Hopi Economy and Subsistence

EDWARD A. KENNARD

The economy of the Hopi can be best understood historically. The prehistoric foundation was an agriculture based upon the cultivation of corn, beans, squash, gourds, and cotton. During the sixteenth and seventeenth centuries Hopis acquired from the Spaniards domesticated animals—horses, mules, burros, sheep, and cattle. From the same source they derived peaches and apricots. Chili peppers from Mexico were also introduced during this time. The period of American contact, which dates from 1848, has been marked by gradual but accelerating additions of a wide variety of consumption goods, new skills, and a cash economy first supplementing and later displacing the traditional subsistence economy.

Agriculture

Land Tenure

Each village is autonomous and has its own land. The cultivated fields of one are separated from another by sight lines and geographic features, projected southward from the mesas. Along the water courses below the mesas, the fields of each village are divided into large sections assigned to the various matrilineal clans of the village. Formerly, each clan allotment was marked by boundary stones, set up at the corners of the fields, with symbols of the clans painted on them (Forde 1931:368). The clan land system of the First and Second Mesa villages and the boundaries between villages are shown in Forde (1931: maps 2, 3, 4).

Within each clan allotment, fields are assigned to women of the clan, and they are planted and cultivated by the men of the household—husbands, brothers, or sons (fig. 1). With the pattern of matrilineal inheritance and matrilocal residence, fields tend to become associated with specific households. Each clan has land in more than one location so that if one fails, either through lack of rain or from sudden flooding that destroys the crop, the other may still be productive.

middle, Calif. Histl. Soc., Los Angeles: Title Insurance Coll.; bottom, Smithsonian, NAA. Fig. 1. Hopi farming. top, Corn plants in dune field below Hotevilla, photograph by Cradoc Bagshaw, July or Aug. 1975; middle, men roasting unhusked corn in a field near Oraibi, photograph possibly by G. Wharton James or C.C. Pierce, probably about 1900; bottom, terraced gardens at Hotevilla, photograph by O.C. Havens, 1924.

HP4913

Smithsonian, Dept. of Anthr.: a, 84139; b, 166761; c, 128902.

Fig. 2. Hopi uses of gourds. a, Container decorated with black painted human and animal figures, collected 1883; b, painted ceremonial container, collected 1892; c, painted gourd snout for mask worn by some kachina impersonators, collected 1885. Length of c 27 cm, rest same scale.

Formerly, some fields were allocated to the chiefs of ceremonial societies, and they were planted for them by the men of the village, but this custom has disappeared (Parsons 1925a:87; Forde 1931:map 4).

In addition to the clan lands, any man may establish a field in the area beyond them. He has the right to use it as long as he cultivates it and may assign it to another; however, should he abandon it, that land reverts to the common domain. About 1900, the best fields for the floodwater irrigation employed were along the water courses close to the villages. However, as the Polacca, Wepo, and Oraibi washes grew deeper and wider, much of this land was destroyed. Consequently, new fields were developed 20 and 30 miles south, where the water spreads more readily over the flatter land of the valleys. The possession of horses and wagons, and later pickup trucks, facilitated the development of more distant fields.

Hopi agriculture has always been precarious, subject to long-term wet and dry cycles. In the period 1866-1870 there was a nearly total crop failure, and some villages were abandoned, while the people sought refuge with the Pueblos to the east. In a study of land use in the Oraibi valley, it was discovered that the dissection of the wash had over a period of 50 years destroyed approximately one-third of the fields that had been in cultivation (Bradfield 1971). This may have been responsible for the gradual growth of Moenkopi, a satellite of Oraibi, 40 miles to the northwest, where there was a system of irrigation.

There is no private property in grazing land. Horses

Smithsonian, NAA.

Fig. 3. Peaches and squash drying on the rooftops in the east courtyard of Oraibi. Photograph by John K. Hillers, about 1879.

