexual women: An endocrine and psychological study. Journal of Endocrinology 63:549-556.

Gundlach, R. H., and Riess, B. F. (1968). Self and sexual identity in the female: A study of female homosexuals. In Riess, B. F. (ed.), New Directions in Mental Health, Grune and Stratton, New York.

Hamilton, G. V. (1914). A study of sexual tendencies in monkeys and baboons. Journal of Animal Behavior 4:295-318.

Hamilton, W. D. (1962). The genetical evolution of social behaviour. II. Journal of Theoretical Biology 7:17-52.

Hamilton, W. D. (1972). Altruism and related phenomena, mainly in social insects. Annual Review of Ecology and Systematics 3:193-232.

Handelman, D. (1967). The development of a Washo shaman. Ethnology 6:444-464.

Hardman, E. T. (1888). Notes on some habits and customs of the natives

of the Kimberley district, western Australia. Proceedings of the Royal Irish Academy (3rd series) 1:70-75.

Hassrick, R. B. (1964). The Sioux: Life and Customs of a Warrior Society. University of Oklahoma Press, Norman.

Hatterer, L. J. (1970). Changing Homosexuality in the Male. McGraw-Hill, New York.

Hays, H. R. (1963). In the Beginnings. Putnam's, New York.

Hemphill, R. E., Leitch, A., and Stuart, J. R. (1958). A factual study of male homosexuality. British Medical Journal I:1317-1323.

Heston, L. L., and Shields, J. (1968). Homosexuality in twins: A family study and a registry study. Archives of General Psychiatry 18(2):149-160.

Hill, W. W. (1935). The status of the hermaphrodite and transvestite in Navaho culture. American Anthropologist 37:273-279.

Hill, W. W. (1938). Note on the Pima berdache. American Anthropologist 40:338-340.

Hirschfeld, M. (1912). Gründe für das angeborensein der homosexualität. Jahrbuch für sexuelle Zwischenstufen 12:404-418.

Hoebel, E. A. (1960). The Cheyennes: Indians of the Great Plains. Holt, Rinehart, and Winston, New York.

Hoenig, J., and Kenna, J. C. (1974). The prevalence of transsexualism in England and Wales. British Journal of Psychiatry 124:181-190.

Hooker, E. (1969). Parental relations and male homosexuality in patient and nonpatient samples. Journal of Consulting and Clinical Psychology 33:140-142.

Houston, L. N. (1965). Vocational interest patterns of institutionalized youthful offenders as measured by a nonverbal inventory. Journal of Clinical Psychology 21:213-214.

Hrdy, S. B. (1975). Male and female strategies of reproduction among the langurs of Abu. Unpublished Ph.D. thesis, Department of Anthropology, Harvard University, Cambridge, Massachusetts.

Hunt, M. (1974). Sexual Behavior in the 1970s. Playboy Press, Chicago.

Hutchinson, G. E. (1959). A speculative consideration of certain possible forms of sexual selection in man. American Naturalist 93: 81-91.

Innis, A. C. (1958). The behaviour of the giraffe, Giraffa camelopardalis, in the eastern Transvaal. Proceedings of the Zoological Society of London 131:245-278.

Kahney, R. (1976). Origin. Gay Community News (Boston) 3(38):10, 13.

Kallmann, F. J. (1952). Comparative twin study on the genetic aspects of male homosexuality. Journal of Nervous and Mental Disease 115:283-298.

Kallmann, F. J. (1953). Heredity in Health and Mental Disorder. Norton, New York.

Kallmann, F. J. (1960). Discussion. Psychosomatic Medicine 22:258-259.

Karsch, F. (1900). Päderastie und tribadie bei den tieren auf grund der literatur. Jahrbuch für sexuelle Zwischenstufen 2:126-160.

Kaufman, I.C., and Rosenblum, L.A. (1966). A behavioral taxonomy for Macaca nemestrina and Macaca radiata. Primates 7:205-258.

Kaufmann, J. H. (1965). Studies on the behavior of captive tree shrews

(Tupaia glis). Folia Primatologica 3:50-74.

Kempf, E. J. (1917). The social and sexual behavior of infrahuman primates with some comparable facts in human behavior. The Psychoanalytic Review 4:127-154.

Kenyon, F. E. (1974). Female homosexuality: A review. In Loraine, J. A. (ed.), Understanding Homosexuality: Its Biological and Psychological Bases, American Elsevier, New York, pp. 83-119.

