Chapter 2. ENVIRONMENT, TECHNOLOGY AND CULTURE

> [The] fundamental procedures of cultural ecology are as follows: First, the interrelationship of exploitative or productive technology and the environment must be analyzed.
>
> Julian H. Steward, 1955

I. Introduction

A. Technology as Cultural Adaptation

Julian Steward argued that technology was the window between the natural world and human society and culture. As we saw in the last lecture people are unlike other animals in the extent of their culture. We cannot safely use the ordinary theory of ecology and evolution from biology without taking culture into account. However, culture is a huge mass of socially transmitted preferences, attitudes, knowledge, concepts and so forth. Language, religion, political opinions, dress customs, and many other things are learned. Among all these parts of culture, technology is, according to Steward, the obvious place for the human ecologist to start, because it is the way that we make our living in the world that couples us directly to the rest of nature. Like any other organism, we have to acquire resources from the environment to survive and reproduce. Using technology we learn from others rather than anatomical adaptations does not alter the fundamental need to make a living. Steward was perfectly willing to imagine that other parts of culture were important, and could have ecological explanations, but he insisted that if this was so, it would be because they somehow affected technology. For example, a cultural system of gender rules deriving from religion has obvious ecological consequences if it restricts the use of important forms of technology to half of the population, as is often the case.

Steward was one of the pioneers of the field of cultural ecology. One of the great contributions of cultural ecologists was to furnish us with a taxonomy of human cultures based on subsistence relations. We will use this taxonomy in this course. It turns out to be a great scheme to systematically organize the great mass of things we know about human behavior. Ask Steward's first question *How do they make a living?* and much else falls into place. Human ecology has gone a long way since the pioneering work of the original cultural ecologists, but there is still no better first question. The success of the cultural anthropologists' classification scheme is evidence that they got the importance of the process of adaptation via technology roughly right. Cultural ecologists were thus key pioneer contributors to human ecology.

The purpose of this lecture is to use the history of cultural ecology as means to introduce you to some of the main issues in applying ecological and evolutionary ideas to humans.

B. An Example—Alkali Cooking of Maize

The humble example of corn cooking techniques nicely illustrates how ecological and evolutionary ideas apply to cultural patterns. Corn (maize) is an important part of the diet of many subsistence cultivators in the world. In the early 1970s Solomon Katz, a biological anthropologist interested in cultural ecology, studied the common, but not universal, practice of boiling corn in alkaline solutions such as wood ash, to make *masa harina*, hominy, or similar products. (Tortillas are made of masa harina, not plain corn meal.) It turns out that boiling corn in this way makes more of the amino acid lysine available. Lysine is the amino acid that is least abundant in corn, relative to human nutritional needs. Alkali treatment in the New World is strongly correlated with dependence on corn; societies that are heavily dependent on corn treat it, but those that have access to ample game or other sources of proteins rich in lysine do not. Given that alkali treatment is troublesome but effective in increasing lysine, this looks like a highly adaptive process. Score one point for the ecological approach.

Some sort of evolutionary process must have produced the ecological correlation. Corn is also a widely used staple in the Old World, (especially in Africa) but alkali treatment is absent. Africans have depended on corn for only a few hundred years, while the crop is indigenous to America and has been cultivated for thousands of years. People may be smart, but the small, statistical effects of alkali treatment on health and welfare must be hard to discover. Some complex process operating over long spans of time must act to "create" cultural adaptations much like natural selection "creates" organic adaptations. Score a point for the need for an evolutionary theory of cultural adaptation.

Alkali treatment is a typical Stewardian technological adaptation, not an organic one. Alkali treatment is an item of traditional culture among many American cultivators. It is a technological adaptation, not a genetic one. As we have noted, very many human "adaptations" are of this sort. *One might go so far as to say that the main human genetic adaptation is the neural and anatomical machinery to use culturally acquired technology as an adaptive device.* We have big brains to acquire the requisite ideas by culture, and our upright posture frees our hands to implement them.

A limitation of the cultural ecologists' explanations was that they lacked much of a theory of the processes of cultural adaptation and evolution. While the patterns of correlation between practices and environment, and the long time needed for them to arise, exem-

plified by alkali cooking, are compelling at one level, a convincing, detailed account of how such things happen was lacking. Compared to the great attention population biologists have given to the processes of organic evolution, social scientists' accounts of cultural evolution are quite underdeveloped. Rectifying this incompleteness is currently one of the most important frontiers of human ecology, and some major problems are still unsolved. .

Keep in mind that skepticism is the main engine of scientific progress, the scientist's rule is to try to doubt every explanation with the proviso that the least dubious one is provisionally accepted.

C. Cultural Anthropologists' Critique

A second important issue is that many cultural behaviors ***don't*** *look very adaptive*. For example, folk medicine is often based on the idea that treatments of diseases should bear some relationship to the diseases that they are supposed to cure. Under this theory, European folk medicine used liverworts (small, primitive terrestrial plants) to cure liver disease because liverworts look like livers, and fox lungs to cure respiratory ailments because of the purported respiratory prowess of foxes. This idea became accepted medical theory in the l8th century under the label "doctrine of signs." A Benevolent Creator would have given such hints to his favorite species. God would advertise His remedies, like painkiller and laxative makers, so to speak. Today, it is clear that such a theory is useless. Score one for the skeptics of the ecological approach.

The doctrine of signs was more than just an elementary mistake, it was part of a much larger Western supernatural belief system. The most spectacular of these possible examples of maladaptation are bound up with complex systems of supernatural beliefs. The doctrine of signs was an adjunct to the peculiarly rationalized theology of medieval and modern European Christianity. Religion and other ideological, extra-rational belief systems are common motivations for apparently debilitating and dangerous beliefs ranging from lavish expenditures of resources for propitiating gods to suicidal sacrifices in holy wars. At the very least, justifying the doctrine of signs with a religious argument based on the assumption of a Benevolent Creator who would leave signs inhibited a more rational approach to medicine. Even worse, some empiricists like Galileo were actively harassed by the Church as heretics; not a few scientists were killed by the Inquisition. Religions of course do often promote quite adaptive behavior; for example, belonging to conservative Christian faiths seems to protect people from substance abuse.

Quite aside from religion, much more mundane symbolic rituals consume vast quantities of human time and resources to no obvious benefit. This Fall many of us wasted 3 hours most Sundays watching our favorite football team. Perhaps we even enjoyed it, at least when they won. How could such behavior conceivably be adaptive? Most of you can probably invent an adaptive hypothesis for sports fans' behavior, but how much confidence do you have in it?

Many social scientists argue that non-adaptive processes are much more important than adaptive ones in determining human behavior. For cultural ecologists, following Steward, technology is a large, open window through which the natural world lights up a large fraction of culture. The critics of ecology think the window is small and opaque, and that culture is largely insulated from nature by thick walls. Technology may be a window on the natural world all right, but the size of the window, the color of the glass, the direction it faces, and every other thing about it are determined by our language, political and social system, supernatural belief system and the like. If the ecological/evolutionary approach is to be wholly successful, it must make a place for symbolic behavior and consider they hypothesis that culture sometimes produces non-adaptive or maladaptive behavior.