HP4914

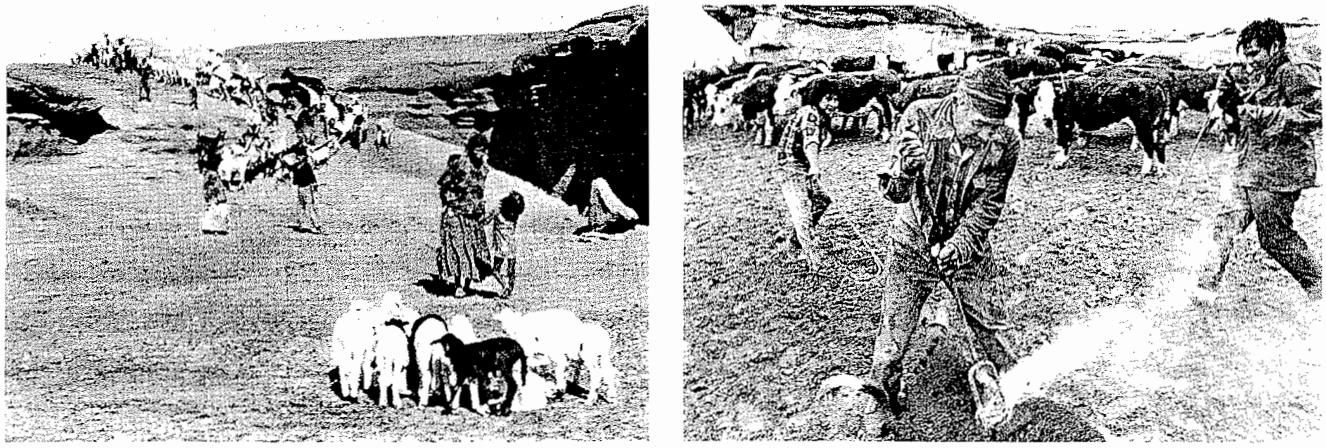
and burros are hobbled and permitted to graze where they will. Cattle are permitted to drift in areas where there is a relatively permanent supply of water. Sheep are herded every day and corralled at night. Most sheep owners have shelters or regular Hopi houses in the area where they customarily graze their sheep. Sometimes they have their major cornfields in the same area in places like Coyote Spring and Burro Spring.

Irrigated gardens watered from nearby springs are utilized for the cultivation of chili peppers, onions, and other vegetables; and titles to these small plots are jealously guarded. A Patki clan plot below Wepo spring was planted every year by men from Shongopavi, whose grandmother had come from the Tewa village at First Mesa (Forde 1931:391).

Although the pattern of land ownership is clear in Hopi theory and reflects the myths of the settlement of each village, adjustments have to be made. Matrilineages vary in size and increase or decrease in a few generations. Should there be a shortage of land in his wife's clan lands, a man may be assigned a field of his own clan's land, or in his father's if there is a surplus (Forde 1931:380). Fields for beans, melons, squash, and gourds are sometimes planted adjacent to a cornfield, but bean fields are also located on the tops of the mesas, as are orchards at both Second Mesa and Hotevilla.

left, Milwaukee Public Mus.; right, Los Angeles Co. Mus. of Nat. Hist.

Fig. 4. Hunting of rabbits done individually or in small groups and as a more organized communal pursuit is connected with ceremonial activities and can itself entail many ritual procedures (Beaglehole 1936:11-17, 23-25). left, Man from Oraibi with a rabbit stick, a throwing stick made in distinctively flat curved shape with a defined handle (and often with painted decoration) that is used to flush out rabbits; photograph by Sumner W. Matteson, perhaps about 1900. right, Rabbit hunters at camp, probably at Kawaika, Ariz., 1901, carrying bows and arrows (also used to hunt rabbits) and apparently mugging for the camera; photograph by Adam C. Vroman or Walter Hough (NAA, BAE original prints).



left, Milwaukee Public Mus.

Fig. 5. Stock raising. left, Woman and children herding sheep and goats, photographed about 1900 by Sumner W. Matteson. In more recent times this, like cattle herding, has been an exclusively men's activity. right, Willie Coin branding a calf; photographed south of Oraibi by Cradoc Bagshaw, July-Sept. 1975.

HP4915

Crops

Hopis plant several varieties of corn, classified by color, but most of the fields are devoted to blue and white. Whiting (1939:67-70) lists 24 varieties of Hopi corn. They also cultivate a short-eared variety of sweet corn.

The first planting occurs in April, usually on dune fields close to the mesas, so that it will be mature by the time of the Niman ceremony in mid-July. The main planting, which is announced by the Crier, usually begins in the middle of May and frequently extends through the month of June. Some men plant their fields by themselves, but others have a work party for planting. The men all assemble at the host's field and complete it in a day. In the evening when they return to the village, the host's wife feeds them all an evening meal in payment.

Sweet corn is baked in field pits (fig. 1) and then stored for future use. Most of the corn crop is harvested in October—picked, husked, and hauled to the village in wagons and trucks. It is sorted by color and stored in the rear room of the house, stacked like cordwood.