Kety, S. S., Rosenthal, D., Wender, P. H., Schulsinger, F., and Jacobsen, B. (1975). Mental illness in the biological and adoptive families of adopted individuals who have become schizophrenic: A preliminary report based on psychiatric interviews. In Fieve, R. R., Rosenthal, D., and Brill, H. (eds.), Genetic Research in Psychiatry, Johns Hopkins University Press, Baltimore, pp. 147-165.

Kiefer, T. M. (1968). A note on cross-sex identification among musicians. Ethnomusicology 12:107-109.

Kinietz, W. V. (1947). Chippewa village: The story of Katikitegon. Cranbrook Institute of Science Bulletin 25:1-259.

Kinsey, A. C., Pomeroy, W. B., and Martin, C. E. (1948). Sexual Behavior in the Human Male. Saunders, Philadelphia.

Kinsey, A. C., Pomeroy, W. B., Martin, C. E., and Gebhard, P. H. (1949). Concepts of normality and abnormality in sexual behavior. In Hoch, P. H., and Zubin, J. (eds.), Psychosexual Development in Health and Disease, Grune and Stratton, New York, pp. 11-32.

Kinsey, A. C., Pomeroy, W. B., Martin, C. E., and Gebhard, P. H. (1953). Sexual Behavior in the Human Female. Saunders, Philadelphia.

Kolodny, R. C., Masters, W. H. Hendryx, J., and Toro, G. (1971). Plasma testosterone and semen analysis in male homosexuals. New England Journal of Medicine 285:1170-1174.

Kolodny, R. C., Jacobs, L. S., Masters, W. H., Toro, G., and Daughaday, W. H. (1972). Plasma gonadotrophins and prolacin in male homosexuals. The Lancet II:18-20.

Kroeber, A. L. (1925). Handbook of the Indians of California. Bureau of American Ethnology Bulletin 78, Government Printing Office, Washington, D.C.

Kroef, J. M. van der (1954). Transvestitism and the religious hermaphrodite in Indonesia. The University of Manila Journal of East Asiatic Studies 3:257-265.

Lafitau, J. F. (1724). Moeurs des Sauvages Ameriquains, Comparées aux Moeurs des Premiers Temps. Saugrain and Hochereau, Paris.

Lambert, C. E. W. (1949). Observations on homosexuals. Istanbul Universitesi Tip Fakültesi Mecmuasi 12:216-220.

Lame Deer, J. F., and Erdoes, R. (1972). Lame Deer: Seeker of Visions. Simon and Schuster, New York.

Langsdorff, G. H. von (1814). Voyages and Travels in Various Parts of the World. Colburn, London, vol. II.

Lasnet, Dr. (1899). Notes d'ethnologie et de médecine sur les Sakalaves du nord-ouest. Annales d'Hygiène et de Médecine Coloniales 2:471-497.

Laws, R. (1974). Deviant sexual behavior: Book review. Journal of Homosexuality 1:223-226.

Layzer, D. (1975). Heritability of IQ: Methodological questions. Science 188:1128-1130.

Lebovitz, P. S. (1972). Feminine behavior in boys: Aspects of its outcome. American Journal of Psychiatry 128(10):103-109.

Levy, R. I. (1971). The community function of Tahitian male transvestitism: A hypothesis. Anthropological Quarterly 44:12-21.

Liddicoat, R. (1961). A study of non-institutionalized homosexuals. Journal of the National Institute for Personnel Research 8:217-249.

Lockard, R. B. (1971). Reflections on the fall of comparative psychology: Is there a message for us all? American Psychologist 26: 168-179.

Loeser, L. H. (1945). The sexual psychopath in the military service (a study of 270 cases). American Journal of Psychiatry 102:92-101.

Loraine, J. A., Ismail, A. A. A., Adamopoulos, D. A., and Dove, G. A. (1970). Endocrine function in male and female homosexuals. British Medical Journal 4:406-408.

Low, H. (1848). Sarawak; Its Inhabitants and Productions. Bentley, London.

Lowie, R. H. (1935). The Crow Indians. Farrar and Rinehart, New York.

Lurie, N. O. (1953). Winnebago berdache. American Anthropologist 55: 708-712.

Maccoby, E. E., and Jacklin, C. N. (1974) The Psychology of Sex Differences. Stanford University Press, Stanford.

Magalhães de Gandavo, P. de (1576). The Histories of Brazil. The Cortes Society, New York, 1922.

Margolese, M. S. (1970). Homosexuality: A new endocrine correlate.

Hormones and Behavior 1:151-155.

Margolese, M. S., and Janiger, O. (1973). Androsterone/etiocholanolone ratios in male homosexuals. British Medical Journal 3:207-210.

