

Third Edition

Harlan's Crops and Man

People, Plants and
Their Domestication

H. Thomas Stalker
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Jack R. Harlan



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Table of Contents

[Cover](#)

[Title Page](#)

[Copyright Page](#)

[Preface](#)

[1 Prologue](#)

[Crop Evolution](#)

[The Hunter-Gatherer Stereotype](#)

[What Do Gatherers Eat?](#)

[Summary](#)

[Understanding Life Cycles of Plants](#)

[General Botanical Knowledge](#)

[Manipulation of Vegetation](#)

[Food Plants in Ritual and Ceremony](#)

[On Sharing the Bounty](#)

[Population Control and the Aged](#)

[Conclusions](#)

[References](#)

[2 Views on Agricultural Origins](#)

[Agriculture as Divine Gift](#)

[Domestication for Religious Reasons](#)

[Domestication by Crowding](#)

[Agriculture as Discovery](#)

[Agriculture by Stress](#)

[Agriculture as an Extension of Gathering](#)

[Domestication by Perception](#)

[A No-Model Model](#)

[Geography of Plant Domestication](#)

[An Ecological Approach](#)

[Conclusions](#)

[References](#)

[3 What Is a Crop?](#)

[Definitions](#)

[Intermediate States](#)

[A Short List of Cultivated Plants](#)

[References](#)

[4 What Is a Weed?](#)

[Definitions](#)

[Intermediate States](#)

[Crop-Weed Complexes](#)

[Some Weed Adaptations](#)

[Weeds and History](#)

[Conclusions](#)

[References](#)

[5 Classification of Cultivated Plants](#)

[Botanical Descriptions and Names](#)

[Problems of Formal Taxonomy](#)

[The Gene Pool System](#)

[Evolutionary Implications](#)

[Conclusions](#)

[References](#)

[6 The Dynamics of Domestication](#)

[Domestication of Seed Crops](#)

[Domestication of Vegetatively Reproduced Crops](#)

[Conclusions](#)

[References](#)

[7 Space, Time, and Variation](#)

[Kinds of Patterns of Variation](#)

[Noncentric Crops](#)

[Diffuse Origins](#)

[Microcenters](#)

[Landrace Populations](#)

[Implications for Plant Breeding](#)

[Conclusions](#)

[References](#)

[8 The Near East](#)

[Introduction](#)

[Archaeological Prelude](#)

[A Note About Dating Archaeological Sites](#)

[Archaeological Sequence of Village Sites](#)

[Spread of Agriculture Out of the Nuclear Area](#)

[Recorded History](#)

[Conclusions](#)

[References](#)

[9 Indigenous African Agriculture](#)

[Introduction](#)

[Archaeological Prelude](#)

[A Savanna Complex](#)

[Crop Competition and Distribution](#)

[Recorded History](#)

[Décrue Agriculture](#)

[Conclusions](#)

[References](#)

[10 The Far East](#)

[Archaeological Prelude](#)

[Recorded History](#)

[Far Eastern Crops](#)

[Hunter-Gatherers of Japan](#)

[Plant Domestication in India](#)

[References](#)

[11 The Americas](#)

[Archaeology](#)

[The Crops](#)

[Indigenous Americans as Biochemists](#)

[Conclusions](#)

[References](#)

[12 Epilogue](#)

[References](#)

[End User License Agreement](#)

List of Tables

Chapter 1

[Table 1.1 Diet of the !Kung Bushmen.](#)

[Table 1.2 Analysis of wild and cultivated wheats.](#)

[Table 1.3 A short list of genera that include one or more species harvested f...](#)

Chapter 2

[Table 2.1 Major time periods delineated by years before present \(BP\).](#)

[Table 2.2 The world's 30 leading food crops in terms of estimated edible dry...](#)

Chapter 3

[Table 3-1 A short list of cultivated plants and their probable origins in the...](#)

[Table 3.2 A short list of cultivated plants and their probable origins in the...](#)

Chapter 4

[Table 4.1 Definitions of weeds.](#)

Chapter 5

[Table 5.1 Classification of sorghum.](#)

Chapter 6

[Table 6.1 Adaptation syndromes resulting from automatic selection due to plan...](#)

[Table 6.2 The more important species of *Dioscorea* used for human food \(adapted...](#)

Chapter 7

[Table 7.1 The international centers with major crop genetic resource holdings...](#)

[Table 7.2 A sample of the major national gene banks in the international syst...](#)

Chapter 8

[Table 8.1 Plant remains from selected early villages. Sources from site repor...](#)

Chapter 11

[Table 11.1 Some early American archaeological sites and associated cultivated...](#)

List of Illustrations

Chapter 1

[Figure 1.1 Food-gathering activities of the Australian Aborigines.](#)

Chapter 2

[Figure 2.1 The eight-centers of origin, according to N. I. Vavilov.](#)