Hopis grow 23 varieties of beans, some quite old but many recently introduced (Whiting 1939:80-83). Several species of squash, pumpkins, and melons are regularly cultivated. The squash is dried and preserved, but melons are eaten when they are ripe in August and September. They plant gourds in the same fields as squash. They are used as spoons, dippers, cups, rattles, pottery scrapers, medicine containers, and as decorations on kachina masks such as snouts and horns (fig. 2).

Fruit trees do not yield a crop every year. Frequently, late frosts when the trees are in blossom destroy the potential for fruit; however, in good years they yield bountifully and most of the fruit is preserved by drying. The peaches and apricots are pitted, split in halves, and spread out on the roof to dry (fig. 3). Orchards or even individual trees are owned by men. It is the tree and not the land on which it grows that is conceived to be property, and it is inherited by men, usually sons of the previous owner.

The estimated agricultural figures for 1893 show the proportionate production at various communities. At First Mesa, 1,200 acres were planted in corn; at Second Mesa, 800; at Oraibi, 1,600. Of the total corn crop of about 2,500,000 pounds, 1,150,000 pounds were consumed, 100,000 were sold to traders, 150,000 were otherwise traded, 500,000 were bartered to Navajos for sheep, and 600,000 were stored as surplus. In addition, 2,000 acres were sowed with vegetables (beans, melons, squash, pumpkin, chili, onions, gourds), sunflowers, and cotton. Peach and apricot orchards accounted for another 1,000 acres (Stephen 1936, 2:954-955).

Wild Plants

The Hopis make extensive use of the wild plants in their habitat. The roots of yucca (soapweed) are used in hair washing, which is an essential part of every ceremony—naming, initiations, girl's puberty grinding, marriage. The leaves are split and sewed around a core in making coiled basketry and in making sifting baskets and trays. The Hopi brush, which is an essential tool in every house, is made from the culms of purple hair grass (Whiting 1939:65). A handful is tied with a piece of string near the butt end. The lower end serves as a hair brush, while the upper is used to sweep the meal from the grinding stones, as well as to sweep the floor of houses with adobe floors.

Of 150 plant species identified in their habitat, the Hopi utilized 134: for agriculture and forage, 11 species; art materials, 16; house building, 4; domestic life, 10; dress and ornament, 6; food, 40; medicine, 29; and religious purposes, for example, prayer sticks and kiva fuel, 18 (Hough 1897:43-44).

Hunting

Hunting has not been important as an economic activity since the sixteenth century when the Hopis acquired domesticated animals. The area is not rich in large game, although deer and antelope were reported to have grazed in the area between the Hopi Buttes and the Little Colorado River. They were formerly hunted by men in pairs, and it was regarded more as a sport than a subsistence quest (Beaglehole 1936).

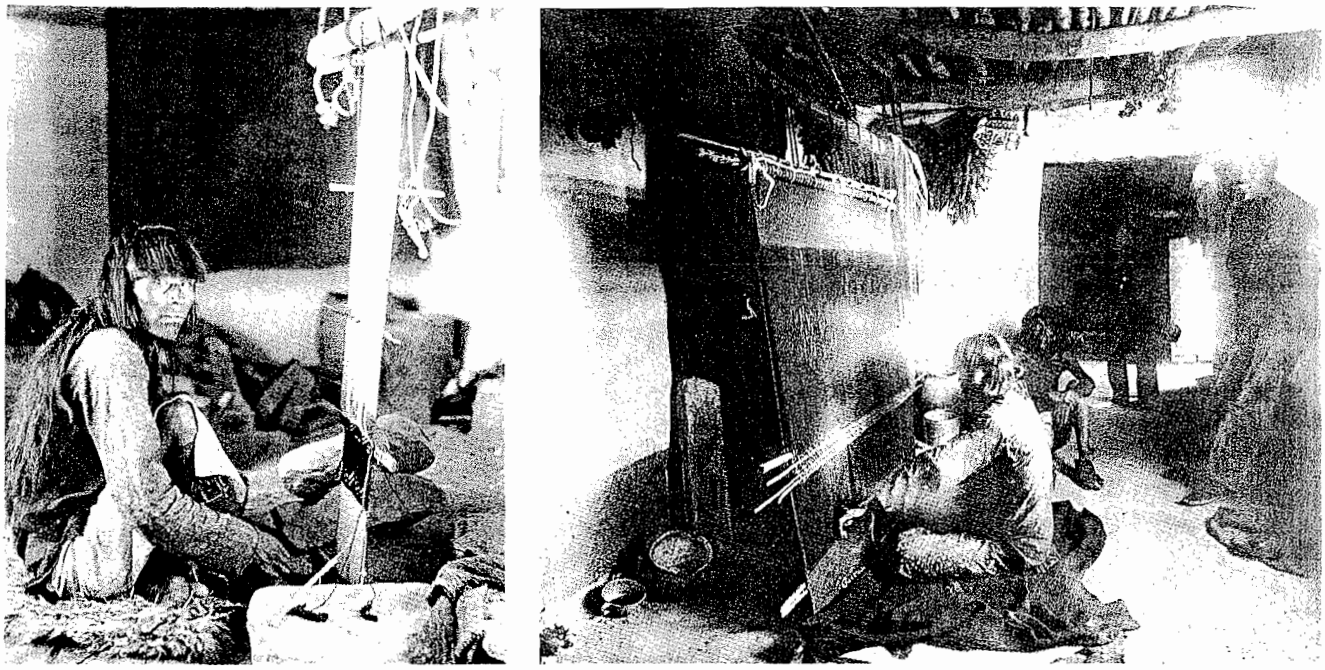
Rabbit hunting is a regular fall and winter sport (fig. 4). Announcement of the hunt is made in the evening before the hunt. The place of assembly, the direction in which they are going to hunt, the place-names along the route of the hunt, and the route of return are all included in the announcement. In the morning the men assemble with their throwing sticks. They form a surround a mile to a mile and one-half in area, and those at the rear close up the circle. When a rabbit is raised the hunters throw their sticks with a side arm motion at it. When a man hits and stuns one, he runs to it and kills it.

