



Cathy Small (1999)

Finding an Invisible History: A Computer Simulation Experiment (in Virtual Polynesia)

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Abstract

A modeled Polynesian society is used to explain why, in Polynesia, growing stratification did not result in a devaluation of women's status, as most theorists would predict. The computer model used to explore this problem--called TongaSim--is a C++ program that attempts to emulate the basic social dynamics of Tonga, a Western Polynesian society. The program is capable of simulating the operation of a chiefdom with up to 100+ chiefly lines whose descendants marry and have children, create and maintain kinship relationships, exact and pay tribute, produce and redistribute agricultural wealth, expand in territory and go to war, and attempt to gain personal and group status.

TongaSim was used to simulate the effect of warfare (a prime mover of stratification) on women's status, specifically the custom of "*fahu*" that asserts the spiritual superiority of sisters and sister's lines over brothers and their lines. Because of intermarriage patterns, this custom also serves to make higher status chiefly lines superior in kinship to lower status chiefly lines and, thus, supports traditional political power. Two simulations were conducted with the model--one with warfare OFF (inactivated) and one with warfare ON, allowing challenging lower chiefs to go to war and seize land if they were able to do so. The effect of warfare on the *fahu* custom and its implications in the virtual system were recorded and examined. The simulation showed that, despite the initial conflict between the interests of rising military chiefs and the *fahu* custom, the custom was appropriated by these rising chiefs, turning the *fahu*'s political effects "on its head." Ultimately in the simulation, the *fahu* custom provided a vehicle for military chiefs to gain status and power. This, it is argued, is consistent with the lack of any historical evidence that the *fahu* was challenged and toppled during periods of growing warfare and stratification.

Keywords:

Polynesia; gender; simulation



Introduction

1.1

This article uses a modeled Polynesian society to explain a quandary in the study of gender and stratification. Scholars have suggested that growing stratification in Polynesia conflicts with the traditionally high position of women, leading, theoretically, at least, to a fall in the status of women as chiefdoms historically became more stratified, war-like and state-like ([Gailey 1987](#)). In ethno-historical accounts, however, despite growing warfare and stratification in many Polynesian societies, the position of women remained high ([Lockwood 1992](#); [Linnekin 1990](#); [James 1988](#)). Is stratification, then, not in conflict with women's status, as others ([Leacock 1983](#); [Sacks 1979](#)) have suggested?

1.2

I wanted to see whether simulation could reveal properties that do not emerge directly in historical accounts. Could it be that the high status of women did conflict with stratification, but does not show up historically as a change in any custom or prerogatives? I hypothesized the following scenario. The prerogatives of women in Tonga were problematic for increasing stratification fueled by military conquest. However, because the emergent military powers simply married into old powers and appropriated traditional rank through kinship. Women's prerogatives -- part of the older base of power -- were not challenged directly and so were not events that showed up in historical accounts.

1.3

The problem in demonstrating this scenario with ethno-historical data is precisely that major historical events would NOT show evidence that women's status was contested by new powers, or that the status of women fell as a result of stratification. Could simulation help us to see the dynamics behind the lack of any surface conflict or change?

The Model

2.1

The computer model used to explore this question, called TongaSim, is a C++ [program](#) that attempts to emulate the basic social dynamics of Tonga, a Western Polynesian society.^[1] TongaSim is conceived as a dynamic and interacting system of linked processes (including production and redistribution, marriage and kinship) within which chiefly agents (familial lines, headed by chiefs) compete for status and ascendancy on a landscape.^[2] The model bases its structure and rules of operation on available archaeological, ethnographic, and historical information about early Polynesian systems with particular attention paid, of course, to Tongan materials.

2.2

The program is capable of simulating the operation of a chiefdom with 100+ chiefly lines whose descendants marry and have children, create and maintain kinship relationships, exact and pay tribute, produce and redistribute agricultural wealth, expand in territory and go to war, and attempt to gain personal and group status. The activities in one generation rearrange the social and economic landscape of the next so that, over time, simulations produce a virtual history--that is, a discrete, observable, and recordable set of dynamic interactions as they occur over multiple generations. This virtual history can be examined to see not only what happened but why, in the context of the simulation, it did happen.