[Figure 2.2 Centers and noncenters of agricultural origins: \(A1\), Near East c...](#)

[Figure 2.3 Well-developed temperate prairies and deserts.](#)

[Figure 2.4 Tropical rainforests, temperate forests, and Mediterranean woodla...](#)

[Figure 2.5 Tropical savannas and dry forests, and tropical highlands.](#)

Chapter 4

[Figure 4.1 Species adaptation to environmental disturbances.](#)

[Figure 4.2 The spectrum of sentiment toward plants.](#)

Chapter 5

[Figure 5.1 Schematic diagram of primary gene pool \(GP-1\), secondary gene poo...](#)

[Figure 5.2 Gene pools of *Arachis*. The cultivated species is an allotetraploi...](#)

Chapter 6

[Figure 6.1 Schematic diagram of differentiation-hybridization cycles dependi...](#)

Chapter 7

[Figure 7.1 Some lesser millets of West Africa. *Brachiaria deflexa* and *Digita...*](#)

[Figure 7.2 Distribution of major areas of cultivation of yams and African ri...](#)

[Figure 7.3 Suggested early movements of sorghum. Initial domestication in sh...](#)

[Figure 7.4 Suggested later movements of sorghum in Africa \(from Harlan and S...](#)

Chapter 8

[Figure 8.1 Distribution of known and reasonably certain sites of wild barley...](#)

[Figure 8.2 Distribution of known and reasonably certain sites of wild einkor...](#)

[Figure 8.3 Distribution of known and reasonably certain sites of wild emmer....](#)

[Figure 8.4 Approximate dates of some Neolithic farming settlements.](#)

Chapter 9

[Figure 9.1 Map of Northern African showing sites and regions mentioned in th...](#)

[Figure 9.2 Known distribution of wild pearl millet \(*Pennisetum glaucum* subsp...](#)

[Figure 9.3 Known distribution of wild African rice \(*Oryza glaberrima* subsp.](#)

[Figure 9.4 Probable areas of domestication of selected African crops: \(1\) *Ur...*](#)

[Figure 9.5 Two ships from Queen Hatshepsut's expedition are being loaded wit...](#)

Chapter 10

[Figure 10.1 Early Neolithic sites in China.](#)

[Figure 10.2 Sites containing evidence of exploitation of local plant and ani...](#)

[Figure 10.3 Known distribution of wild and domesticated rice in Asia. The ga...](#)

Chapter 11

[Figure 11.1 Examples of early sites of plant domestication in the Americas....](#)

[Figure 11.2 Documented sites of teosinte distribution in Central America....](#)

[Figure 11.3 Examples of regions of domestication of several major world crop...](#)

Harlan's Crops and Man: People, Plants and Their Domestication

Third Edition

*H. Thomas Stalker, Marilyn L. Warburton, and Jack R.
Harlan*



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Preface

Third Edition, 2021

Since the second edition of *Crops and Man* was published some 30 years ago, germplasm collections have expanded greatly, molecular genetics has taken root and is being used to answer age-old questions, and archaeological research has discovered many ancient plant and animal remains, uncovered new sites, and expanded our knowledge of the movement of man and his crops throughout the world. Many of the early studies are no longer possible to continue because hunter-gatherers have all but disappeared except in a few relatively isolated regions.

Crop plant evolution involves an understanding of human behavior, as well as extensive knowledge about plants, what happens to plants as man selects traits that he values, and the importance of these plants in varying societies. The process of evolution takes place over both time and space, and as Jack Harlan so eloquently points out, there is no one model or answer to all questions. In this edition, we made every effort to maintain the basic structure of the previous volumes, while updating information that has evolved during the past 30 years. Most of the original references are still used because evolution of particular plants and many theories have not changed, and the older literature presents the foundation for current work.

Jack Harlan did not formulate his theories and concepts by sitting in an office or library and daydreaming; he explored many regions of the world's centers of diversity. He collected more than 12,000 accessions of cereals, forages, legumes, trees, and fruits from more than 45 countries.

Many of these have been extensively used as the sources for disease and insect resistances and to introduce genetic variability to modern production agriculture. He made taxonomic revisions of the genera *Cynodon* and *Sorghum* and studied the evolution of many other species, especially the cereals. He was also involved in archaeological research and had firsthand knowledge of ancient plant types.

Dr. Harlan formulated five concepts as related to crop plant evolution: first, the "Compositespecies" concept where related species intermate to form hybrid swarms with high levels of fitness and aggression, and which are able to expand their ecological range. Secondly, he understood the relationships between crops and companion weeds, and the importance of introgression to maintain diversity in a species. Third, Vavilov's Centers of Origins, which were more centers of diversity than origin, were revised into larger areas. Dr. Harlan recognized that not all crops had distinct centers and that the center of origin is not necessarily (and is more often not), the center of diversity. Fourth, he understood that the origin of crop domestication occurred for different reasons by various peoples and no one concept fits all situations. Thus, he developed a no-model model to incorporate the array of theories for crop domestication. Lastly, a natural classification of cultivated plants was proposed that consisted of gene pools rather than the classical method of morphological descriptions. This allows the thousands of variants of a crop to be lumped together into a single genetically and reproductively unified gene pool.