McBride, A. F., and Hebb, D. O. (1948). Behavior of the captive bottle-nose dolphin, Tursiops truncatus. Journal of Comparative and Physiological Psychology 41:111-123.

McClintock, M. K.—(1971). Menstrual synchrony and suppression. Nature 229:244-245.

McConaghy, N., and Barr, R. F. (1973). Classical, avoidance, and backward conditioning treatments of homosexuality. British Journal of Psychiatry 122:151-162.

Mead, M. (1935). Sex and Temperament in Three Primitive Societies. Morrow, New York.

Mesnikoff, A. M., Rainer, J. D., Kolb, L. C., and Carr, A. C. (1963). Intrafamilial determinants of divergent sexual behavior in twins. American Journal of Psychiatry 119:732-738.

Métraux, A. (1942). Le shamanisme Araucan. Revista del Instituto de Antropología 2:309-362.

Meyer-Holzapfel, M. (1961). Homosexualität bei tieren. Praxis (Schweizerische Rundschau für Medizin) 50:1266-1272.

Michael, R. P., Bonsall, R. W., and Warner, P. (1974). Human vaginal secretions: Volatile fatty acid content. Science 186:1217-1219.

Money, J. (1975). Pedophilia. Talk given 1 November at the 18th Annual Conference of the Society for the Scientific Study of Sex, New York.

Money, J., and Ehrhardt, A. A. (1972). Man & Woman, Boy & Girl: The Differentiation and Dimorphism of Gender Identity from Conception to Maturity. Johns Hopkins University Press, Baltimore, Maryland.

Money, J., and Ogunro, C. (1974). Behavioral sexology: Ten cases of genetic male intersexuality with impaired prenatal and pubertal androgenization. Archives of Sexual Behavior 3:181-205.

Morris, D. (1952). Homosexuality in the ten-spined stickleback (Pygosteus pungitius L.). Behaviour 4:233-261.

Murphy, J. M. (1976). Psychiatric labeling in cross-cultural perspective. Science 191:1019-1028.

Nadler, R. D. (1975). Sexual cyclicity in captive lowland gorillas. Science 189:813-814.

Newton, N. (1973). Interrelationships between sexual responsiveness, birth, and breast feeding. In Zubin, J., and Money, J. (eds.), Contemporary Sexual Behavior: Critical Issues in the 1970s, Johns Hopkins University Press, Baltimore, Maryland, pp. 77-98.

Noble, G. K., and Bradley, H. T. (1933). The mating behavior of lizards; its bearing on the theory of natural selection. Annals of the New York Academy of Sciences 35:25-100.

Norris, L. (1974). Comparison of two groups in a southern state women's prison: Homosexual behavior versus non-homosexual behavior. Psychological Reports 34:75-78.

Ohnuki-Tierney, E. (1973). The shamanism of the Ainu of the northwest coast of southern Sakhalin. Ethnology 12:15-29.

Olson, R. L. (1936). The Quinault indians. University of Washington Publications in Anthropology 6:1-190.

Organ, J. A. (1958). Courtship and spermatophore of Plethodon jordani metcalfi. Copeia 1958:251-259.

Ovesey, L. (1969). Homosexuality and Pseudohomosexuality. Science House, New York.

Parks, G. A., Korth-Schütz, S., Penny, R., Hilding, R. F., Dumars, K. W., Frasier, S. D., and New, M. I. (1974). Variation in pituitary-gonadal function in adolescent male homosexuals and heterosexuals. Journal of Clinical Endocrinology and Metabolism 39:796-801.

Parsons, E. C. (1916). The Zuñi ǰa'mana. American Anthropologist 18: 521-528.

Perkins, M. W. (1973). Homosexuality in female monozygotic twins. Behavior Genetics 3:387-388.

Pillard, R. C., Rose, R. M., and Sherwood, M. (1974). Plasma testosterone levels in homosexual men. Archives of Sexual Behavior 3: 453-458.

Pomeroy, W. B. (1975). The diagnosis and treatment of transvestites and transsexuals. Journal of Sex and Marital Therapy 1:215-224.

Pseudo-Lucian. (1967). Affairs of the heart. In Macleod, M. D. (trans.), Lucian 8:150-235, Harvard University Press, Cambridge, Massachusetts.

Raboch, J., and Šípová, I. (1974). Intelligence in homosexuals, transsexuals, and hypogonadotropic eunuchoids. The Journal of Sex Research 10:156-161.

Raboch, J., Mellan, J., and Stárka, L. (1975). Plasma testosterone in male patients with sexual dysfunction. Archives of Sexual Behavior 4:541-545.