Livestock

The major forms of men's property are sheep and cattle (fig. 5). Horses, burros, and wagons become important as the distance one has to travel to his fields or to cut and haul firewood increases. The size of the flocks and herds has always been limited by the amount of browse and the availability of water.

From the earliest days of the agency at Keams Canyon the government made systematic efforts to aid Hopi stockmen. Drilling deep wells with windmills, storage tanks, and watering troughs has been one of the most effective ways aiding the growth of the Hopi herds. Efforts were also made to improve the quality by assisting in the purchase of pure bred rams and bulls, but the benefits were limited since the Hopi did nothing to control the breeding. It was not until 1944, when a fenced

HP4916

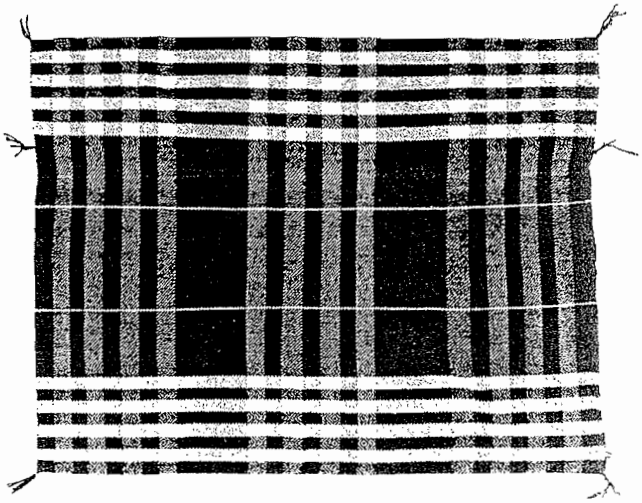


Calif. Histl. Soc., Los Angeles: Title Insurance Coll.

Fig. 6. Men weaving at Oraibi, about 1898. Both men use vertical looms that are suspended from the ceiling beams. left, Man weaving a brocaded ceremonial sash (fig. 7) of the type traded to the other Pueblos; the red, green, and blue weft elements are wrapped completely around the warp elements to produce the design—the white areas being unwrapped warp threads. right, Man weaving a blanket inside a Hopi house; a kachina doll and braids of corn are suspended against the wall to the right of the loom. Photographs by G. Wharton James, about 1898.

Smithsonian, Dept. of Anthr.: 22959.

Fig. 7. Man's ceremonial cotton sash with brocaded designs on top surface at each end formed by nonstructural wool wefts (for technique see Douglas 1938:35-38). Brocade table runners, a modification of the traditional sash, are made for tourist sale (see Kent 1976:fig. 27a). Length 224 cm, collected early 1870s.



U. of N.M., Maxwell Mus. of Anthr., Albuquerque: 63.34.141.

Fig. 8. Man's wearing blanket of brown and white handspun wool in diagonal twill weave. Length 137 cm, collected about 1930.

pasture for rams and bulls was built by the agency, that the program to improve the quality of the stock became effective.

