The Purposes of Ethno-Botany[1]

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To the World's Fair in 1893 was brought a unique collection of objects obtained through the liberality of Mr. Hazzard by the Wetherill brothers in the Mancos cañon, Colorado. Never before in the history of American archaeology had such a complete series of objects been brought together for study and comparison. The University of Pennsylvania was fortunate in securing through the efforts of Mr. Culin the loan of the entire collection, which stands unrivalled in showing a large series of interesting things; plant products in the form of food, dress, and household utensils being very largely represented. It is to the description of the plants and plant products that this article is directed.

Before describing, however, the objects which have been manufactured from plants, it is expedient to make a few preliminary observations on the importance of ethno-botany in general.

1.

The study of ethno-botany aids in elucidating the cultural position of the tribes who used the plants for food, shelter or clothing. The well-known classification of men into-savage, pastoral, agricultural and civilized will roughly serve our purpose. The term pastoral could hardly be applied to the tribes of North America. They were a roving people, traveling from place to place in search of game and settling only long enough to .plant a little corn, beans and pumpkins to break the monotony of a too strict animal diet. Where they did not pursue agriculture, they subsisted on the seeds of wild grasses and herbs. The cliff dwelling peoples, probably driven to the mountain fastnesses, had practically left the hunter stage and had begun to enter the agricultural stage.

A people maybe said to have left the pastoral and entered upon the agricultural stage, when chief dependence is placed upon the returns of the soil under cultivation. With the entrance upon this condition, new implements were devised, new methods of field labor introduced. An examination of the objects in the Hazzard collection clearly shows that they accomplished much by the use of very simple implements. The corn was planted by a pointed stick and hoed by a stick broadly flattened at one end. An examination of other manufactured articles of vegetal origin shows that these people were extremely provident; nothing was allowed to go to waste. It was too difficult a thing to carry the objects from below up the face of the cliff to their dwellings above, and they therefore exercised great care in putting everything to use. If it no longer served one purpose, it was devoted to another. Mr. Cushing has shown that this care was due to certain superstitions which they held concerning the soul of objects, animate and inanimate. For example, when the hollowed out pumpkin no longer served the purpose of a jar it was broken into pieces and the charred fragments served as a scraping instrument. The worn out fibers of Yucca were also conserved and made useful.

This careful husbanding of their resources may be directly traceable to two causes; first, it was difficult to carry large and bulky articles from the level of the cañon to the rockyshelves above, for in many cases steps had to be cut in the perpendicular face of the rock, climbing being facilitated by-wooden climbing crooks, which afterwards were used by their descendants, the Pueblos, ceremonially; second, they lived in an arid region, where the materials ready at hand for the various uses of domestic life were extremely limited, and where the vegetal food supply was limited by the water supply, which in many seasons was very small. The panniers and .baskets, made of cane grass with carrying frame attached, were very serviceable in transporting seeds and fruits from the campestrine levels to the cliffs above. The ladder in the collection, the rounds of which are bound to the uprights by yucca fiber, fulfilled essentially the same purpose. An examination of the collection also shows that they had advanced to the use of a double lever of the second class, for we find them employing a pair of cedar forceps which Mr. Cushing says were used to pick cacti, too

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prickly to be gathered in the ordinary way. In fact a large number of the objects as manufactured from plants shows that they had made considerable progress in the arts, and were less -dependent, therefore, on the uncertain supply of food afforded by following hunting or fishing. In other words, they were to a certain extent independent of their surroundings and could, by planting crops, which they afterwards harvested and stored in granaries, eke out an existence.

2.

An ethno-botanical study throws light upon the past distribution of plants. I have at some length shown[2] that a study of the native uses of maize, etc., leads to the belief that Indian corn was a native of southern central Mexico and from there by trade and barter was carried to the farthest points in North and South America. Another example is found in tobacco which was universally distributed throughout the American continents. The distribution of tobacco, however, is complicated by there being two or three species, which were used in different parts of the western hemisphere. One species *(Nicotiana rustica)* was cultivated by the Indians in New Mexico and Arizona, as observed by Dr. Edw. Palmer. Another species *(Nicotiana quadrivalvis)* was cultivated by the Indians from Missouri to Oregon. One or two species are recorded as having been cultivated in California[3]. One quotation will show that it was cultivated widely. Hernandez de Oviedo in his "Historia general de las Indias" (1535) describes the use of the plant in Sto. Domingo.