2.3

A "typical" run of the model might consist of 10 chiefly lines, each with its own base of land and kin labor (the user may specify these initial conditions). A male chief, who holds the titled position of chief and will pass on the title to a son or brother, heads each line. Lines produce wealth as a function of their population size, land holding and the ability of the chief to provide leadership. When a line reaches half of the carrying capacity of the land that it occupies, it will split, with a younger brother of the chief leaving with kin to settle new land.

2.4

All chiefs marry and will attempt to wed for political advantage. Usually this means a marriage to those of higher status but, depending on the situation of the lineage, a chief may marry for wealth or alliance. Marriage sets up a web of economic and social relationships between lines, with a wife-giving (bride's) line obligated to provide material support to the wife-receiving line. Each marriage will bear 4 children (other fertility values can be specified) and each child is born into a relative "status," depending -- as throughout Polynesia -- on the status of one's mother and father and one's birth order. An heir to the chief will be chosen as successor based on primogeniture and rank, although other considerations enter under specified conditions of the line. The society will play out this scenario for more than 20 generations.

2.5

The simulation allows for variable input for functions, or for functions to be turned on and off. While I described a "typical" run above in accordance with the prevailing conditions in Tongan culture, the simulation parameters may be changed on the opening screen in accordance with other conditions or rules. The user may, for instance, change MARRIAGE RULES in the society, or manipulate the LAND AVAILABLE, or GROWTH RATE for the society. Users also have the capability of turning functions such as WARFARE or RANDOM FERTILITY on or off.

2.6

The simulation test for this article consists of a comparison of the outcomes in the virtual society with WARFARE both on and off. This will allow us to address the questions: How does women's status articulate with warfare? Do the prerogatives of "women's status" interfere with the power hierarchies in the virtual society under conditions of warfare? Is the result different when warfare is not operating?



Hierarchy and The "Fahu" Custom in Tonga

3.1

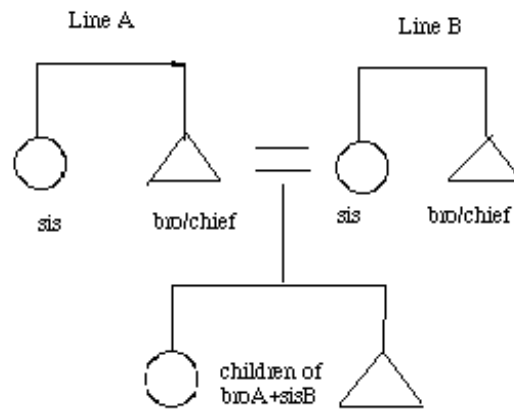
To understand the meaning of the simulation test, the reader may need some background information about Tongan hierarchy. Tonga is a chiefdom in which people are ranked on the basis of birth. Besides broad rankings of "commoner" and "chief," everyone within a single family has a hierarchical relationship to one another based on primogeniture and gender. First-born children are "higher" in prestige than second-born children and sisters in Tonga outrank their brothers. The highest status person, then, in any family will be its eldest daughter. The spiritual superiority of sisters extends as well to their progeny. These principles of prestige and gender underlie one of the most important nexus of "women's power," the *fahu* custom.

3.2

The *fahu* custom is based on the superior spiritual position of sister over brother, and of sister's children over brother and his children. The superiority is expressed in both deference behavior and in a material flow of goods and services from a brother and his line to a sister and her line. When a chiefly woman marries, her children (who are now living as part of husband's line) become "*Fahu*" to her brother's line, and the flow of deference and wealth that follows can be an important source of political power.

3.3

The kinship diagram below illustrates *fahu* relations between two sister-brother pairs, one in line A and one in line B. ^[3]



3.4

If the sister from line B marries the brother from line A, line B must support line A based on the kinship-based principle that a brother must support his sister and his sister's children. The children of line A (through the marriage of brother A with sister B) will be "*fahu* to" the line B chief and his progeny.

3.5

TongaSim is able to play out the all the hundreds of marriages that occurred between chiefly lines, based on known ethnographic priority rules in marriage (i.e., people try to marry for advantage to their line). The program then identifies the *fahu* relationships between people and lines that are created by these marriages, and transfers wealth as custom dictates. In normal operation, because women are married hypergamously (to those of higher rank), the *fahu* custom ends up reinforcing the principles of rank in Polynesia. Those of higher rank emerge as *fahu* to those of lower rank. Women's status and traditional rank, based on genealogy, thus go hand in hand and the powers that be have every reason to support and defend the *fahu*.