Sheep owners usually have one or two partners—a pair of brothers, father and son, uncle and nephew. If there are only two, half a man's days must be devoted to sheep herding. A man will spend two or three days at a time herding and then be relieved by his partner. Men who have corrals close to the mesa pen their sheep at night and go out to herd each day. During lambing season all hands are with the flock, and each earmarks the lambs from his own ewes. Table 1 gives five examples of how Oraibi men allocated their work activity in autumn 1933.

In June the flocks are brought close to the village, and

HP4917

Table 1. Work Distribution of 5 Oraibi Men, Aug. 7–Nov. 12, 1933, by Numbers of Days

Type of Work	*Luther*	*King*	*Cecil*	*Alex*	*Don*	*Total*
Herding	0[a]	49	22	17	22	110
Cornfields	10	10	9	14.5	23	66.5
Bean fields	3	1	3.5	0	0	7.5
Melon fields	9.5	6	3	3	1.5	23
House building	9.5	8	20	0	0	37.5
Wood hauling	1	7	5	1	4	18
Horses	0	1	3.5	9.5	2.5	16.5
Other work	14.5	7	6	3	5.5	36
No work	3.5	9	10	35	10.5	68
Days noted	51	98	82	83	69	383

SOURCE: Titiev 1944:196.
[a] Luther owned no sheep.

Mus. of Northern Ariz., Flagstaff: a, E6363; b, E7804; c, E5964; d, E5370.
Fig. 9. Contemporary Hopi and Hopi-Tewa pottery from First Mesa. a, Jar with black and red on orange bear-paw design used by the Nampeyo family; made at Polacca by Dextra Quotskuyva, great granddaughter of Nampeyo, collected 1973. b, White wedding jar with black and red decorations made by Nancy Lewis of Sichomovi, collected 1977. c, Black on red bowl by Ella Mae Talashie of Walpi, collected 1973. d, Orange jar with black painted Sikyatki-type designs, made by Lorna Lomakema of Tewa Village, collected 1974. Diameter of a 22.4 cm, rest same scale.

work parties assemble to shear the sheep. The wool clip is sold to the traders, and until the end of World War II it was often the only source of money for many men. Most Hopis do not sell their lambs; they are butchered and eaten on all the occasions during the year that require feasts, such dance days, weddings, and initiations. They practically never butcher just to have meat in their diet. What little is not cooked for the immediate occasion is dried in the sun and preserved for future use.

Cattle are always marketed.

In 1937, the total livestock on the Hopi reservation consisted of 11,203 sheep, 317 goats, 7,695 head of cattle, and 5,085 burros and horses (Hack 1942:17). In 1944 the government instituted a stock-reduction program to bring the total number of animals within the carrying capacity of the range. Since it had been preceded by the program of controlled breeding and improved quality, the actual income of the Hopis was not reduced. All stock owners were issued grazing permits, and reductions were made in proportion to the number of head owned at the time.

With the spread of wage work and other forms of cash income on the reservation since 1946, Hopis have been shifting their forms of livestock from sheep to cattle, which do not require constant care. At the same time, the widespread ownership of cars and trucks has reduced the need for horses and burros, freeing that many more range units for cattle.

Trade

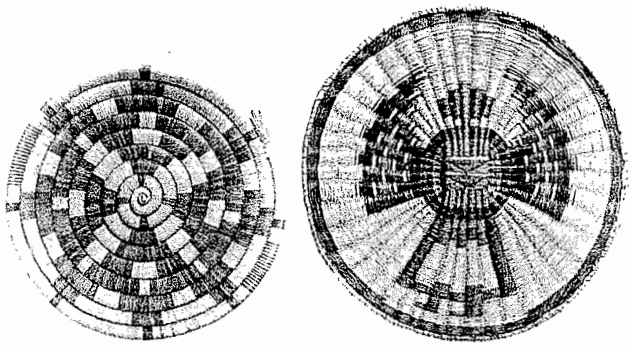
The Hopis have traded with the Najavo for sheep and wool, with the Havasupai for buckskins, and with Zuni and the Eastern Pueblos for turquoise and other goods. Hopi weavers of ceremonial garments have kept the other Pueblos supplied for many years (fig. 6).

A trading post at Keams Canyon was operating in 1881, and Hubbell's post at Oraibi was established in 1919. All other posts and stores on the reservation have been owned and managed by Hopis. Tom Pavatea's post at Polacca was one of the largest and most successful. When he died in 1941, his estate was valued at more than $40,000.