Rado, S. (1940). A critical examination of the concept of bisexuality. Psychosomatic Medicine 2:459-467.

Rainer, J. D., Mesnikoff, A. M., Kolb, L. C., and Carr, A. C. (1960). Homosexuality and heterosexuality in identical twins. Psychosomatic Medicine 22:251-258.

Ravenscroft, A. G. B. (1892). Some habits and customs of the Chingalee tribe, Northern Territory, S. A. Transactions of the Royal Society of South Australia 15:121-122.

Reclus, É. (1896). Primitive Folk: Studies in Comparative Ethnology. Walter Scott, London.

Róheim, G. (1933). Women and their life in central Australia. Journal of the Royal Anthropological Institute of Great Britain and Ireland 63:207-265.

Romm, M. E. (1965). Sexuality and homosexuality in women. In Marmor, J. (ed.), Sexual Inverstion: The Multiple Roots of Homosexuality, Basic Books, New York, pp. 282-301.

Roth, H. L. (1896). The Natives of Sarawak and British North Borneo. Truslove and Hanson, London.

Ruitenbeek, H. M. (1973). The myth of bisexuality. In Ruitenbeek, H. M. (ed.), Homosexuality: A Changing Picture, Souvenir Press, London, pp. 199-204.

Sabalis, R. F., Frances, A., Appenzeller, A. N., and Moseley, W. B. (1974). The three sisters: Transsexual male siblings. American Journal of Psychiatry 131:907-909.

Saghir, M. T., and Robins, E. (1973). Male and Female Homosexuality:

A Comprehensive Investigation. Williams and Wilkins, Baltimore, Maryland.

Schärer, H. (1946). Die Gottesidee der Ngadju Dajak in Süd-Borneo. Brill, Leiden.

Seligman, M. E. P. (1976). Preparedness, phobias, and sexual learning. Paper presented 22 February at the annual meeting of the American Association for the Advancement of Science, Boston.

Seligmann, C. G. (1902). Sexual inversion among primitive races. The Alienist and Neurologist 23:11-15.

Shea, J. G. (1903). Discovery and Exploration of the Mississippi Valley with the Original Narratives of Marquette, Allouez, Membré, and Anastase Douay. McDonough, Albany, second edition.

Sherfey, M. J. (1972). The Nature and Evolution of Female Sexuality. Random House, New York.

Siegelman, M. (1973). Birth order and family size of homosexual men and women. Journal of Consulting and Clinical Psychology 41:164.

Siegelman, M. (1974a). Parental background of male homosexuals and heterosexuals. Archives of Sexual Behavior 3:3-18.

Siegelman, M. (1974b). Parental beckground of homosexual and heterosexual women. The British Journal of Psychiatry 124:14-21.

Simms, S. C. (1903). Crow indian hermaphrodites. American Anthropologist 5:580-581.

Slater, E. (1962). Birth order and maternal age of homosexuals. The Lancet I:69-71.

Smith, K. D., Tcholakian, R. K., Chowdhury, M., and Steinberger, E. Rapid oscillations in plasma levels of testosterone, luteinizing

hormone, and follicle-stimulating hormone in men. (1974). Fertility and Sterility 25:965-975.

Socarides, C. W. (1968). The Overt Homosexual. Grune and Stratton, New York.

Socarides, C. W. (1970). Homosexuality and medicine. Journal of the American Medical Association 212:1199-1202.

Socarides, C. W. (1974). Quoted in Time 103(13):45.

Solecki, R. S. (1975). Shanidar IV, a Neanderthal flower burial in northern Iraq. Science 190:880-881.

Spencer, J. C. (1961). Contribution to the symposium on sexual deviation. Canadian Journal of Corrections 3:481-484.

Spencer, R. F., Jennings, J. D., Dibble, C. E., Johnson, E., King, A. R., Stern, T., Stewart, K. M., Stewart, O. C., and Wallace, W. J. (1965). The Tribes of the Great Plains. Harper and Row, New York.

Spier, L. (1930). Klamath ethnography. University of California Publications in American Archaeology and Ethnology 30:1-338.

Spier, L. (1933). Yuman Tribes of the Gila River. University of Chicago Press, Chicago.

Srivastava, P. K., Marco, Ph. J., and Lucas, F. V. (1974). Interphase Y chromatin fluorescence in homosexual and heterosexual men. Journal de Génétique Humaine 22:397-403.

Stephan, W. G. (1973). Parental relationships and early social experiences of activist male homosexuals and male heterosexuals. Journal of Abnormal Psychology 82:506-513.

Stoller, R. J. (1972). Etiological factors in female transsexualism:

A first approximation. Archives of Sexual Behavior 2:47-64.