II. Discoveries of Human Diversity and Uniqueness

A. Introduction

Social scientists of the 19th and 20th Centuries documented the immense variety of human behavior in time and space and some striking differences between contemporary behavior and that of other animals. We call these discoveries, because the broad outlines of the data don't change much as new information comes available. We will constantly draw upon the general results on diversity and uniqueness in the rest of the course to outline (1) just what it is human ecology (and/or the rest of the social sciences) has to explain, and (2) sources of data to test hypotheses. Aside from these uses, some familiarity with both is an important part of a general education!

B. Human Diversity

The discovery of human diversity is the great contribution of classical anthropology, archaeology and history. Human behavior is very different from place to place and time to time. *The* discovery is really a set of many small discoveries linked together in a sensible framework. The main outlines of human diversity were sketched in the 19th Century. This body of knowledge developed more or less in parallel with the discovery of organic diversity and the existence of adaptive patterns mentioned in lecture 1. Indeed, several important figures, such as Charles Darwin and John Wesley Powell, the explorer of the Grand Canyon

Country, made significant contributions to both ethnography and natural history.

The proper discovery of human diversity was surprisingly recent. The diversity of peoples had, of course impressed people from time immemorial, but generally one society was only really familiar with its immediate neighbors, who in turn tended to be relatively alike. To the extent that distant people were known at all the knowledge was partial, distorted, and unsystematic. The advent of the voyages of discovery late in the 15th Century greatly increased contact with more distant societies, but appreciation of the nature of human diversity was quite poor until a more scientific approach to exploration was begun in the latter part of the 18th Century.

When Darwin wrote his *Descent of Man* in 1871, he devoted the seventh chapter to racial differences. A certain amount of his data came from his own observations on the voyage of the Beagle, where he got a chance to observe Hispanic Americans, Indians, and Blacks in South America, and a few peoples elsewhere. His most famous observations were of the Fuegans who lived at the tip of South America. Several Fuegans had been taken by Captain Fitzroy of the Beagle to England on a previous voyage. They had been instructed in the rudiments of Christianity and Civilization and were being returned to help bring the "benefits" of Christianity and civilization to their fellows. However, by the 1870's Darwin could depend upon much more than his own observations; a host of similar scientific travellers accounts were available, and the science of anthropology was emerging.

Darwin's analysis of the differences between the races is a good example of how scientists eventually made progress in the face of popular ethnocentrism. His methods were those of careful observation, and broad comparison. For example, he formulated detailed questionnaires on human behavior to a large number of correspondents. He could check their answers against his own broad base of personal observations. Then he reasoned very carefully about the assembled data. For example, the people of Tierra Del Fuego that he observed on the Beagle voyage struck him as the most "primitive" group known to him. However, they were obviously close in race and language to much more "advance" Native Americans living in temperate Argentina. The environment of Tierra del Fuego was exceedingly difficult and that of Argentina relatively benign. Darwin argued that the "primitiveness" of the Fuegans was an adaptation to their environment, not a biological characteristic. He considered that a mass of comparative evidence supported a similar interpretation. Regarding the English tendency to ethnocentrism, he observed that his own people had been "hideous savages" themselves not so very long ago!

Darwin allowed that at first observation a trained naturalist is inclined to classify the different races as distinct species because of the differences in "bodily constitution,"

"mental disposition," and adaptation to differing climates. Indeed in terms of phenotype (especially behavior, but also physiognomy), humans are extremely variable, and, of course, we are an extremely widely distributed species. However, Darwin argued, the interfertility of all human populations, especially of the massive cases of genetic mixing he observed in South America and elsewhere, and the impossibility of producing a clean racial classification without a mass of intergrading populations, made the separated species idea untenable. The different-species argument required that mixed blood people do more poorly than pure types. Its proponents argued that mulattos, for example, were sickly and disease prone. But Darwin had visited places largely populated by mulattos and mestizos, and as far as he could see they did just fine! On the issue of mental differences Darwin was "incessantly struck... with the many little traits of character showing how similar their [Indians and Blacks with whom he had been intimate on the *Beagle* voyage] minds were to ours." He considered that sexual selection (fad and fashion in standards of human beauty) was chiefly responsible for biological differences like skin color. Darwin didn't use the concept of culture, which was just in the process of being developed by Edward Tylor in the 1870s. But he did attribute human differences to "civilization," a rather parallel concept, and began to demolish the ethnocentric interpretation of races as species. All things considered, Darwin's view is quite modern for his time, and ideas like separate species for the separate races were widely touted despite his argument. Unfortunately few of Darwin's contemporaries in the 19th Century followed his lead. Getting rid of ethnocentrism in the human sciences was a 20th Century struggle, and some vigilance is still warranted, even in scientific circles.

Even today much is left to understand about human diversity, but the main outlines of what has varied and where seem safely in hand. You can form an impression of the ethnographic data available on humans by studying the maps of figure 2-1, from Jorgensen (1980). He and his collaborators summarized the known information for 172 Western American Indian tribes. They combed the literature for information on each tribe, and used statistical techniques to extract patterns which are displayed in maps. We have selected three maps. Figure 2-1a shows environmental areas, based on a statistical summary of 132 variables., including the physical environment (temperature and rainfall), and dominant plants and animals (the many blank areas indicate insufficient data for the analysis). Figure 2-1b maps language as conventionally classified by linguists based on similarities of language structure, sounds, and words. Figure 2-1c shows a statistical summary of 46 variables related to subsistence technology. Note the reasonable correlation between technology and economy in many areas, but the weak relationship between language and the other two patterns. Roughly similar data is available for the whole world. In the 1950's G.P. Murdock and his collaborators began to assemble world-wide samples of ethnographic data for anal-

ysis. By now, their working base of ethnographic (and some historical) accounts numbers over 1,000. We will refer to this compendium repeatedly in Part II of the course.