In 1937 of a total of 17 licensed trading posts 15 were owned by Hopis. Many have been started, operated for a number of years, and then abandoned. Clothing, flour, sugar, coffee, and canned goods were sold; and craft products, corn, and wool were taken in payment as well as money when it was available.

With the spread of wage work, both on and off the reservation, and with the completion of a network of paved roads, a cash economy has been gradually displacing the traditional subsistence economy. As a result trading posts have become supermarkets. Bottled gas,

HP4918



Smithsonian, Dept. of Anthr.: 166452, 213546.

Fig. 10. Basketry plaques. left, Second Mesa coiled basketry plaque; coiled foundation bundles of shredded yucca or grasses are closely sewed with strips of split yucca leaves (O. Mason 1976:257; Underhill 1944:29); collected 1892. right, Third Mesa wicker basketry plaque; two bound groups of peeled and smoothed sumac or willow stems are crossed and lashed to form radiating ribs around which stems of rabbitbrush are woven (Hough 1918:265-266; Underhill 1944:20-25) to form Kwahu (eagle) kachina design; the basket edge is wrapped with yucca leaf strips; collected 1901. Diameter of right 35 cm, other same scale.

top, Calif. Histl. Soc., Los Angeles: Title Insurance Coll.; bottom, U. of Ariz., Ariz. State Mus., Tucson.

Fig. 11. Making coiled plaques, trays and baskets. top, Group of women outside house, probably in a Second Mesa village about 1895-1900. bottom, Annabella Nequatewa (a Shongopavi basketmaker) with her grandchild and her husband, Edmund Nequatewa, who makes kachina dolls (these are on the table between them, with brushes and paints with which he has just been painting them). Photographs by unknown photographer (top) and by Helga Teiwes, Oct. 1973 (bottom).

top, Calif. Histl. Soc., Los Angeles: Title Insurance Coll.; bottom, U. of Ariz., Ariz. State Mus., Tucson.

Fig. 12. Making basketry. top, An Oraibi woman, her hair bound in the style worn by married women, making a wicker basketry plaque. Her husband is knitting, or possibly crocheting, one of a pair of cotton or wool leggings, an item typically manufactured by men. Photograph by G. Wharton James, about 1898. bottom, Marietta Tewa, a resident of the Third Mesa town of Kyakotsmovi, making a twilled yucca ring basket (2 finished baskets on table). Photograph by Helga Teiwes, Oct. 1973.

HP4919

electricity, and refrigeration permit the sale of fresh meat, frozen vegetables, fruit, and a multiplicity of other foodstuffs.

Crafts

A supplementary source of income in every household is the production of crafts. Since the beginning of the twentieth century, women's products have tended to become specialized; at First Mesa they make pottery (fig. 9), at Second Mesa coiled basketry (figs. 10-11), and at Third Mesa wicker basketry (figs. 10, 12).

Hopi men do the weaving, and the bulk of their work is in ceremonial garments of cotton and wool. Sashes (fig. 7), kilts, wedding robes, belts, and garters are the most commonly produced forms of the weaver's art. They also make the woolen black dress, which is part of a woman's traditional costume, and knit black or blue leggings, which are worn in dances. Some men also weave a striped woolen blanket (fig. 8).

Since about 1930, the Museum of Northern Arizona in Flagstaff has encouraged the production of the best work, holding an annual exhibition in July. Prizes including cash awards are given for the best pieces, and they are sold to the public at whatever price the craftsman puts upon his work.

The carving and painting of kachina dolls has become increasingly popular since the growth of a cash economy. Originally made for distribution by the kachinas to girls at dances, they are now made in large numbers for sale in the market. They tend to become larger and more elaborately carved and feathered to appeal to the tastes of the buyers.

Until 1946, there were a few Hopi silversmiths, but their work was not distinguishable from that of the Navajo or Zuni. In that year a group of 17 Hopi veterans was taught the art, and a set of traditional Hopi design elements was adapted to the possibilities of the medium. In 1965 there were seven men who worked full time at silver and another 12 who worked during the winter months. They now constitute a guild with its own hallmark (fig. 15).

On top of Second Mesa, at the junction of the roads from Shongopavi and Mishongnovi the Hopi Craft Guild has its own building, where native products are displayed and sold. Any craftsman, potter, basketmaker, weaver, or silversmith can have his work displayed and sold there. The other half of the building is devoted to work benches and supplies for the silversmiths.

Household Economy

The basic economic unit of production and consumption has always been the household. It is here that the basic division of labor between men's work and women's work, between male property and female property, is focused.