"Eine Kalebasse füllten die Indianer mit einem Kräuterpulver, das sie Cohobba oder Guioja nannten. In die Kalebasse steckten sie einfache oder gabelförmige Röhren, so dass eine oder beide Öffnungen in die Nasenlöcher passten; denn die Insulaner rauchten ihren Tabak durch die Nase."[4]

The use of cedar was considerable. Cedar was used to make cactus pickers; cedar bark was twisted into headbands, woven into mats, and used in the broken up form as tinder. We find its use also in the eastern states, for in a collection of objects in the university museum taken from the Ohio mounds is a piece of a well preserved log although buried for hundreds of years. A microscopic examination shows the several cell wall layers still intact and the woody .elements excellently preserved. These examples, with numerous others that might be taken from European archeology, for instance the existence of a peculiar variety of barley in the lake dwellings of Switzerland, prove that the study of plants in this way is of importance as deciding upon the original home and past distribution.

3.

An ethno-botanical study helps us to decide as to the ancient trade routes. I have shown that maize was introduced into the West Indies by the tribes which had emigrated from the South American continent; that South America derived the cereal from the tribes living adjacent to the Rio Grande and tributaries.

Considerable difficulty, however, is experienced in the study of a single isolated plant, for the trade routes may have been various, but when we introduce as evidence two or at least half a dozen plants, we can determine with greater accuracy the main trade routes.

There cannot be any doubt that such trade routes existed. My grandfather used to narrate stories of the Indians that passed his father's house in central Pennsylvania on their way to the salt licks of Virginia. I remember seeing the trail that led southward through his woodland, as used by Chief Hogan and his band of hunters.

The discovery by Dr. Amos Brown of catlinite in the Hazzard Collection, also shows that the Indians of the southwestern United States had intercourse with the tribes residing in what is now the state of Minnesota. Mr. Joly says with relation to European archaeology: "How far the commercial relations of the primitive people of Europe extended and what routes they followed is a question the solution of which, like that of so many others, is as yet merely guessed at. However the presence of amber from the Baltic, and of white Mediterranean coral in Switzerland, Italy and elsewhere, of carved flints in abundance in the Isle of Elba where this rock does not exist in the natural state, arrows made of the black obsidian of Sardinia, found in the same island and in that of Pianosa, the jade axes found at Pauillac in the department of Gers; those of augite of Auvergne found in Brittany; the green turquoise of Brittany discovered in several dolmens in the south of France; all of these articles of which the rough material is foreign to the country where they are found, prove that from the earliest ages more or less commercial relations existed among the most ancient in-

habitants of Europe." The same principles apply to the discovery of plant products in various parts of the globe. Commerce very early carried yew wood from the Rhine country to the Baltic, where the tree was and thence to the Esths and Wends where the yew was. not found.

The first step in deciding upon the ancient trade routes is to ascertain (1) what plants were used by the cliff dwelling Indians, for example, of the Mancas cañon in Colorado, (2) to systematically tabulate the distant and local plants and (3) to discover, if possible the home of the non-indigenous plants. When all of these points are decided upon, we shall have sufficient data with which to map out the Indian trade routes.

There are several ways by which the plants as used by the cliff dwellers can be determined. *(a)* By a direct botanical determination of the species of plant used. This is possible in many cases when we have seeds, nuts, tubers, bulbs, and berries used as food; also by a botanical analysis of the pot herbs which may have the leaves and flowers preserved. An examination of the human excrement might disclose by means of the undigested voided seeds, the plants that were used as food. In dealing, however, with the raw materials of manufacture, it is often very difficult to determine from what vegetal source they were derived. *(b)* A microscopic examination of the plant product will reveal much; for example, if it be a piece of wood, its woody characters. We could determine by such an examination whether the stem was that of an angiosperm or that of a gymnosperm. In case the piece of wood shows a gymnospermic structure, it is quite possible by use of knowledge already gained to determine whether it be yew wood or that of the pine, the fir, the larch and the juniper. A microscopic examination of a dicotyledonous stem would also help us in identifying the wood.