3.6

The question to be answered by simulation is this: Does warfare and the ensuing changes in stratification that warfare creates, change this pattern? In other words, does *fahu* become "problematic" to those in power under conditions of warfare?

Warfare and Women's Status: A Simulation Test

4.1

To answer this question, I programmed the model for a simple test. I wanted to see whether *fahu* relationships became problematic as warfare, and hence stratification, occurred in the model. First, I built an output device that would allow me to view all *fahu* relationships by generation and that would identify any "problematic" cases of *fahu*. A problematic case is an instance of *fahu* that fails to support principles of rank; that is, where *fahu* relationships cause people of higher rank to support those of lower rank,^[4] as pictured below. I will call these "Inverse Fahu" relationships.

Table 1

	...FEMALE from HIGHER line	...MALE from HIGHER line
If a female from a LOWER line marries...		<i>fahu</i> reinforces power structure
If a male from a LOWER line marries...	INVERSE FAHU (<i>fahu</i> reverses power structure)	

4.2

Second, I included a toggle switch that allowed me to inactivate the WARFARE function. With WARFARE ON, I enable warfare to occur if conditions that cause war, e.g., population growth and land competition, are present. By turning WARFARE OFF, I disable the possibility of growth of stratification through conquest.

4.3

I begin by running a simulation with WARFARE OFF, and then look at the nature of the *fahu* relationships that are created between lines over a period of 20 generations. I am interested in the number and percentage of "Inverse Fahu" relationships that occur when the society is not threatened internally by war. I then run a simulation with WARFARE ON and consider the same set of data. I then compare the two sets of output to answer the question: Did the presence of warfare, result in more instances of "Inverse Fahu," i.e., where the *fahu* custom results in the obligation of higher lines and chiefs to lower lines and chiefs?

Results

5.1

Simulations with the model suggested that INVERSE FAHU relationships *were* directly related to warfare. The chart below compares the number and percentage of inverse (or problematic) *fahu* relationships in the simulation after 20 generations with warfare off and after 20 generations with warfare on. The differences between the two simulation runs are shown in the last column.

Table 2: Incidence of "Inverse Fahu"

	Warfare OFF	Warfare ON	Difference
Incidences of Inverse Fahu	29	68	39
Percentage of Inverse Fahu of All Marriages	4.6%	12.2%	7.6%

5.2

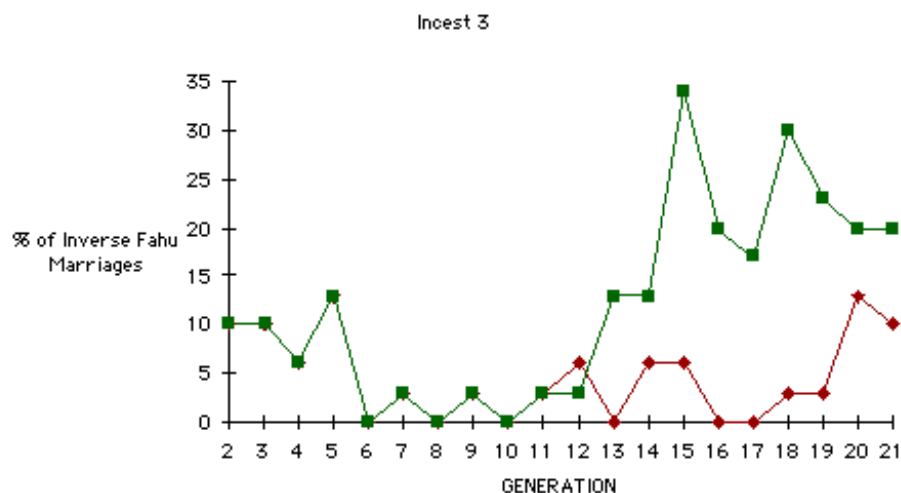
In making this comparison, I do not claim that there was an actual historical time when warfare was absent vs. present. Indeed, according to linguistic and archaeological evidence, some warfare is probably endemic to Polynesian chiefdoms ([Kirch 1984](#)). However, warfare did seem to increase in frequency and scope as chiefdoms developed, and this warfare activity is seen as a central force in increasing stratification in many Polynesia societies.