Every Hopi house has a set of three grinding stones, set in a wooden frame (fig. 16). The metates differ in the degree of coarseness. When corn is ground it is first shelled and cracked, and then ground successively on each of the metates until it is as fine as powder. Since almost all Hopi foodstuffs are made of it, plaques piled high with meal are one of the commonest forms of payment in exchanges between households.

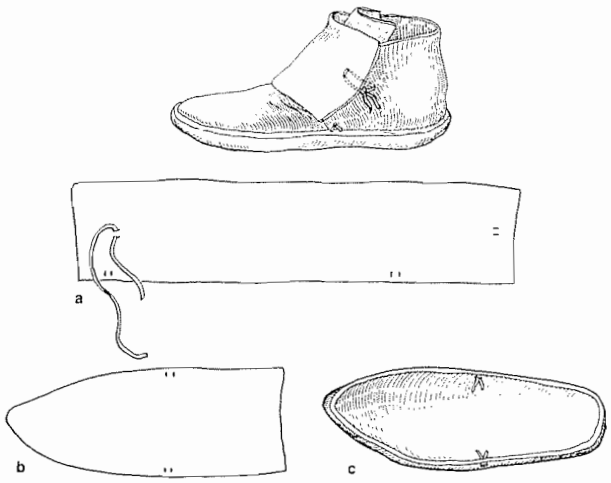
The other essential item of equipment is the piki stone (fig. 17), sometimes located in a back room, but more often in a small house built for that purpose. Piki (*píki*) is a wafer-thin bread of finely ground blue cornmeal. A fire is built under the stone, the surface is rubbed with the oil from cotton seeds or watermelon seeds, and a thin batter is spread upon the hot stone by hand. The piki is peeled off the stone, turned over for a minute, and then folded into squares or rolled up like a diploma (fig. 17). It is prepared before all ceremonies, and it is an item of daily consumption. Many houses also have a stone and adobe beehive-shaped oven outside, which is used for baking bread.

In addition to piki, and many other dishes prepared from a cornmeal base, a standard feast dish is hominy and mutton stew (*nõqkwìvi*). The women prepare the hominy and the men butcher sheep, which are then boiled together. Child naming on the twentieth day, a girl's grinding following first menses, marriages, boy's initiation, as well as all the ceremonies of the annual cycle require the preparation of these foods.

At marriage a girl spends four days grinding and making piki at her mother-in-law's house. Meanwhile the men who are relatives of the groom are carding and spinning cotton and setting up a loom in a kiva to make the bride's wedding clothes (see "Hopi Social Organization," figs. 17-18, this vol). Until the weaving is finished, the bride stays grinding and cooking. When the clothes are finished, she is dressed in them and returns to her own house accompanied by her mother-in-law, bearing a bowl of hominy stew. After they feast, her mother-in-law's bowl is filled with other Hopi foods as a gift. Later the girl and her mother and female relatives will grind and prepare other kinds of food, which is carried to the house of every man who participated in the weaving. When a boy has his Wuwuchim (*wíwicìm*) initiation, his mother gives ground meal, piki, and other food to his ceremonial father's sister. A woman who sponsors a kachina dance is obligated to prepare food to feed all the dancers as well as the guests who will visit her house.

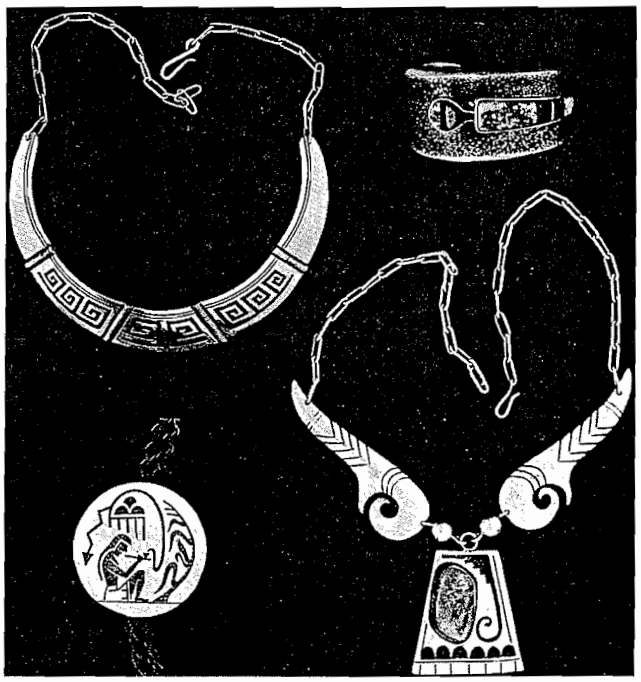
A man contributes his work, his fruit, his livestock or his income to whatever house he is living in: his wife's when he is married, his mother's before marriage, or his mother's or sister's if he should be divorced.