For his masterful accomplishments and service to the agriculture community, Dr. Harlan received many highly prestigious recognitions and awards, both nationally and internationally. His contributions have been recognized in symposia and in Europe a conference series named after

him continues to bring together scientists to discuss topics in crop plant evolution.

Jack Harlan was a brilliant scientist and a true scholar. He stimulated all those who knew him to explore new avenues of learning and to never stop acquiring knowledge, not only in their specialty, but in related fields as well. Jack R. Harlan was my mentor, graduate advisor, and friend.

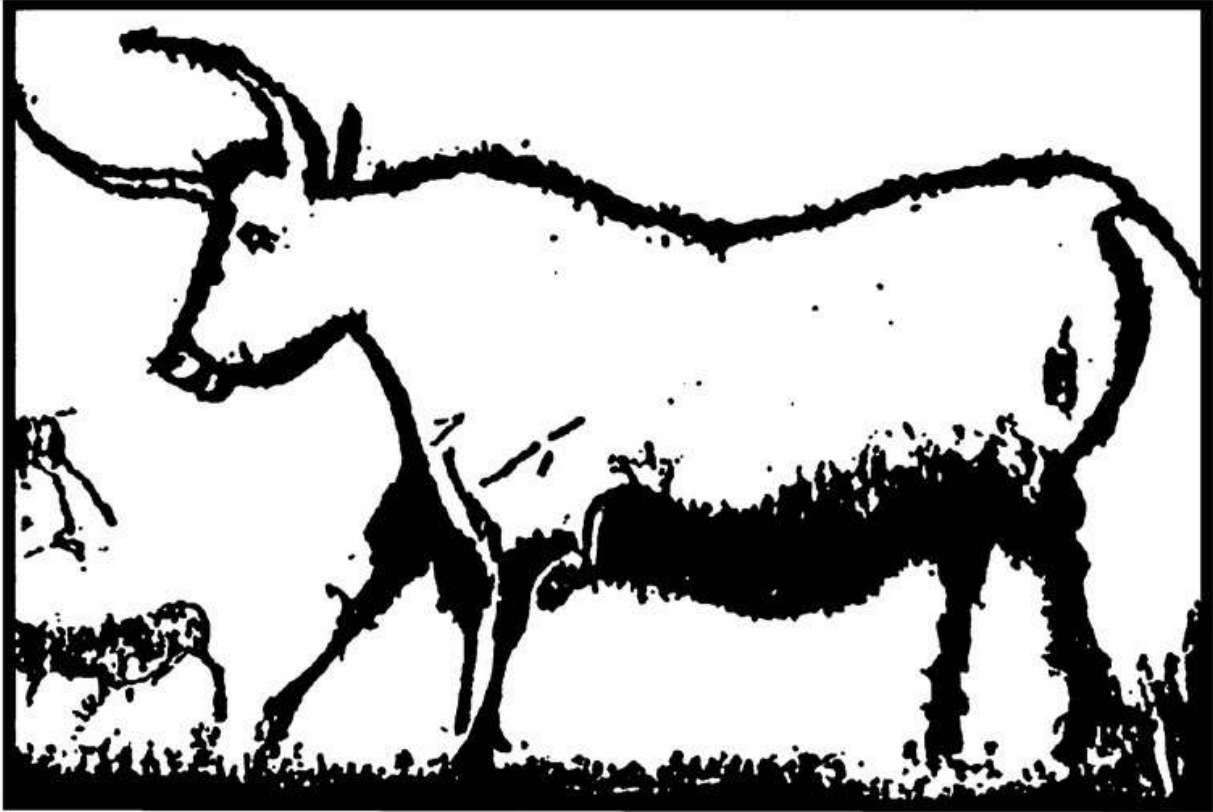
Harlan's use of the word "man" to describe all people was commonplace at the time of his writing. We have left this gender non-descript word use in our attempt to maintain the original flavor of his entertaining story style, and trust our readers understand we mean no disrespect.

In this revision, we hope that young plant scientists will broaden their views of the world around them to better understand the evolution of humans and the plants that feed the world. The book does not present the genetics of speciation, polyploidy, or plant breeding. But rather, it is intended to present views of evolution through the personal experiences of Jack Harlan and set the foundations for patterns of crop diversity.