C. Human Uniqueness

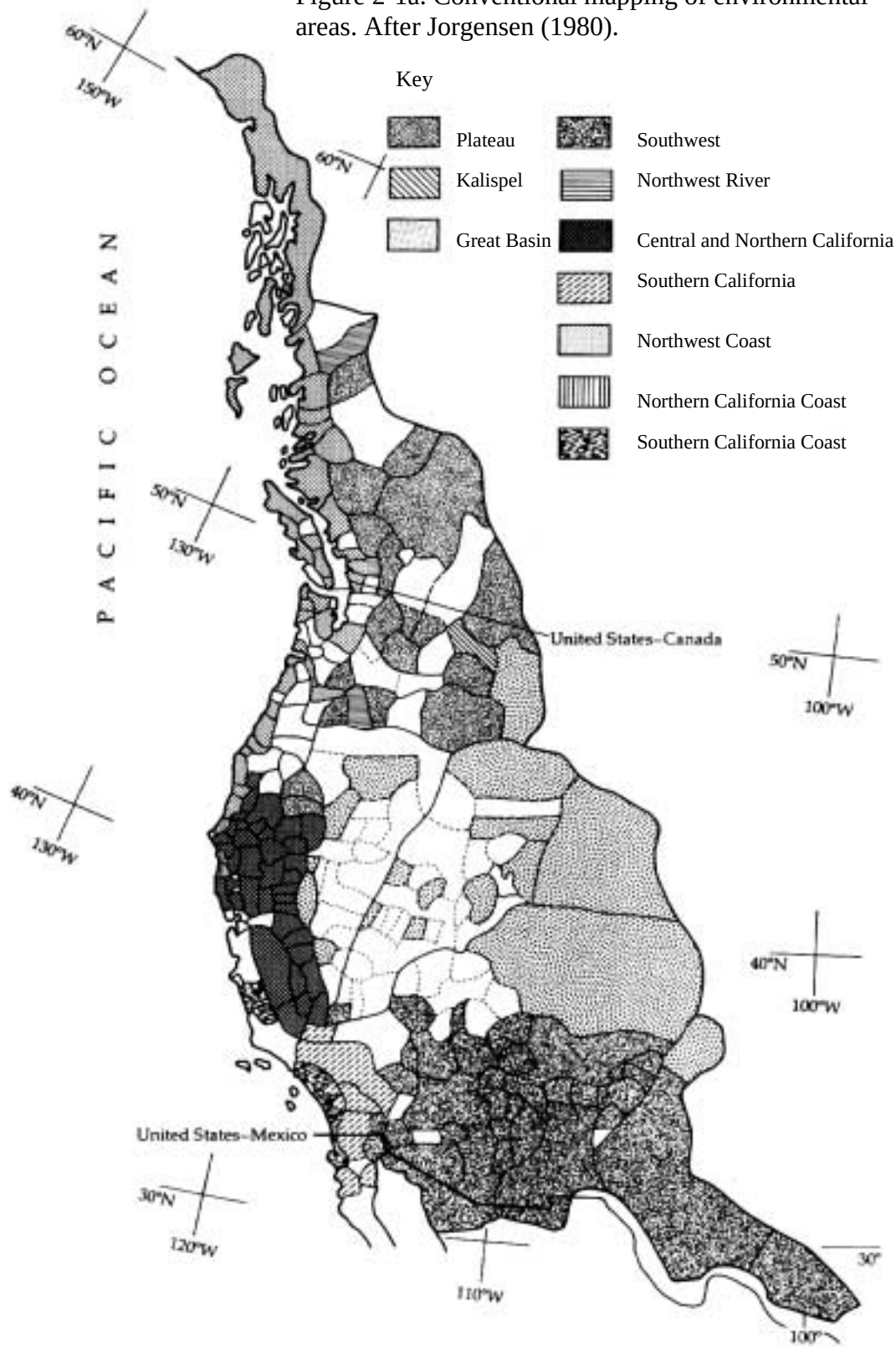
What are we to make of the differences between humans and other animals? Are they significant enough to require fundamentally different theories, or will small amendments to biology suffice? It all depends on how different we are, and in what ways. After all every species is unique, or it isn't really a separate species! Recall from the last chapter that there are several candidates for features that are unique to humans, or at least exaggerated in our species relative to most other animals, including our ape relatives. The possession of cultural transmission, complex societies with division of labor, and symbolic communication capacities, especially language are the most important examples.

Folk traditions are quite inconsistent in their views of the resemblance between humans and other animals. Some traditions, for example the Judeo-Christian, give "Man" a very special place in the cosmos, next to God. Other traditions endow animals with human-like characteristics. We are prone to think of these latter as primitive "animism." (In "animistic" religious traditions, animals, plants, streams, rock formations, and the like are believed to have human-like motives and abilities.) However, modern children's stories make rich use of animals with human characteristics, pet owners give personal names to their favorite animals, and TV nature programs exaggerate the human-like traits of animals. An example is given in Figure 2-2 (from Bodecker, 1974; in the story humans destroy a mushroom village inhabited by insects. The other small animals gather to help them put it right, each according to its own special skills).

Like human diversity, the proper discovery of human uniqueness is rather recent. Just what the differences between humans and other animals are is mostly a discovery of the 20th century. K. Frisch, N. Tinbergen, and K. Lorenz won the Nobel Prize in the early 1970s for the development of the careful field observational methods that were necessary to describe and dissect animal behavior accurately. With this work, and with the publication of Edward O. Wilson's (1975), the famous Harvard student of ants, magisterial summary of animal behavior in a comparative evolutionary framework, that the main outlines of how animal and human behavior differ had been discovered. The problem has been to describe as accurately as possible the similarities and differences between animal and human behavior.

Like the discovery of human diversity, a proper account of human uniqueness was a result of the application of scientific methods. Let us take the example of culture or imitative learning. 19th Century naturalists were pretty sophisticated in many respects, but as

Figure 2-1a. Conventional mapping of environmental areas. After Jorgensen (1980).