HP4920



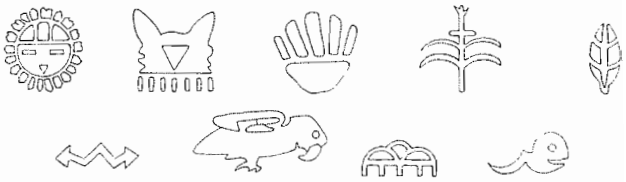
after Hough 1918:fig. 15.

Fig. 13. Construction of ordinary men's and women's moccasins consisting of three sections sewed together: a, ankle wrap and b, vamp with tongue, both of tanned deerskin; c, sole of cow (formerly elk) rawhide (see Kewanwytewa and Bartlett 1946).



Mus. of Northern Ariz., Flagstaff: E3387, E5949, E6213, E5110.

Fig. 14. Hopi silver jewelry characterized by the silver overlay technique (Bedinger 1973:203-204), minimal use of turquoise, and traditional Hopi pottery and textile designs (M. Wright 1972:38; M.R.F. Colton 1939:2). top left, Overlay choker made by Billy Rae Howee of Shongopavi, collected 1964; top right, cast bracelet in distinctive contemporary style of Charles Loloma of Hotevilla, with gold bezel around Turquoise Girl anthropomorphic figure in turquoise, Italian oxblood coral, lapis lazuli, and ironwood (see M. Wright 1972:69; Fair 1975), collected 1973. bottom left, Bolo tie with overlay design described by silversmiths, Lawrence and Gracilda Saufkie of Shongopavi, as a kiva chief blowing smoke into the clouds to make rain for the corn crops, collected 1973; bottom right, necklace with overlay, turquoise setting, and stamped designs by Morris Robinson of Bacabi, collected 1955. Diameter of bottom left 5.0 cm, rest same scale.



after M. Wright 1972: top, pp. 92, 87, 85, 90; bottom, pp. 87, 81, 83.

Fig. 15. Hopi Silvercraft Guild and silversmith's stamps. top row, left to right, One of the several similar stamps of the Hopi Silvercraft Guild depicting the sun, and personal marks of Hopi silversmiths representing Crow Mother, bear paw, corn plant, feather, and bottom row, lightning, parrot, rain cloud, and tadpole.

Milwaukee Public Mus.

Fig. 16. Unmarried woman grinding cornmeal at Sichomovi; each Hopi house has a set of two to four grinding stones, of graduated fineness, tilted in bins, on which corn is successively ground by rubbing with a long stone mano (3 stand in corner, and one in bin in foreground); photograph by Sumner W. Matteson, about 1900.

Traditionally, the family was of the extended matrilineal type. In more recent years when it became easier to build a house or have it built, young couples moved into houses of their own. As a result, a census of the three Second Mesa villages in 1961 revealed that about one-half the families were nuclear in pattern, the other half reflecting the extended matrilineal form (Kennard 1965:30).

While the effects of contact with the larger society upon the Hopi economy and culture are similar in all villages, the extent is variable. Moenkopi, the westernmost village of all those whose people came from Old Oraibi, has been for many years the most highly acculturated. Only 13 miles from U.S. Highway 89 leading south to Flagstaff, and only two miles from the Western Navajo Agency at Tuba City, it has been a ready reservoir of manpower and skills. With the breakdown of the traditional order at Old Oraibi there has been little to tie them to the traditional way of life. As the population grew from 200 in 1903 to 592 in 1962, even the available irrigated land would have been inadequate to support them (Nagata 1970:224).

HP4921

left, Calif. Histl. Soc., Los Angeles: Title Insurance Coll.; center and right, Mus of N.M., Santa Fe.

Fig. 17. left, Woman identified as Mashongke toasting cornmeal—probably to remove moisture after preliminary grinding—in a jar on the interior cooking fire, stirring it with the basket in her hand, brush of bound grass at left; photograph by G. Wharton James at Oraibi, 1898. center, Piki stone greased with burro fat is over the fire; a thin layer of batter spread on it cooks instantly and is peeled off, then laid on top of the next sheet being baked, then folded and sometimes rolled (Beaglehole 1937:63-64). right, Carrying folded piki bread, perhaps to a ceremony, probably at Oraibi. center and right, by unknown photographer 1917 or before.

HP4922