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Raleigh, North Carolina

1

Prologue: The Golden Age



First of all the immortals who dwell on Olympian homes brought into being the golden race of immortal men. These belonged to the time when Kronos ruled over heaven, and they lived like gods without care in their hearts, free and apart from labor and misery. Nor was the terror of old age on them, but always with youthful hands and feet they took their delight in festive pleasures apart from all evil; and they died as if going to sleep. Every good thing was theirs to enjoy: the grain-giving earth produced her fruits spontaneously, abundantly, freely; and they in complete satisfaction lived off their fields without any cares in blessed abundance.

Hesiod, eighth century BC(Translated by R. M. Frazer, [1983](#))

Crop Evolution

In this book, we shall be dealing with evolution. We shall try to describe the evolution of crop plants from their wild progenitors to fully domesticated races and the emergence of agricultural economies from preagricultural ones. We shall deal with the activities of man that shaped the evolution of crops and that influenced the shaping of crops as human societies evolved. Crops are artifacts made and molded by man as much as a flint arrowhead, a stone axe head, or a clay pot. On the other hand, man has become so utterly dependent on the plants he grows for food that, in a sense, the plants have “domesticated” *him*. A fully domesticated plant cannot survive without the aid of man, but only a minute fraction of the human population could survive without cultivated plants. Crops and man are mutually dependent and we shall attempt to describe how this intimate symbiosis evolved.

The word “*evolution*” means an opening out, an unfolding, a realization of potential as in the opening of a flower or the germination of a seed. It implies a gradual process rather than sudden or cataclysmic events, with each living thing being derived genetically from preceding living things. Evolution as a process means change with time and the changes may be relatively slow or rapid, the time relatively long or short. Thus, the differences brought about by evolution over time may be small or great. As we shall see, some cultivated plants differ very little, if at all, from their progenitors. The same can be said for the evolution of agricultural economies and the sociological changes that have occurred in the process of developing fully agricultural and industrial societies from hunting-gathering systems.

To develop a degree of understanding of what has happened and what agricultural systems mean to mankind, we need some sort of picture of what life was like before agriculture. We need to establish a baseline from which we can visualize the domestication of plants and the emergence of agriculture. What kinds of plants did man eat before today's crops were available? What did he know about plants, and what might have caused him to begin the process of domestication? The descriptions given here will necessarily be brief and sketchy, but will give an idea of the condition of man before he began to grow plants with the purpose of using them for food.

We also need to know something about man as a hunter to understand ourselves. Lee and DeVore ([1968](#)) have put it succinctly:

Cultural Man has been on earth for some 2,000,000 years; for over 99% of this period he has lived as a hunter-gatherer. Only in this last 10,000 years has man begun to domesticate plants and animals, to use metals and to harness energy sources other than the human body... Of the estimated 80,000,000,000 men who have ever lived out a life span on earth, over 90% have lived as hunters and gatherers; about 6% have lived by agriculture and the remaining few percent have lived in industrial societies. To date, the hunting way of life has been the most successful and persistent adaptation man has ever achieved.

As a matter of general education and self-understanding, it is important that we know something about this basic human adaptation. There are two general approaches to the problem: (a) we can study surviving nonagricultural societies and examine the ethnographic observations made within the last few centuries, or (b) we can attempt to interpret preagricultural life from the artifacts, refuse, and

other clues left by ancient man and recovered by archaeological techniques. In this chapter, we shall deal primarily with the first approach but the archaeological record shall be touched on in later sections.

The Hunter-Gatherer Stereotype

Traditionally, agricultural people have looked down on hunting people who are described as “savage,” “backward,” “primitive,” “ignorant,” “indolent,” “lazy,” “wild,” and “lacking in intelligence.” Europeans applied the term “civilized tribes” to some eastern North American natives who lived in towns and cultivated plants, but these Native Americans themselves referred to the hunting tribes of the plains as “wild Indians.” In Africa, farming groups that surround hunter-gatherers, “... did not merely assert their political dominance over the hunter-gatherers and ex-hunter-gatherers they encapsulated; they also treated them as inferiors, as people apart, stigmatized them and discriminated against them” (Woodburn, [1988](#), p. 37). Similar attitudes prevail in Asia, Oceania, and Tropical America. The prejudice is nearly universal.

The stereotype includes the idea that hunting-gathering people were always on the verge of starvation and that the pursuit of food took so much of their time and energy that there was not enough of either one left over to build more “advanced” cultures. Hunters were too nomadic to cultivate plants and too ignorant or unintelligent to understand the life cycles of plants. The idea of sowing or planting had never occurred to them and they lacked the intelligence to conceive of it. Hunters were concerned with animals and had no interest in plants. In the stereotype that developed, it was generally agreed that the life of the hunter-gatherer was “nasty, brutish, and short,” and that any study of such people would only reveal that they lived like animals, were

of low intelligence, and were intellectually insensitive and incapable of "improvement."