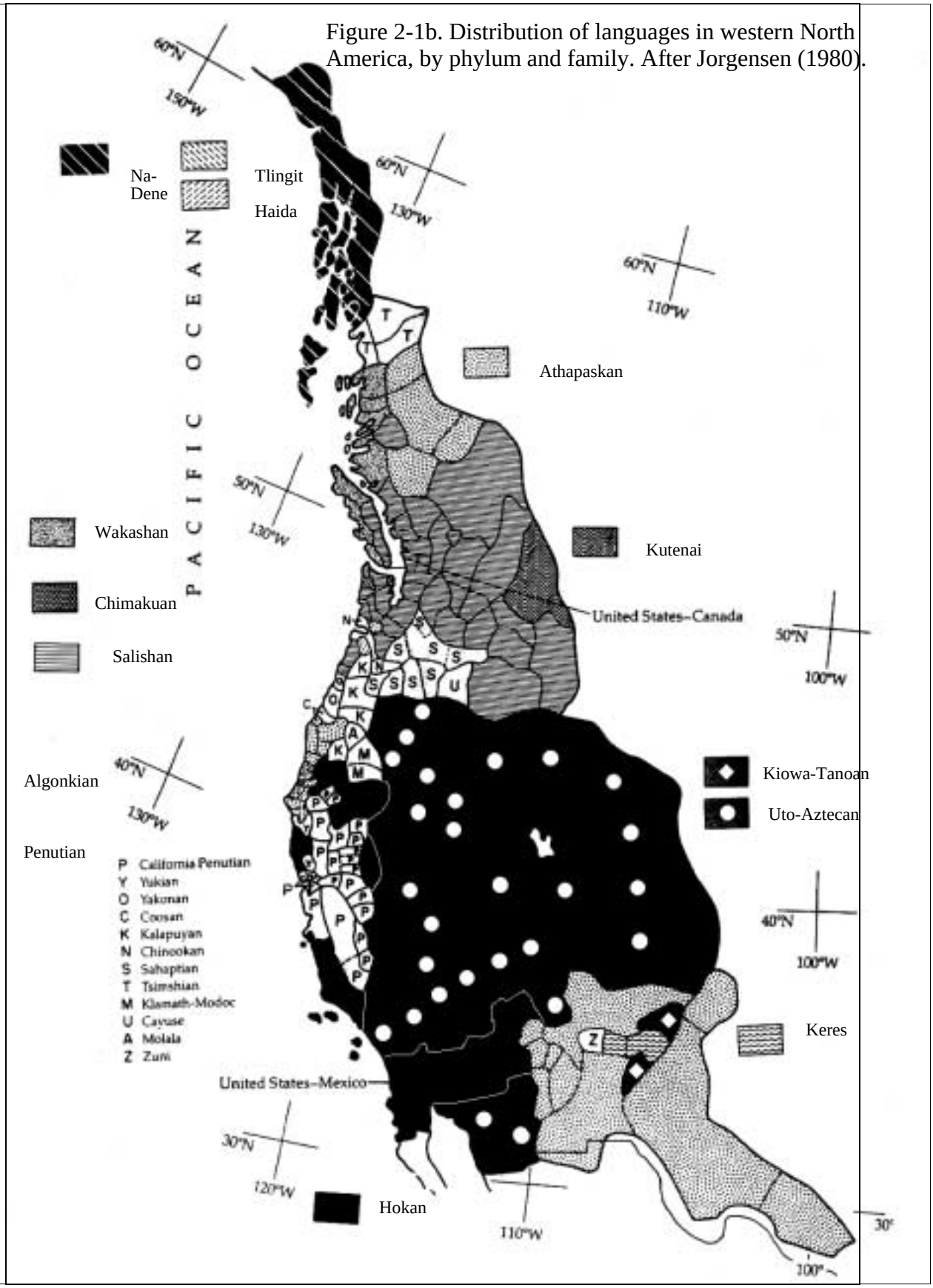


Figure 2-1b. Distribution of languages in western North America, by phylum and family. After Jorgensen (1980).

Figure 2-1c. Conventional mapping of economic organization areas. After Jorgensen (1980).

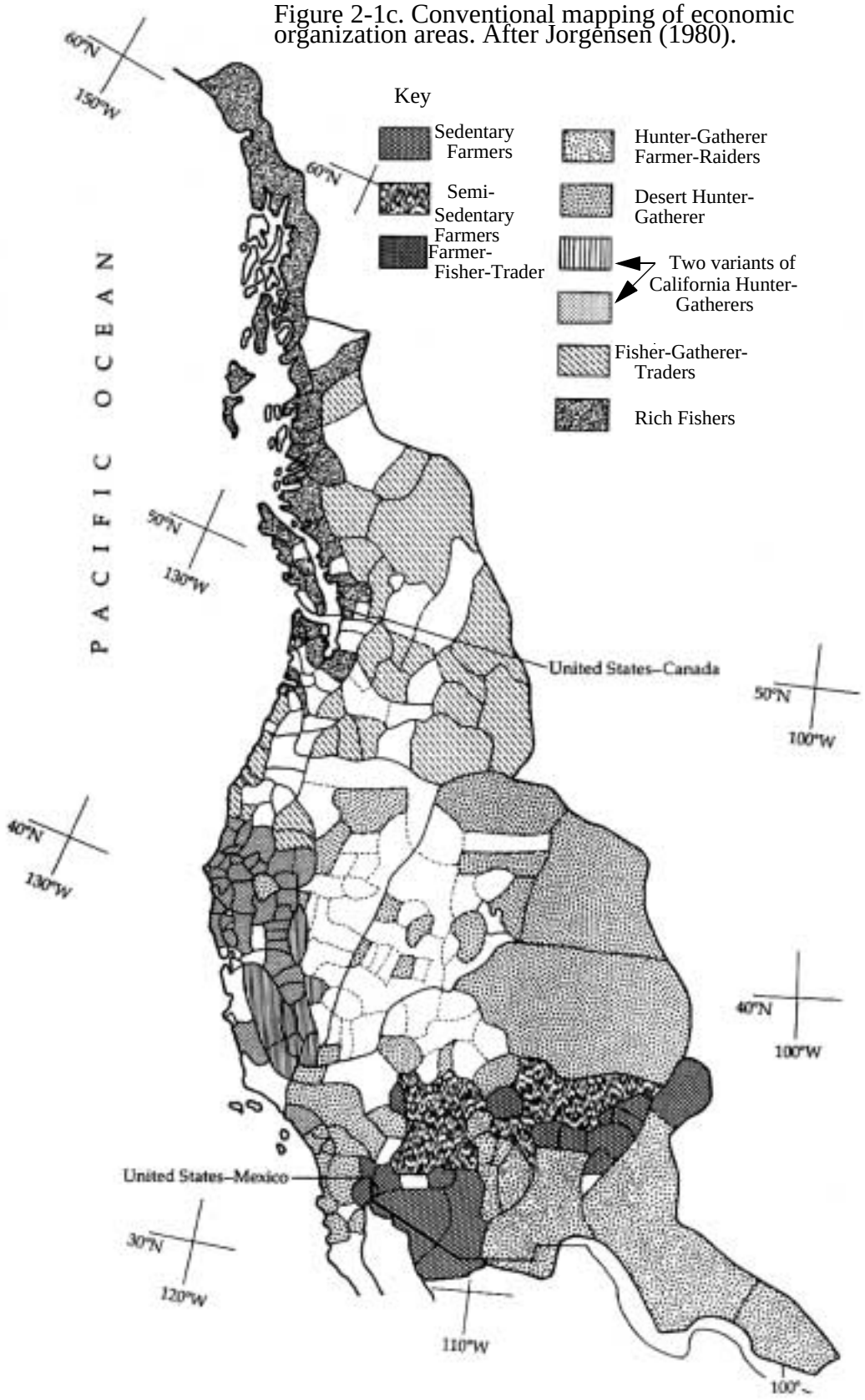
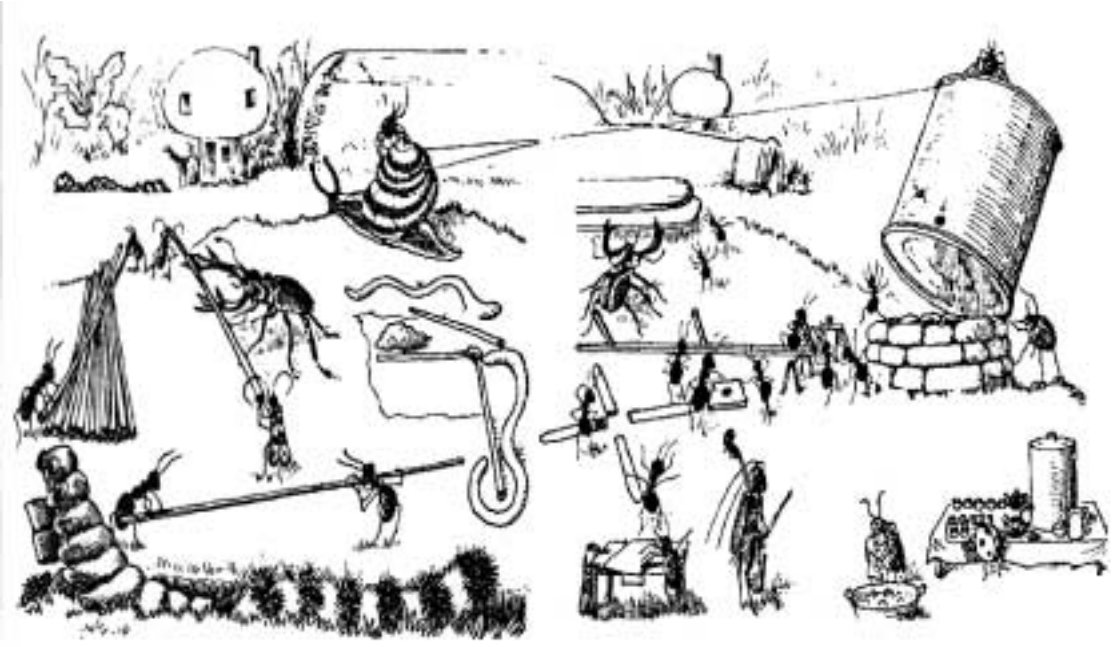


Figure 2-2. Fanciful portrayal of human-like cooperation among invertebrates from a children's book (Bodecker, 1974:42-43).