5.3

The table [above](#) indicates the way that warfare interacts with the *fahu* custom in a structural sense. By comparing Column 1 with Column 2, one can see that warfare tends to be associated with increased instances and proportions of "Inverse Fahu" events. With warfare on, there are 39 more cases where *fahu* relationships undercut status hierarchies between lines by obligating a higher line to support a lower line than occurs when there is no warfare. Both the number and percentage of cases is 2-3 times as many *with* warfare than without. Consistently, then, under conditions of warfare, the *fahu* custom "upsets the apple cart" by challenging the superiority of high chiefly lines.

5.4

Further support for the role of warfare is seen when one looks at the results over time. Below is a graph of the percentage of "Inverse Fahu" marriages over the 20 generations of the simulation with warfare on (green line with boxes) and warfare off (red line with diamonds). In the first half of the simulation, the condition of warfare makes no difference in the incidence of "Inverse Fahu." The reason is that during the early generations of the simulation there is enough land in the system for lines to expand and split without interfering with one another. Although warfare is on and hence can occur, lines do not actually go to war with one another until there is a land shortage and they begin to compete for territory. In the simulation land becomes filled in by generation 10 and generation 11 is the first generation where lines do not have new territory in which to expand. It is telling, then, that "Inverse Fahu" results -- identical in the first 10 generations, namely generations 2 through 11, ^[5] under the two conditions of warfare -- begin to diverge in generation 12.



The extent of these changes is displayed in [Table 3](#), which looks at the effect of warfare on the percentage of inverse marriages in generations 12-21. Under the conditions of land scarcity that obtain during this time period, warfare is frequent. It is also this time period when there are many "Inverse Fahu" marriages. Overall, approximately 1 in 20 marriages (4.7%) are "inverse" with warfare OFF, while almost 1 in 5 marriages is inverse (19.3%) with warfare ON.

Table 3: Percentage of Inverse Fahu Marriages, Second 10 generations

Gen.	12	13	14	15	16	17	18	19	20	21	Average %
WAR											
OFF	6%	0%	6%	6%	0%	0%	3%	3%	13%	10%	4.7%
WAR											
ON	3%	13%	13%	34%	20%	17%	30%	23%	20%	20%	19.3%

5.5

Detailed examination of the virtual history of lines sheds further light on the relationship of warfare and *fahu*, specifically why warfare has this effect on *fahu*. The overall simulation is designed so that lines marry to their own advantage. In other words, although most lines choose to marry their chiefs to those of higher status, the decision to marry is based on an assessment of what the line needs. If a line is stable, it will marry for status. However, if it is relatively high in status but low in wealth, it will marry for wealth. If it is under threat of attack from a neighboring chief, and it is weaker than that chief, it will try to "marry out" of its difficulties by marrying into the threatening line. ^[6] All

these "rules" of marriage are operating principles that are supported by historical and ethnographic literature (see [Bott 1982](#)).

5.6

The inverse *fahu* comes about in, a general sense, as traditional power attempts to establish marriages alliances with rising military power. In a typical example of "inverse *fahu*" taken from directly from the virtual history, a more powerful line (B), which is lower in status, encounters a higher status but less powerful line (A) on adjacent land. The Line A assesses the threat of war and the likelihood of winning a war. Seeing that the war is not likely to be won because of the superior strength of the encroaching line, Line A, although higher in status, will marry out its daughter to the threatening line. This averts warfare, and usually keeps land in the family, but it also creates a situation of inverse *fahu* where the higher ranked line now has a kinship obligation to the lower line.

5.7

The dynamics just described occurred in the majority of the simulation cases involving inverse *fahu* when warfare was ON. Inverse *fahu*, then, increases with warfare because it is a frequent strategy of those with traditional rank to avoid war when the aggressing line, because of its size and strength, is likely to be victorious. It is also the case that, because of warfare, some lines gain land and people, thus increases in wealth. High status lines seeking to increase their wealth through marriages to well-to-do lines end up, likewise, in inverse *fahu* relationships with lines whose wealth came from military power.