Occasionally, an unusually perceptive student of mankind tried to point out that hunting man might be as intelligent as anyone else; that he had a sensitive spiritual and religious outlook; that he was capable of high art; that his mythologies were worthy of serious consideration; and that he was, in fact, as one of us and belonged to the same species with all its weaknesses and potentialities. Such opinions were seldom taken very seriously until recent years. It has finally become apparent that no part of the stereotype is correct and that widely held presuppositions are all completely false and untenable. Our ancestors were not as stupid or as brutish as we wanted to believe.

In 1966, Richard B. Lee and Irven DeVore organized a symposium on Man the Hunter held at the University of Chicago and published in 1968. Lee reported on his studies of the San !Kung of the Dobe area, Botswana. Over a three-week period, Lee ([1968](#)) found that !Kung Bushmen spent 2.3, 1.9, and 3.2 days for the first, second, and third week, respectively, in subsistence activities. He wrote, "In all, the adults of the Dobe camp worked about 2 ½ days a week. Since the average working day was about 6 hr long, the fact emerges that !Kung Bushmen of Dobe, despite their harsh environment, devote from 12 to 19 hr a week to getting food."

Among the Bushmen, neither the children nor the aged are pressed into service. Children can help if they wish, but are not expected to contribute regularly to the work force until they are married. The aged are respected for their knowledge, experience, and legendary lore; and are cared for even when blind or lame or unable to contribute to the food-gathering activities. Neither nonproductive children nor the aged are considered a burden.

To the !Kung Bushman, the mongongo nut [*Schinziophyton rautanenii* (Schinz) Radcl.-Sm] is basically the staff of life. These nuts are available year-round and are remarkably nutritious ([Table 1.1](#)). The average daily per-capita consumption of 300 nuts weighs “only about 7.5 ounces (212.6 g) but contains the caloric equivalent of 2.5 pounds (1134 g) of cooked rice and the protein equivalent of 14 ounces (397 g) of lean beef” (Lee, [1968](#)). Lee found the diet adequate, starvation unknown, the general health good, and longevity about as good as in modern industrial societies. The average of 2140 calories per person daily ([Table 1.1](#)) compares favorably to the 2015 USDA recommendations of 2400–3000 calories for an adult male and 1800–2400 calories for an adult female (<https://health.gov/dietaryguidelines/2015/guidelines/appendix-2/>).

[Table 1.1](#) Diet of the !Kung Bushmen.

Source: Adapted from Lee ([1968](#)).

	Protein (g/day)	Calories per person per day	Percent caloric contribution of meat and vegetables
Meat	34.5	690	33
Mongongo nuts	56.7	1,260	67
Other vegetable foods	1.9	190	
Total	93.1	2,140	100

Sahlins ([1968](#)) came in with almost identical figures for subsistence activities of the Australian Aborigines he studied and elaborated on his term “original affluent society.” One can be affluent, he said, either by having a

great deal or by not wanting much. If one is consistently on the move and must carry all one's possessions, one does not want much. The Aborigines also appeared to be well fed and healthy, and enjoyed a great deal of leisure time.

Gatherers can obtain food in abundance even in the deserts of Australia and the Kalahari Desert of Africa. The rhythm of food-getting activities is almost identical between the Australian Aborigine and the !Kung Bushmen of southern Africa. The women and children are primarily involved in obtaining plant and small animal materials. Hunting is reserved for males at the age of puberty or older but is more of a sport than a necessity. Meat is a welcome addition to a rather dull diet but is seldom required in any abundance for adequate nutrition. Both males and females tend to work for 2 days and every third day is a holiday ([Figure 1.1](#)). Even during the days they work, only about 3-4 hr per day are employed to supply food for the entire group (Australian data presented by Sahlins, [1968](#)).