Strehlow, C. (1913). Das soziale leben der Aranda und Loritja. Veröffentlichungen aus dem städtischen Völker-Museum I, T. IV, Abt. I:1-103.

Struhsaker, T. T. (1967). Behavior of vervet monkeys (Cercopithecus aethiops). University of California Publications in Zoology 82:1-65.

Swanson, H. D. (1974). Human Reproduction: Biology and Social Change. Oxford University Press, New York.

Symonds, J. A. (1897). A problem in Greek ethics. In Ellis, H. (ed.), Studies in the Psychology of Sex, Vol. 2, Pt. 2, Wilson and Macmillan, London, first ed., 1897; or Arno, New York, 1975; Appendix A.

Tanner, J. (1830). A Narrative of the Captivity and Adventures of John Tanner. Carvill, New York.

Taylor, G. R. (1965). Historical and mythological aspects of homosexuality. In Marmor, J. (ed.), Sexual Inversion: The Multiple Roots of Homosexuality, Basic Books, New York, pp. 140-164.

Thornhill, A. R. (1976). Personal communication after lecture given 13 February at the Department of Biology, Harvard University, Cambridge, Massachusetts.

Tourney, G., and Hatfield, L. M. (1973). Androgen metabolism in schizophrenics, homosexuals, and normal controls. Biological Psychiatry 6:23-36.

Tourney, G., Petrilli, A. J., and Hatfield, L. M. (1975). Hormonal relationships in homosexual men. American Journal of Psychiatry 132(3):288-290.

Tripp, C. A. (1975). The Homosexual Matrix. McGraw-Hill, New York.

Trivers, R. L. (1972). Parental investment and sexual selection. In Campbell, B. (ed.), Sexual Selection and the Descent of Man 1871-1971, Aldine, Chicago, pp. 136-179.

Trivers, R. L. (1974). Parent-offspring conflict. American Zoologist 14:249-264.

Trivers, R. L., and Hare, H. (1976). Haplodiploidy and the evolution of the social insects. Science 191:249-263.

Trivers, R. L., and Willard, D. E. (1973). Natural selection of parental ability to vary the sex ratio of offspring. Science 179: 90-92.

Turnbull, J. (1813). A Voyage Round the World in the Years 1800-1804. Maxwell, London, second edition.

Turner, R. K., Pielmaier, H., James, S., and Orwin, A. (1974). Personality characteristics of male homosexuals referred for aversion therapy: A comparative study. British Journal of Psychiatry 125: 447-449.

Wålinder, J. (1968). Transsexualism: Definition, prevalence, and sex distribution. Acta Psychiatrica Scandinavica Supplementum 203: 255-257.

Waltrip, B. (1965). Elmer Gage: American indian. One: The Homosexual Viewpoint 13(3):6-10.

Ward, I. L. (1972). Prenatal stess feminizes and demasculinizes the behavior of males. Science 175:82-84.

Weinrich, J. D. (1974). Marihuana and sex: Letter to the editor. New England Journal of Medicine 291:309.

Weinrich, J. D. (1976). Environmental predictability and reproductive strategy: Effects of class and race in humans. Ph.D. thesis, Department of Biology, Harvard University, Cambridge, Massachusetts, Part I.

Werner, D. (1975). On the societal acceptance or rejection of male homosexuality. M. A. thesis, Hunter College, City University of New York.

Wickler, W. (1973). The Sexual Code: The Social Behavior of Animals and Men. Anchor/Doubleday, Garden City, New York.

Wilbur, C. B. (1965). Clinical aspects of female homosexuality. In Marmor, J. (ed.), Sexual Inversion: The Multiple Roots of Homosexuality, Basic Books, New York, pp. 268-281.

Wilson, E. O. (1975). Sociobiology: The New Synthesis. Harvard University Press, Cambridge, Massachusetts.

Zuckerman, S. (1932). The Social Life of Monkeys and Apes. Harcourt, Brace, New York.

Zuger, B. (1966). Effeminate behavior present in boys from early childhood: I. The clinical syndrome and follow-up studies. The Journal of Pediatrics 69:1098-1107.

Zuger, B. (1970). The role of familial factors in persistent effeminate behavior in boys. American Journal of Psychiatry 126(8): 151-154.

Zuger, B. (1974). Effeminate behavior in boys: Parental age and other factors. Archives of General Psychiatry 30:173-177.

Zuger, B., and Taylor, P. (1969). Effeminate behavior present in boys from early childhood. II. Comparison with similar symptoms in non-effeminate boys. Pediatrics 44:375-380.