"When work began the following day, some enterprising earthworms offered to do the plumbing. A firm of carpenter ants undertook construction and shingling. Caterpillars, fitted with little scoops, did earth removal. Spider spun ropes for hoisting. Snail -- slow but dependable -- did the hoisting. Moth carried shingles to the ants. Firefly and her two younger brothers worked in the greenhouse. Ladybug produced tea, toast, and strawberry jam for everybody. And while they all worked, Cricket played encouraging music for them."

late as 1884 George Romanes, a follower of Darwin, wrote an influential book in which he attributed to all sorts of animals the ability to learn from other animals. For example, he and Darwin both believed that honeybees could learn techniques for extracting nectar from difficult flowers by observing bumblebees. They were led to this conclusion by a case Darwin observed in which first bumblebees, and later on the same morning, then honeybees did come to obtain nectar by biting open difficult flowers. (Independent individual learning by the honey bees was almost certainly the cause of this pattern rather than observational learning from bumblebees.)

Experimental methods demolished conclusions based on loose anthropocentric interpretations of animal behavior. Experimental studies, especially by the influential psychologist Thorndike (1911), led to extreme skepticism about *any* claims for social learning (protoculture) in animals based on uncontrolled observations. Thorndike and his colleagues tested animals for imitative learning by exposing untrained animals like cats to trained demonstrators, such as cats that had learned to press a bar to avoid a painful shock. In such experiments, exposure to a trained conspecific does not measurably speed up the learning process compared to control conditions where no demonstrator is present. Such psycholo-

gists made “anthropomorphizing” (reasoning about animal behavior by analogies to human behavior) an accusatory term.

Only in the last decade have comparative psychologists come to have a reasonably clear picture of how much social learning takes place in animals. The general answer is clearly that many examples can be cited in birds and mammals, but certainly the capacities of culture in animals are much more modest than in humans (Zentall and Galef, 1988). This may surprise some of you, but there is no evidence that the whales and dolphins have a particularly high order of intelligence, capacities for culture, or any other mental characteristics that are out of the mammalian norm in the direction of humans, many interesting TV programs notwithstanding. The Swiss primatologist Hans Kummer tells an anecdote to illustrate the limitations of monkey imitation, drawn from his long-term observation of macaques at the Zurich Zoo. It seems that one year the monkeys were housed in a cage next to an apple tree. A few apples fell inside the cage and were much relished by the 15 or so animals housed there. One animal discovered how to use a stick to reach under the bottom bar of the cage and scrape apples that landed outside into the cage. This caused a tremendous excitement, and other animals began staring at the outside apples, playing with the stick, and otherwise acting as if they were trying to imitate the scraping behavior. None succeeded. Imitative tasks that humans find quite easy, even our relatively big-brained primate cousins find virtually impossible! The authors in the Zentall and Galef volume describe a number of animal protoculture systems, but humans appear to unique in both the amount of information acquired by imitation, and speed and flexibility of our imitative capacity.

D. Methods to avoid ethnocentrism, mythologizing, and anthropocentrism

We emphasize: The advantage that 19th Century ethnographers and historians had over previous observers was more scientific methods. Lacking formal methods, people are prone to corrupt their observations with ethnocentrism, mythology, and anthropocentrism.

People have a very strong tendency to place negative value judgments on the strange behavior of aliens, something we call ***ethnocentrism***. We still sometimes use the Greeks' old term “barbarians”. Foreigners are speakers of harsh, unpleasant crude languages, yammering like animals, thought the Greeks: “bar bar bar bar...,” hence “barbarians.” They are immoral and dirty, uptight and cunning, and other bad things. Their supposed evil behavior is often used to frighten children; Latin American parents tell their kids if they are bad El Draco (the English pirate/patriot Francis Drake) will come and take them away to an unmentionably horrible fate. Drake was actually quite chivalrous, not a wanton killer at all, (at least according to his English biographers!). Worse, intellectuals often use “primitive” people as role players in ethical writings without any regard for the true facts. For example,

to Thomas Hobbes primitives were people whose lives had to be nasty brutish and short in order to clearly display the virtues of the orderly civilization regulated by the state he favored. These value judgments, folk or scholarly, very seriously interfere with accurate observation and sound evaluation of unfamiliar cultures. Your authors have worked in Africa, Micronesia, and Latin America. We have often been struck by how even professional people and scientists slip into the habit of dealing with cultural diversity by invidious distinctions. Only professional anthropologists and a few people who "go native" avoid this tendency. It is not that anthropologists are saints or that anyone is ever completely objective. But in anthropology if anyone can show that your observations or interpretations are ethnocentric, it is a serious professional embarrassment. Anthropologists try hard to avoid, and criticize people who don't avoid, ethnocentrism. It doesn't always work perfectly, but it is *much better than not trying at all* (Nettler, 1984: 138-140). The norm against ethnocentrism is like the Ten Commandments. Many rules ore good ones, even if we can't really expect anyone to obey them perfectly. We certainly hope that you will learn enough about the realities of human diversity in this course to be able yourself to mainly avoid ethnocentrism (and feel guilty when you lapse!). This doesn't mean that you aren't perfectly free, in good conscience, to draw ethical conclusions about foreigner's practices in the end. Few would go so far as to say that avoiding ethnocentrism means that you have to accept the Nazis' behavior 1933-45 as quaint German customs! It is just that it is wise to understand before leaping to condemnation (see epigraph to Chapter 19...

An illustrative excerpt from George Bernard Shaw's *Cæsar and Cleopatra* (1900; 1957):

(*Cæsar, Cleopatra, Theodotus, & Britannus (a native of Britain) are discussing Cleo's upcoming marriage to her brother Ptolemy:*)

THEODOTUS. Cæsar: you are a stranger here, and not conversant with our laws. The kings and queens of Egypt may not marry except with their own royal blood. Ptolemy and Cleopatra are born king and consort just as they are born brother and sister.

BRITANNUS [*shocked*] Cæsar: this is not proper.

THEODOTUS [*outraged*[1]] How!