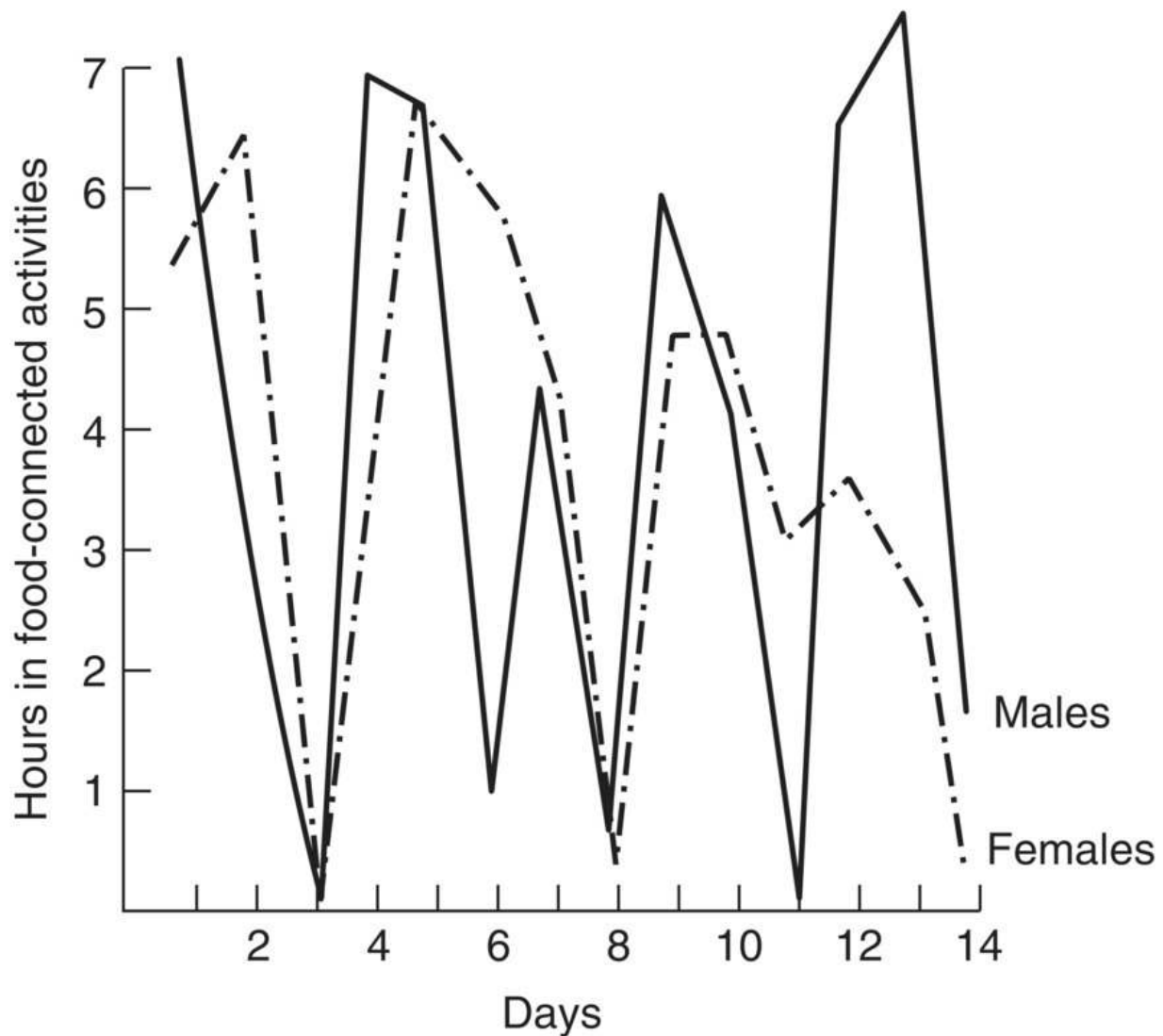


Figure 1.1 Food-gathering activities of the Australian Aborigines.

Source: Adapted from Sahlins (1968).

Other reports at the symposium tended to support these general findings. A picture emerged of leisure, if not affluent societies, where the food supply was assured even under difficult environmental conditions and could be obtained from natural sources with little effort. The picture described did seem to fit the golden age of Hesiod or the Biblical Garden of Eden.

The publication of *Man the Hunter* was a surprise to many who believed some version of the hunter stereotype. The stimulation was enormous. Between 1968 and 1992, there were at least 12 international conferences on hunter-gatherers as a direct result, but not all were published. A few of the early conferences included ones published by Ingold et al. ([1988a](#), [1988b](#)) and by Schire ([1984](#)). In addition, one may cite Bicchieri ([1972](#)), *Hunters and Gatherers Today*; Dahlberg ([1981](#)), *Woman, the Gatherer*; Winterhalder and Smith ([1981](#)), *Hunter-gatherer Foraging Strategies*; Williams and Hunn ([1982](#)), *Resource Managers: North American and Australian Hunter-gatherers*; Koyama and Thomas ([1982](#)), *Affluent Foragers: Pacific Coasts East and West*; Price and Brown ([1985](#)), *Prehistoric Hunter-gatherers: The Emergence of Social and Cultural Complexity*; Harris and Hillman ([1989](#)), *Foraging and Farming: The Evolution of Plant Exploitation*; and such regional treatments as Hallam ([1975](#)), *Fire and Hearth: A Study of Aboriginal Usage and European Usurpation in Southwestern Australia*; Silberbauer ([1981](#), p. 242), *Hunter and Habitat in the Central Kalahari Desert*; Riches ([1982](#)), *Northern Nomadic Hunter-gatherers*; Lee ([1984](#)), *The Dobe!Kung*; Akazawa and Aikens ([1986](#)), *Prehistoric Hunter-gatherers in Japan*; and there are many hundreds of additional research papers. There is now a vast amount of new material on the subject, but some of the oldest papers are still the most useful because observations were made before the hunter-gatherers were so restricted and encapsulated as they are now.