5.8

Under conditions of warfare, marriages for alliance and marriages for wealth result in many more "inverse *fahu*" scenarios in which the superior relatives are those with military clout. Put in another way, under conditions of warfare, the *fahu* custom will operate against traditional genealogical authority and in favor of military power about 20% of the time.

Interpretation

6.1

What then can we speculate about history from this simulation exercise? In a structural sense, the *fahu* custom supported traditional power, based on genealogical descent. The prerogatives of the "sister," expressed in her spiritual superiority and the custom of *fahu*, was part of a larger system of marriage and hierarchy that reinforced the ranking system by obligating those of lower rank to those of higher rank. Theoretically, this set of customs would oppose challenges to genealogical-based power by rising lower chiefs whose power base was warfare. Why then wouldn't warring chiefs, who eventually come to power, seek to overthrow the *fahu* custom and why would not we see this historically?

6.2

The simulation demonstrated how the *fahu* would articulate with rising military power. Although 80% of marriages, even under conditions of warfare, would seem to support genealogical power, *fahu* also provided a vehicle through which powerful lower chiefs could legitimate their power. In many virtual instances the *fahu* was appropriated by those with non-traditional power (military power or wealth acquired through military conquest) in an effort to enhance their position in the traditional system rather than challenge that system. Through the threat of warfare, and an ensuing marriage for alliance, "inverse *fahu*" enabled lower lines to establish kinship relationships of superiority to higher lines.

6.3

Over time these lower lines would become part of the status hierarchy they initially opposed. Consider the case of the threatening chief (in line B), who managed to marry a daughter of high

status line A. Although line A will owe support and deference to line B through the *fahu* custom, the chief of line B or his line are neither "higher" in status for having made such a marriage nor would they be higher had they defeated line A in war. This arises because, in ethnographic terms, one cannot directly appropriate rank and prestige through power and wealth. However, because of his marriage to a high chieftess from line A, chief B assures that his children will assume high chiefly status. Since status is genealogical and based on the status of both parents (with primacy in Tonga accorded to the status of the mother), the child of chief B will be of high rank because his mother was an elder sister of Line A. The next titleholder of line B will thus increase in rank and, in turn, raise the status of the line. Military strength and size has, in essence, been parlayed into legitimate rank through marriage and the use of the *fahu* custom.

6.4

Under these conditions, rising military chiefs would not oppose the *fahu* custom. Although *fahu* will support the rank relations among lines in 80% of cases, it also may be "reversed" and cause higher chiefs to owe kinship obligations to lower chiefs. Moreover, combined with strategic marriages, the lower powerful chiefly lines will soon become bonafide members of high rank through their children. What was structurally problematic for rising power then becomes historically advantageous.

6.5

Traditional powers would also be unlikely to oppose *fahu*. Even though the *fahu* custom has become increasingly problematic for them with warfare and the rise of "inverse *fahu*" situations, it still remains a bulwark of genealogical power in the majority of cases. For both traditional and non-traditional powers, *fahu* thus would be a double-edged sword, but one that both sets of powers would have an interest in retaining.

6.6

Simulation suggests a history, then, that would not come to full light just by using historical sources. It points to a custom that probably was contentious for both traditional and military powers, but one which could not have been consistently opposed by either. Despite volatile dynamics underlying it, the *fahu* would have appeared stable on the historical surface.

Notes

¹This work was supported by a POWRE grant (SBR 9753111) from the National Science Foundation.

²Lines, not chiefs, were our beginning unit of analysis although chiefs could break away from lines and act independently of them.

³In kinship diagrams, circles represent women and triangles represent males. Horizontal connections between figures represent sibling relationships while circles or triangles attached by vertical lines represent children-parent relations. An "equals" sign means marriage.

⁴I specified that the difference between the lines should be pronounced. The program identified any inverse *fahu* relationship where a substantially higher line (33% higher in status than its *fahu*) was obligated to a lower line.

⁵The very first generation of the simulation is an initialization generation. It is not until generation 2 that any "activity" occurs. Therefore, my statistics begin with generation 2 as the first generation.

⁶In addition, conquering lines may force the defeated line to marry out its eldest daughter of highest status ([Collocott 1923](#); [Gifford 1929](#)).

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