CÆSAR [*recovering his self-possession*] Pardon him, Theodotus: he is a barbarian, and thinks that the customs of his tribe and island are the laws of nature.

1. (at Britannus' breach of protocol)

Ethnocentrism is not only a Western hang-up. It is not quite universal; pairs of groups have a wide range of attitudes toward each other. However, invidious distinctions are quite common. In simple societies, the society's name for itself often translates as "Human Beings," and their names for neighbors often gloss as something disparaging, like "Rotten Fish Eaters."

Mythologizing *history is a related problem to ethnocentrism*. People most commonly use history of their own group for present-day purposes. For example, a story about a people's past may be part of its definition as a Culture. That is how we use the Mayflower settlers in American history. We are all mythical descendants of people fleeing persecution to seek a new life in the New World free of the irrational prejudices of the old. Actually, even the Quakers, who later in America did become models of tolerance, caused much difficulty for Oliver Cromwell, the leader of the 17th Century English arch Protestants against the near-Catholic practices of Charles I and his supporters. Massachusetts Puritans were utterly intolerant of Quakers and other dissenting Protestants, whipping them savagely and ejecting them from the Colony. We try to help ourselves assimilate new settlers by tying their experiences to the myth that the original Founders established principles of tolerance. If you can be portrayed as fleeing persecution you are already half American when you step off the boat (or airplane these days). Of course, tolerance, after we discovered it and when we remember to apply it, has been a principle that has served us well! Myths may serve important social functions, even if not the truth, as the great world historian William McNeill has observed. Brown (1988) has an interesting hypothesis about why history is so commonly mythologized, but written with more critical objectivity by some people in some societies.

Often, the early scholarly historians tried to make history tell moral lessons for contemporary political struggles. The tendency of certain liberal 19th Century British historians to use history to buttress their political predilections (History is on *our* side!) has given the name "whig history" to this sort of exercise. Of course, people in the past were fighting their own battles, not ours. It interferes with accurately assessing the past if we have to look over our shoulders to see if the answers we get will help or hinder our political preferences in the present.

Anthropocentrism *is the mistake of making humans the measure of all things.* This is an extremely misleading way to view the relationship between humans and the rest of nature. In this course, we will make a lot of comparisons between humans and other organisms. It is the working assumption of human ecology that humans are *basically* similar to other organisms! Once we allow for similarities, it opens the possibility of smuggling folk

anthropocentric notions into our views of natural processes. Perhaps we also need to worry about "zoocentrism," importing too much from ecology and evolutionary biology. Many of the pioneering students of the application of biological ideas to humans were entomologists (Edward Wilson and Richard Alexander are examples). Anyone who actually likes bugs has to be watched carefully! (Richerson is an entomologist, by the way.) The pitfall of anthropocentrism (and entomocentrism) is an ever-present danger, which we can avoid only by calibrating human uniqueness as carefully as we can.

III. The First Ecological/Evolutionary Synthesis

Julian Steward's 1955 book Theory of Cultral Change *was important because it was the first synthesis of the discoveries of human diversity and uniqueness using ecological and evolutionary ideas*. The development of classical anthropology between Darwin's and Steward's time is a fascinating and complex story that we have to compress in the interests of time. Suffice it to say, the main conceptual development in the late 19th and early 20th Century was the development of the concept of culture. Using this concept, descriptive anthropologists collected the huge corpus of ethnographic data we referred to above. Steward's project was to make theoretical sense of this mass of data using ideas of ecology and evolution *borrowed* from biology and *adapted* to account for the uniquely cultural and social aspects of human adaptation. He gave us a simple, workable *model of adaptation* to environment via culture. Understanding the successes and failures in his argument cuts to the most basic issues in human ecology.

A.Method of Cultural Ecology

The basic method Steward advocated was to trace the effects of environment, acting through technology, as deep into a culture as the effects actually went. Recall from the first part of the lecture the key role of technology for Steward's method.

He was reacting to two other views he considered oversimplified. The first was environmental determinism, championed by a geographer, Ellsworth Huntington. Huntington's views were rather ethnocentric. For example, he thought that Europeans were culturally superior, and that this superiority came from the favorable climate of Europe. His views required a one-to-one mapping of environment onto culture. This clearly goes too far. For example, it is hard to account for the recent history of California in these terms. 200 years ago, it was inhabited by Native Americans whose behaved very differently from Mediterranean peoples living under the same climate. Spanish settlement did change everything in the direction of Mediterranean customs (much modified by passage through Mexico), but the Anglo conquest turned behavior in still another direction. Rigid environ-

metal determinism cannot account for the diversity of customs that can exist in the same environment. In reaction to environmental determinism, the famous Berkeley anthropologist Alfred Kroeber introduced the idea of "environmental possibilism." His favorite example was maize growing. Maize requires summers of a certain warmth to mature. Inside the zone that met these requirements, maize production was possible, but whether or not a culture took up maize production inside the zone had nothing to do with ecology. This clear went too far in the opposite direction. Maize growing people had tended to expand in the New World to the limits of maize cultivation, because in favorable environments maize production supported larger populations than any other economy, and large populations can generally outcompete smaller ones. Environmental determinism went too far, but environmental possibilism equally plainly gave up too much.

Steward's second procedure was to trace the effects of technology to patterns of social behavior, especially the organization of work. In humans, making a living is a social activity. There is almost always a division of labor between the sexes, with a cooperative household economy involving both men's and women's work. The organization of work is highly variable between different societies. Steward argued that much of this variation was a result of ecological imperatives. Given a certain environment and a certain type of technology, there will be more and less effective ways to organize society to accomplish work. The more effective ways will generally prevail.

Steward's most famous example is the way the organization of hunting and gathering work varied as a function of environment in North America. Consider the application of this technology in three kinds of environments. (l) A very sparse environment with dispersed resources of plants and small game (rabbits), such as the American Great Basin. The best social organization to exploit such an environment is likely to be the smallest functional human society. And, indeed, a type of social unit Steward called the *family band* is indeed characteristic in such habitats. People live most of the time in a roving household consisting of a husband, wife, children and a few related hangers-on. (2) A habitat in which small groups of large game animals (deer) are an important resource. Here very large packages of meat are available, but several hunters can advantageously collaborate to track, kill, and butcher the animal. Here the main social unit is usually organized around several males who trace their ancestry through a common male ancestor. Steward called this the *patrilineal band* form of social organization. (3) An environment in which large groups of migratory big game (bison) are common. Here, the optimal social group may be many more than are available in any one lineage. The large, but dispersed, herds must be found, and many people can collaborate to attack and process them. Here, Steward called the association of

many patrilineal groups into a single residential group of up to a few hundred people the *composite band.*

The third procedure was to trace the effects of technology and work organization as they affect other parts of culture. For example, the demography of a society, including such things as its total size and the size of individual settlements, is a function of economic productivity. The amount of resources a society can obtain depends upon the environment, the technology, and how effectively work is organized. Total size and settlement size in turn affect the economic division of labor. Large societies can support craft specialists, like weavers and potters who make tools for everyone else and trade for food. In small societies, craft specialization is curtailed; everyone has to make tools for themselves because the number of potential customers is too small to support a specialist. The big composite bands of the Plains bison hunters included war chiefs, ordinary chiefs, shaman, police societies, and a number of other specialists and complex institutions lacking in the family bands of the societies of the Great Basin.