The biases of some of the investigators were often clear. Some set out to dispute the “affluent society” concept and others to support it. Some of the anthropologists were hung up on Marxist views of “history,” since the egalitarian nature of most hunter-gatherer societies suggested Marx's view of communism: “No one starves unless all starve”; “no

man need go hungry while another eats”; “rich and poor perish together,” and so forth (Lee, [1988](#)). The quotes are from observers of Iroquois, Ainu, and Nuer, respectively, and seem to equate egalitarianism with hunger, which is probably not fair. Incidentally, Karl Marx took his model of basic communism from an agricultural Iroquois society, not from hunter-gatherers, who are not so likely to starve.

What do the new studies show? To no one's surprise, they show that the golden age was more golden for some than for others. Even a few examples of famine were found (Johnson & Earle, [1987](#), p. 374). Brian Hayden ([1981](#)) listed a number of tribes showing a continuum of work from “a few minutes per day” (Tanaina in Alaska) or 2 hr per day (Hadza in Tanzania) to “all day every day” or “too busy to visit relatives” (Birhor in India). Well, I have been too busy to visit relatives even when I wasn't doing much of anything. It also comes as no surprise that if processing and cooking time is added to collecting time, it takes longer to get a meal than some figures would suggest. Processing some foods is laborious and time-consuming. Grinding or pounding seeds into flour has always been drudgery, and boiling toxic foods in several changes of water takes a lot of time. Still, is watching a pot boil hard labor, especially if the kids make a game of picking up sticks to keep the fire going? And, of course, farmers must also process their food, too, so the addition of processing and cooking time does not necessarily change the comparison.

There are certain aspects of time and work that do not seem to receive due attention. Suppose you like your work? I always have, and have spent far more time at it than necessary for survival. Consider those men of industrial societies who spend endless hours cramped and freezing in a duck blind for little or no reward, or those who huddle in a shelter fishing through the ice in the middle of a Minnesota winter. The social aspects are what matter; after

a few nips of whiskey, no one cares if the rod bends or not. I record two ethnographic notes from my own experience, both from farming societies, but the principles apply to anyone. Early one morning on a deserted road in Afghanistan, I came across a line of men dressed in colorful embroidered jackets, balloon pants, and pixie-toed shoes. They had two drums and were singing and dancing up and down with their sickles in the air. A group of women followed, shrouded in their chadors, but obviously enjoying the occasion. I stopped and asked in broken Farsee: "Is this a wedding celebration or something?" They looked surprised and said: "No, nothing. We are just going out to cut wheat." Harvest time is a good time of year even if it is hot and the "work" is hard. It is a time for socializing and, if the harvest is good, for celebrating.

A second observation was in eastern Turkey. My interpreter and I had seen a family harvesting a field and we stopped. He talked to the people while I collected some samples. My interpreter later told me that he had commented to the farmer that he could harvest the field in half the time if he would use a scythe and cradle. The farmer looked at him in astonishment and said: "Then what would I do?" There is a certain amount of Parkinson's law in all these activities. One fills up the time available. What is the meaning of time if there is more of it than you know how to use? As for getting by with the least effort possible for survival, I do not think that is human nature. Sure, anyone can drink vin ordinaire, but why not work a little harder and drink Chateauneuf-du-Pape?

How do hunter-gatherers spend their leisure? Apparently they sleep a lot, but there are other diversions. Gambling is popular among many tribes; Woodburn ([1970](#), p. 59) states that the Hadza people spend more time in gambling than in obtaining food. The most popular gambling stake is poisoned arrows. There are also music, dances, ritual and

ceremony, rites of passage, playing cat's cradle, storytelling, creative arts, making useful and decorative articles, and similar activities. Life appears easy, but generally dull. Perhaps as a consequence there is a great deal of coming and going; the camp population is fluid and camps may be moved on the slightest pretext or for no reason at all. Understandably, there is a tendency to concentrate on the foods most easily obtained at a given time, and these are likely to change from season to season and, to some extent, from year to year. Groups of people in many gathering societies tend to be very fluid for that reason. When food is at maximum abundance, there is a tendency to gather in large bands. This is the season for rejoicing, celebrating, observing ancient tribal rituals, arranging marriages, and having naming ceremonies, coming of age ceremonies, and so on. The tribe is more fully represented at this time. During the most difficult season of the year, the people may break up into microbands to better exploit the gathering range and to avoid exhausting the food supply near the larger camps.

Many Australian Aborigines remain apart much of the yearly cycle even after becoming dependent on European agricultural-industrial systems. For most of the year they find jobs as ranch hands, laborers, mechanics, and so forth, but they may quit whatever they are doing, take off their store-bought clothes, and take a three-month "walkabout" during their traditionally festive season. Gathering is still easier than working at that time of year.