We have a piece of wood before us which we cut in order to determine its microscopic appearance. A striking feature in such a section is the concentric circle of ducts in the early spring growth of wood; in the thick rings sometimes there are two or three rows of ducts, the third one being of smaller size than the others. "The first row forms in the spring as the leaves are opening." The largest duct is usually round and 0.13 of an inch in diameter; some are smaller and others flattened or elliptical. Except when first forming these ducts are never open, as usually stated, but are filled with delicate tyloses. Surrounding these ducts are small cells, which are termed tracheids, having minute thin places in their sides; the middle lamella of the cell, however, being not visibly perforated. Some cells containing starch are also intermingled with these tracheids. In an annual layer of vigorous growth large bundles or masses of hard, dense fibers are seen just out of the concentric circles of ducts, and when fully formed extend through the outer part of the layer. These fibers vary in diameter from .006 to .0075 of an inch. The medullary rays run through the bundles and at frequent intervals are intersected by cells running parallel to the axis of the tree, thus dividing a mass of hard fibers into small rectangles. Such a detailed description coincides with the structure of the white oak, and after applying further tests we can rest assured that the wood is from one of the most valuable of our forest trees.

If the study of the microscopic structure leads to no definite conclusion as to the nature of the wood, then we might have recourse to other methods. (l) The specific gravity of the specimen can be readily calculated whether the wood is heavier or lighter than water. A piece of wood tested in this way showed a sp. gr. of 0.4504. Upon comparing this figure with that of the tables in Sargent's voluminous work on the North American forest trees we find the number to correspond with that set down for chestnut wood. (2) An ash determination is also a means of discovering the species of tree from which the, wood was taken. (3) The weight of the wood per cubic foot in pounds, and its fuel value are also means of deciding as to the kind of tree used.

We have now seven important facts concerning our piece of wood:

1. Its geographical habitat.
2. Its specific gravity.
3. Its microscopical structure.
4. Its fuel value.
5. Its resistance to transverse strain and compression.
6. Its weight in pounds per cubic foot.
7. Its ash.

We can judge as to the past meteorological conditions by an examination of the annual rings of wood, but the difficulty is to determine in the case of such woods as are to be found in the Hazzard collection, the year in which the wood was collected, whether at once or after the piece had lain on the

ground for some time. We have, however, in the wood a valuable indication as to the years of drought and excesses of rainfall. A recent writer in *Forest Leaves* (6: 51) describes the irregularity of growth very forcibly and gives tables supporting his statements. He says: "Having observed, in cutting various timber trees, the irregularity of growth at different periods of tree life, and being interested in the striking coincidence of these irregularities with the occurrence of certain forest fires, an examination was made. On counting back the rings to where these irregularities occur, it was found that these checks, scars and decreased growth' of rings denoted an interference with the regular healthy life of the tree, the result of forest fires occurring at these periods."

Having determined the wood as used by the Indians, the next thing is to determine whether the plant is indigenous or introduced into the locality. The place from which it came can in most cases be definitely located by botanical explorations.

4.

Ethno-botany is useful as suggesting new lines of manufacture at the present day. This is especially true of woven stuffs. Mr. F. H. Cushing has shown that by unraveling the woven frabrics a clue can be obtained as to the manner of weaving. He has succeeded in imitating skilfully a large number of Indian stitches and has discovered many interesting and suggestive facts in connection with the early weaver's art.

The especial province of ethno-botany is to study microscopically the nature of the fiber employed, as in many cases new methods of obtaining raw materials from hitherto undeveloped sources might be suggested. Not that we have not improved on the methods of our ancestors, but the sedentary Indians of the arid districts of our country were extremely ingenious and put to the best use all the plants round about them. Again, we may learn by this study new uses of plants of which we were in ignorance. A stimulant and nerve tonic new to materia medica has been discovered in this way. Dr. D. Webster Prentiss discovered the action of the drug popularly known as mescal button, which is yielded by *Anhalonium Lewinii*. He obtained the supplies through agent James Mooney of the U. S. Bureau of Ethnology, who resided among the Indians of the southwest, especially the Kioways, for many years. It is to the use of the mescal button by the Kioways in their religious ceremonies that the white man owes his present knowledge of the drug.