For Steward, the excitement was to find out exactly how far these threads would go toward parts of culture remote from the technological window. Clearly, some features of culture are quite free to vary independently of technology and environment. Language is an extreme example. Basques, English, and Japanese work in very similar industrial societies today in very similar environments. Not long ago, they all worked in similar agrarian economies. Long ago, speakers of the ancestors these very distantly related languages were hunters and gatherers somewhere in temperate Eurasia. Aside from a few loan words perhaps, this long history of living in similar environments and using similar technology has not caused their languages to become similar. In figure 2-1, look carefully at the patterns for language families like Penutian and Athapaskan. Migrations of ancient North Americans apparently carried speakers of any given language from one environment to another. As they moved into new environments they tended to acquire new, appropriate technology, but retain their old language. Athapaskans are believed to be latecomers to North America from Asia. In comparatively recent times, some Athapaskan groups moved from Western Canada to Coastal California and to the Southwest.

What about things like ritual and religion? On the one hand, exactly what supernatural beliefs might be seem like language; people are free to believe in whatever God(s) they want. On the other, religious support for social norms may be important to social organization, and sometimes things like the Jewish/Moslem pork prohibition seem to have direct ecological consequences. Since Steward, this has indeed been the “hot topic” of cultural ecology. We will review the results in subsequent lectures.

B. The Culture Core

Steward's main ideas are summarized in his concept of the ***culture core***. The culture core is those features of culture that really are illuminated by the technological window. They are those features that are related to the work of making a living in a particular environment. As we have seen, aspects of social organization related to work are certainly part of the culture core. Most of the variations of language were out, according to Steward. In between was a vast grey area to be filled in. Figure 2-3 illustrates the concept of the culture core in contrast to environmental determinism and environmental possibilism. One way of reading the history of cultural ecology since 1955 is that we have been trying to determine what does and doesn't belong in the culture core.

STEWARD'S KEY IDEA:

Technology is the "window" through which people look at their environment. Our adaptations are mainly technological, and how we interact with any given environment depends first of all on the tools we bring to that environment.

.

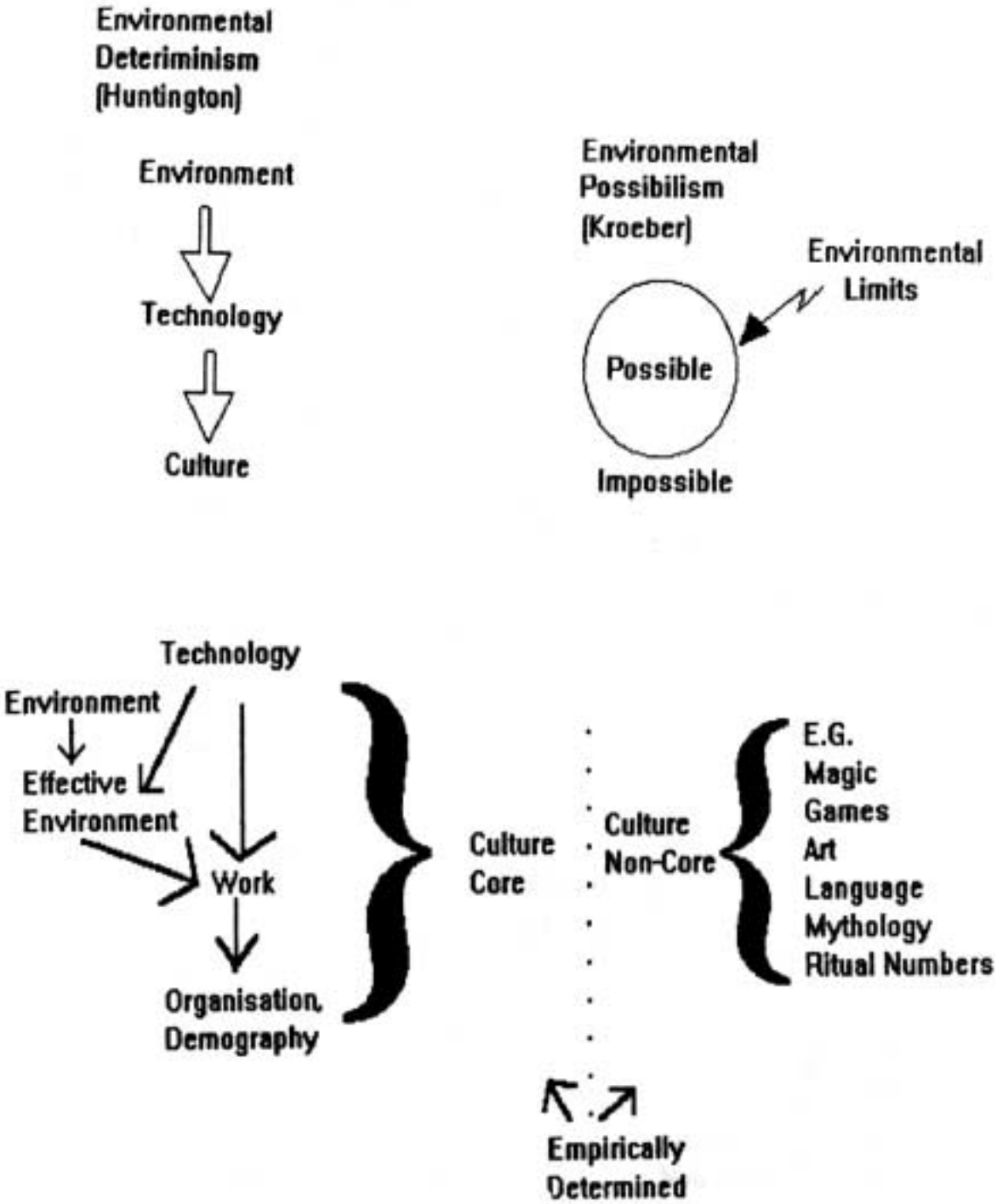
C. Problems with mechanism

The idea of technological adaptations sounded much easier than it turned out to be, more for theoretical than empirical reasons. The problem is that the idea of cultural adaptation was very vague. As we'll see in part III of the course, the concept of adaptation in biology has a rather exact basis in the process of natural selection, which is rather better worked out for genes than for culture. In the 1970s a yawning gap opened between what biology-based students of behavior thought natural selection could do, and what cultural ecologists supposed it could do. When evolutionary biologists G.C Williams (1966), E.O. Wilson (1975) and R.D. Alexander (1979) made a point of this, all hell broke loose in what is called the *sociobiology debate*. Your instructors are among those who have been working to clean up the intellectual blood spilled by the sociobiology debate.

D. Problems with long-term history

Human technology has been making rapid "progress" for the last 10,000 years, independently of local adaptation. You can see this pattern in Figure 2-1 in the Southwest. Beginning about 200BC, the Pueblo groups, derived from several different linguistic stocks, had adopted maize farming and village life, based on ancient traditions of Central

Figure 2-3. Diagram of the culture core concept in comparison to environmental determinism and possibilism. Thanks to R. Bettinger.