The study of hunting tribes that have survived long enough to have been observed by modern ethnographers is full of difficulties and pitfalls. Many tribes had become profoundly modified through contact with and by the pressures applied by agriculturalists. Some were reduced to the status of slaves or servants; others were restricted on reservations or their normal ranges were constricted by pressures of

stronger groups. The social and economic structures of many tribes were in an advanced stage of disintegration at the time of ethnographic description.

The geographic distribution of surviving hunters results in a serious bias. By and large, hunters have survived where agriculture is unrewarding. We find them in the Kalahari Desert and adjacent dry savanna in southern Africa, in small pockets of tropical rain forest, in the frozen wastes of the Arctic, or in western North America, but there are no examples left in the more productive agricultural lands of the world.

At the time of European contact, the eastern forests and woodlands of North America were largely populated by native agriculturalists; the people living in the plains and westward mostly maintained hunting-gathering economies. There were enclaves of farmers, such as the Mandan on the Missouri River in North Dakota, and a highly sophisticated agriculture had developed in the Southwest USA where people practiced irrigation on a large scale and often lived in towns. Some farming was practiced along the Colorado River watershed and into southern California, but most of the California natives and other tribes of western North America lived by hunting, fishing, and gathering. A substantial body of information has been assembled about them, but we must remember that they did have contact with farming people and some of their cultural elements could have been borrowed.

Data for hunter-gatherers in South America have been accumulating during the late 20th and into the 21st centuries. In the review by Scheinsohn ([2003](#)), she indicates distinct areas occupied by hunter-gatherers in the grasslands of Argentina and southern Chile, farming communities in the highlands of western South America, and mixed hunter-gatherer and farming societies in more

mid-to-low land areas of Bolivia, Brazil, and Venezuela by about 6000 BP (Before Present). There is some evidence of man in South America by at least 30,000 BP (Scheinsohn, [2003](#)), and these peoples were certainly hunter-gatherers. The Bushman of southern Africa has been studied in some detail, but we know historically that they had long contact with the livestock-herding Hottentot and farming Bantu tribes. The Congo pygmies often spend part of each year with agricultural people. The Ainu of Japan have taken up some farming in the last century or so. Many of the hunter-gatherers of India are so constricted by agriculturalists that they have virtually become members of a nonfarming caste.

The Andaman Islanders succeeded in preserving a greater degree of isolation, partly by killing off strangers who landed or were shipwrecked on their shores. Still, we know they borrowed some customs from outsiders. Both pottery and pigs seem to have been introduced about 1500 AD (Coon, [1971](#)). It is even possible that they were agriculturalists when they arrived and abandoned the practice when they found it unnecessary.

Perhaps our most reliable data come from Australia. At the time of European contact in the early 19th century, there was an entire continent populated by an estimated 300,000 people without a single domesticated plant and no genuine agriculture. Although it is true that for some centuries before European contact there were Malayan traders visiting northern Australia on a fairly regular basis, there is little evidence that this resulted in significant changes in use of food resources and it did not induce the Aborigines to take up the cultivation of plants. The Torres Strait is also rather narrow and some contact with agricultural Melanesians occurred. That this would influence the whole of Australia very much seems doubtful.

I shall, therefore, rely more on ethnographic data from Australia than elsewhere, but will remind the reader that any reconstruction of a way of life of some thousands of years ago, based on a small, biased sample of living people, is full of hazards and sources of error. The earlier accounts may have more value than some of the later ones because the effects of European contact were rapid and profound.

Woodburn ([1988](#)) and in a series of papers, outlined an important distinction between immediate return strategies and delayed return strategies. The former live from day to day, or at most a few days at a time on current returns. Delayed return groups have longer-term goals; these include manufacturing of boats, nets, weirs, traps, and deadfalls, tending bee hives, the capture and keeping of animals to be eaten later, the replacement of the tops of yams at digging time, sowing of seeds, managing vegetation with fire, water spreading, irrigation, flooding of forests, arranged marriages, and so forth. The Australian Aborigines were delayed return strategists of great skill, and as such were closer to agriculturalists than to immediate return hunter-gatherers such as the Bushmen and Hadza. Great Basin and West Coast Native Americans and the Jomon of Japan were also delayed return strategists.

As more and more data have accumulated, a consensus has developed that present day and recent hunter-gatherers, whether of immediate or delayed return, have evolved in parallel with agriculturalists and no longer represent the original condition before agriculture. They are not the “pristine” hunter-gatherers of 10,000–12,000 years ago. In addition, the diversity among hunter-gatherers is such that no single model can represent them. There is not even a single model for Australia, let alone the other hunter-gatherers in the world. Our extensive field studies will not