The Indians assemble in their council tents usually on Saturday night, and seat themselves each with his supply of buttons, about a large camp fire, which is kept burning brightly. Button after button is swallowed from sundown until three o'clock A. M. Throughout the ceremony, there is no dancing or singing, but a continual monotonous beating upon drums is kept up by the attendants. The Indians sit in a blissful reverie for hours, enjoying the beautiful visions of color and other manifestations caused by the resulting intoxication. In fact, most of the plants which the new world afforded were made known in this way; tobacco, chocolate, the potato, maize, and tomato were first used by the Indians of North and South America and afterwards borrowed by white men.

One of the principal features of the equipment of every ethnological museum where ethno-botany is to be studied should be a collection of seeds, kept in glass bottles, and systematically arranged. The identification of all kinds of seeds collected from so many sources is impossible without such a collection.

"The seed collection of the Division of Botany, U. S. Department of Agriculture, is put up in glass specimen tubes without necks, and of two sizes, one 5 cm long and 1.5cm diameter, the other 10 cm long by 3 cm. In addition to the seeds, one or two capsules of the dry fruits are inclosed whenever possible. Fleshy fruits of our native wild plants are kept in a preservative fluid of some kind. Seedlings of economic plants in various stages of germination are also kept in alcohol for reference and study. The bottles are placed in cloth covered trays made of heavy binder's board. The trays for the smaller bottles hold 100 specimens. These are placed in one case, which is to contain also, so far as possible, herbarium specimens of the plants from which the seeds were taken. A card index to the collection is of great assistance in finding specimens."[5]

The equipment would not be complete without a series of microscopic slides, prepared to show longitudinal, transverse, and tangential sections of all our native woods. These should be indexed and catalogued in such a way as to be easily available for comparative use.

Lastly, an ethno-botanic garden should surround the museum building to provide living plants for study in connection with the objects of vegetal origin displayed in the museum.[6]

Only aboriginal American plants should find a place in such a garden. No plant can be found more graceful than maize, a grass associated with the myth of the aboriginal races of America and worthy the place as our national emblem. This plant has been little thought of for decorative purposes in our gardens. Yet it is decidedly ornamental and worthy of esteem. The sunflower, too, ought to be grown. The Indians recognized its value, for the Moquis and Supais planted it for food, and used the ground seed mixed with cornmeal as a dainty. The tobacco plant should not be forgotten, as it is decidedly ornamental.

The tomato with its crimson fruit, the pumpkin vine, the, bean and the potato should find a place in some corner of the aboriginal American garden. The oak, yielding acorns, and the willow, dye stuffs, can be planted with good effect, while a pond, in which grow the arrow-leaf *(Sagittaria variabilis)* and yellow lotus *(Nelumbium luteum),* both furnishing aboriginal root-esculents, water cress, a salad plant, and wild rice, *(Zizania aquatics),* would serve to break the rigid outlines of the formal beds.

The plants should be arranged with reference to the Indian tribes which cultivated them. The plants of the Algonquin should stand apart from those of the Iroquois, those of the Aztecs from those of the Pueblos. Such a geographic arrangement is most desirable for educational purposes.

An arrangement according to the uses of the plants ought also be made. The strictly agricultural plants, such as corn, beans, pumpkins, etc., ought to be sown in one bed; the fiber plants, like basswood (*Tilia Americana*), sumac (*Rhus aromatica*), willow (*Salix lasiandra*), unicorn plant (*Martynia proboscidea*), yucca (*Yucca brevifolia*), in another; the dye plants, as alder (*Ainus incana*), celandine, smartweed, poke, white maple, gold thread (*Coptis*) is still another. The myth plants and medicine plants are important also, as showing the culture of the aborigines. They should by no means be excluded from this garden.

There can be no doubt, therefore, that such ethno-botanic gardens would stimulate greatly the interest in Indian plants, and at the same time they would be of the greatest scientific value. Nothing of the kind has ever been tried along the lines suggested, and such a garden would soon become a Mecca for those who desire to write upon our American plants and their uses among the aborigines.

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Notes

(1) A lecture delivered before the University Archaeological Association, December 4, 1895.

(2) Maize: A botanical and economic study. Contrib. Botan. Laboratory Univ. of Pa. 1: 75.

(3) U. S. Dept. Agr. Rep. 1886: 76.

(4) A. B. REICHENBACH. Die Pflanzen im Dienste der Menschheit. I. Der Tabak 2.

(5) Year Book of the Department of Agriculture 1894: 408.

(6) HARSHBERGER, Museum and Garden. The Philadelphia Evening Telegraph. October 26, 1895. p. 5.