Mexico. The recently intrusive Athapaskans (Apache and Navaho) engaged in a simpler system of maize growing, with a much stronger hunting and gathering component, in the same general environment. If the history of other regions, like Europe, is any guide, even-

tually corn farming would have spread into all of the temperate moist to semi-arid West. California was an especially prime area for irrigated agriculture, as later developments showed, but corn farming was only just knocking at our door along the Colorado River as late as 1750.

Ecologists prefer to work with equilibrium adaptations, rather than fold in the vagarities of historical chance. Usually evolutionary ecologists find that many animal behaviors are close to the long run adaptive optimum; most animals are not in the midst of a fundamental historical transformation of their adaptations as we watch. Humans are an exception. During the last 2 million years our abilities to use culture to acquire adaptations have expanded dramatically. During just the last 100,000 years or so we acquired a fully modern physique and intellect, probably including language and similar "fancy" culture capacities. During the last 10,000 years we have developed farming and "civilization." Humans are a speedily moving target for adaptive analysis! Steward and his contemporaries solved this problem to a first approximation by separating their evolutionary and ecological theories. The evolutionary "theory" was completely descriptive. People had been progressing from simpler to more complex technology, and we could roughly categorize the phenomenon into stages. The famous stages of "savagery," "barbarism," and "civilization" (due to L.H. Morgan in the 19th Century) were replaced by the finer and less ethnocentric technological distinctions we'll use in lectures 3-7. These don't solve the problem that there is not even a hint of a mechanism telling us how societies "progress" from one stage to another. Progressive stage theories were long ago passe in evolutionary biology, but a completely adequate Darwinian theory of long-term change was also lacking. In the late 1970s Stephen Gould and some colleagues pointed this out, and ignited another very messy controversy know as the *macroevolution debate*. We return to questions raised by this debate in lectures in Part V at the end of the course.

In the meantime, realize that Steward and other cultural ecologists held their noses and used the assumption of equilibrium adaptations, taking history as given. The working method was: (1) take the basic technology of a group as given by history, and fixed. It does change fairl slowly normally. Say they are hunter-gatherers. (2) Analyze the marginal adaptive adjustments people make in their culture core to adapt the historically given technology to their environment. That is what Steward did with his band structure analysis described above. He didn't ask why hunters didn't settle down and farm corn instead, only how they organized their societies given the best hunting strategy differed depending upon the kind and density of prey hunted. There is no problem with this approach, so long as we realize that it sets aside the huge variation that exists across spans time and space measured in thou-

sands of years and thousands of kilometers.. As we'll see, a modernized version of it is applied to good effect by human sociobiologists (Borgerhoff Mulder has applied it to calculating how many co-wives a woman should tolerate, given that a society has a history of permitting polygyny.) However, it is a shame to leave the most important things to atheoretical descriptive stages. In biology, Darwinism is supposed to be a complete theory of evolutionary change. We want an evolutionary theory that has a causal motor and wheels to run on! Natural selection and genes are the main motor and wheels of organic evolution. The wheels of cultural evolution are information transfer by teaching and imitation clearly enough, but what are the motors? Steward had no answer, but we will introduce some good candidates in later chapters.

Human macroevolution is important for both social science and biology. Cultural macroevolution is occurring rapidly, and we happen to have caught our species in the act of revolutionary changes. We may have important lessons for the general theory of macroevolution.

V. Summary

Ecological and evolutionary ideas borrowed from biology are promising methodological tools to investigate the great diversity of human behavior. We are animals and have to garner resources to survive and reproduce. If we don't do so fairly effectively we'll disappear, probably with the assistance of a shove from a human group that is more effectively adapted. We do some cute things with culture, but even these often look suspiciously like adaptive means to make a living. It is hard to see how human populations can be exempt from the "laws" of nature in the form of the need to work to make a living.

Humans are unique. Our cultural mode of adaptation is largely missing even in our close primate relatives that lack not only fancy things like language, but simple "monkey see, monkey do" imitation. The highly social nature of humans is unusual. Most animals are more like bears than humans--solitary and hostile. large-scale cooperation with non-relatives is especially unusual.

Our unique features cause theoretical trouble. Some of the cute things we do don't look very adaptive. Some that do appear adaptive, like live in large, cooperative, communicating groups seem to make us the earth's dominant animal. However, sociobiologists inspired by evolutionary biology and more classical social scientists have disagreed vociferously about how this can work.

Environmental interactions focussed on technology, social organization, and the rest

of the culture core are a good place to start on these complex problems. The cultural ecologists' simple model of cultural adaptation via technology and work, and aspects of culture closely related to work gets us a long way on diversity problem and on the problem of adjusting ecology and evolution for human peculiarities. Its problems have required new models to buttress its vagueness and oversimplification, but it is a good model for all of that!

VI. Bibliographic notes

References:

Alexander, R.D. 1979. *Darwinism and Human Affairs*. Seattle: Univ. Washington Press.

Bernard Shaw, George. 1900; 1957. *Cæsar and Cleopatra*. New York: Penguin Books.

Bodecker, N.M. 1974. *The Mushroom Center Disaster*. Atheneum.

Brown, D.E. 1988. *Hierarchy, History, and Human Nature: The Social Origins of Historical Consciousness*. Tuscon: Univ. of Arizona Press.

Darwin, C. 1874. *The Descent of Man and Selection in Relation to Sex.* 2nd Edition. London: Murray.

Jorgensen, J.G. 1980. *Western Indians*. San Francisco: Freeman.

Katz, S.H., M.L. Hediger, and L.A. Valleroy. 1974. Traditional maize processing techniques in the New World. *Science* 184: 765-773.

Kroeber, A.L. 1939. *Cultural and Natural Areas of Native North America*. Univ. Calif. Publ. Amer. Arch. Ethnol. 38:1-242.

Morgan, L.H. 1910. *Ancient Society.* Chicago: C.H. Kerr.

Murdock, J.P. 1949. *Social Structure.* New York: Macmillan.

_____. 1967. *The Ethnographic Atlas.* Pittsburgh: Univ. of Pittsburgh Press.

Nettler, Gwynn. 1984. *Explaining Crime, 3rd Ed.* New York: McGraw-Hill.

Romanes, G.J. 1884. *Mental Evolution in Animals.* New York: AMS Press.

Steward, J.H. 1955. *The Theory of Culture Change: the methodology of multilinear evolution.* Urbana: Univ. of Illinois Press.

Thorndike, E.L. 1911. *Animal Intelligence*. New York: Macmillan.

Tylor, E.B. 1958 [1871]. *Primitive Culture*. New York: Harper.

Wilson, E.O. 1975. *Sociobiology: The New Synthesis*. Cambridge: Harvard.

Williams, G.C. 1966. *Adaptation and Natural Selection: A Critique of Some Current Evolutionary Thought.* Princeton: Princeton Univ. Press.

Zentall, T. and B.G.F. Galef. 1988. *Social Learning: A Biopsychological Approach*. Lawrence Erlbaum.