Comparative Anatomy of Branches, Roots and Wood of Some North American Dicotyledonous and Coniferous Trees and Woody Shrubs Used in Ethnographic Artifacts: Identification and Conservation Concerns

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CHAPTER 1 INTRODUCTION

1. 1 The Book

This book deals with the comparative anatomy of the tissues of the bark, phloem, heartwood, sapwood, and pith in wood, branches, and roots of woody shrubs, hardwood trees and softwood coniferous trees, that were reported to be used historically in making ethnographic and archaeological artifacts. The species researched in this book are endemic to Northwest Coast of North America. The species used in the following chapters have anatomical characteristics that are also common in other genera in the same family. Even though the book is on species in the NWCoast of Canada , the information is applicable to tree genera in similar latitudinal environments in Canada, USA, Europe and Asia.

The goal of the information is to assist; curators with their research and conservators with their care of artifacts. Identification of a species is usually a curator's job and is used to determine provenience. Conservators can obtain the species/genus identification by research or provenience. Knowing the species/genus will give them access to literature on how other conservators have dealt with problems of the same species. Knowing the anatomy will give them a heads up on what the inherent structural problems are and what treatment may or may not be required. Some materials may be light sensitive, some may have soluble dye, and some may be inherently physically weak and on the road to destruction, etc.

Conservation treatments are not discussed in this book. The decision to undertake any treatment is the ethical responsibility of the professional conservator, the curator and or owner's agreement and cultural constraints.

Commonly, in dealing with woody materials, the heartwood (wood) of trees is usually discussed. It is the inner tissue of a tree trunk. It is dead tissue for structural strength to hold the trees upright, and is called just wood or heartwood. We know a lot about this tissue because it is commercially used in many types of cultural objects. Thus, there is a great deal of information and many keys for identification in the literature about heartwood, but there is extremely little about the comparative anatomy of the tissues of the bark, sapwood, branches, and roots. The visual knowledge of all these tissues is needed when attempting to identify the species of a minute fraction of a sample from a waterlogged archaeological artifact or ethnographic woven basket.

The book includes separate chapters, each one on a comparison of a specific anatomical woody structure in a number of salient species. This assists in the identification of species or genera. In the introduction of each chapter there is a general description of the anatomy of the tissues being discussed. There are often species specific cells, crystals, and unique cell contents that can be used for identification of species.. These are mentioned when significant for identification.

Some ethnographic information in reference to the plant part in the structure of the artifact is presented in this book, not medicinal or food use. "Native American Ethnobotany**", a** database of foods, drugs, dyes, and fibers of Native American Peoples, derived from plants at -

http://herb,und,umich.edu/herb/search - gives information on searches according to species, plant part or species, i.e., branch, bast fiber, root , etc., and gives a multitude of ethnographic uses.

Researching hydrated or bone dry 10,000 year old artifact material is different from using sound wood. When wood anatomy is taught the first step is to study the tissue pattern on a specific surfaces of the round of heartwood in a tree. For example –what the cells look like on the top surface - the transverse surface, on the radial surface, a cut through the radius of the circle- and the outer tangential surface of the circle. Knowing what a cell looks like in any of these orientations allows one to hopefully identify it.

But to complicate it even more, there are alterations to the tissues due to - the harvesting method, modification of the plant part for use in making an object and the deterioration due to ethnographic use or environmental impacts. A dead cell that has lost some or all of its cellular water, some polymeric materials, polysaccharides, and proteins, has shrunk, and has lost at least some elasticity, tensile strength etc. Sometimes minute samples can be taken on a specific surface of an archaeological sample, but commonly the minute sample may be of any one or partially through several orientation surfaces. It is this disoriented tissue that has to be used for identification. But all in all, with the visual knowledge of cells one usually can find something that is recognizable. .

DNA is often considered the panacea of all identification problems. It too requires removing a sample, no different in size than from that used for microscopy. Archaeological wood is usually just a lignin shell of cells because of water leaching, fungal activity and aerobic and anaerobic bacterial activity. Often, not enough protoplasmic material with nuclear material is left for DNA analysis. Terpenes –volatile chemicals-are species specific chemicals in woods are commonly used for identification of sound wood samples, but it too has been leached and volatized and not present in deteriorated wood.

The terminology used in the text is explained as it goes along and there is a glossary for further explanations. The terminology is easy because all plants have the same parts, but the patterns of the cells and tissues are variable with species.

Relevant morphological, anatomical, and chemical features of plant parts are needed to interpret the changes and their influence on the stability of the artifact. Understanding the structure and inherent strengths or weaknesses assist conservators in logical care for an object. These are presented throughout the text were possible. Also, throughout the text a few examples of the materials from artifacts are presented for comparison.

The main group of plants covered in this book are the higher plants. Taxonomically they are divided into two groups according to the type of seeds they produce. Those that produce seeds in a fruit like a nut or apple are called the angiosperms and those that produce a naked seed are the gymnosperm trees commonly called coniferous trees, i.e., fir, spruce, hemlock, cedar, pine etc.

The angiosperms are further divided taxonomically into two groups according to their number of cotyledons. Cotyledons are specialized seed leaf-like structure designed for food storage of the embryo. Those with two leaves are the dicotyledons (dicots) and those with one leaf are the monocotyledons (monocots).

The plant material researched in this book is the heartwood, sapwood, branch and root anatomy of the dicot trees and woody shrubs and the gymnosperm coniferous trees

The photographs are of free hand sections of living and dried material and prepared histological microscope slides. The free hand material used for microscopy photographs is mainly unstained water mounted samples. Most plant materials have enough natural color contrast in the tissues, thus staining is not necessary. The author's photographs were taken by a hand held camera over a simple light microscope eye piece. The photos are easily down loaded to computers with a Data Stick USB Flash Drive. A camera attached electronically to a computer monitor set up is excellent if available.

1.2 The chapters

Chapter 2 is an introduction to the tissue terminology used throughout the chapters. The trees and plants have functional tissues that are in all and are named the same, for example, xylem is the term for the supportive tissue in all plants. The tissues in all plants do vary in anatomy but their function is the same. Thus the terms are used throughout and are a limited number. There is a glossary (appendix i) of terms to assist in understanding the terminology.

The chapters are presented in an order for logical presentation of the anatomy of the tissues of the plant parts used in artifacts. Thus in branch or root in order, : the outer bark; inner bark; phloem; xylem; and central pith. In each chapter information is presented for curators and conservators to assist in identification of species, to understand the reason for the ethnological use of the plant part or tissue, and to be aware of its inherent weakness.

Chapter 3 is on the comparative anatomy of the outer bark of significant branches and ramets of dicotyledonous woody trees and shrubs.

Chapter 4 is on the bark of coniferous branches.

Chapter 5 is solely on the secondary phloem of the western red cedar. It is the most commonly used bark in NWC ethnographic artifacts.

Chapter 6 is a comparison of 2nd xylem in heartwood, sapwood in branches and roots, as observed on the three surfaces: transverse, radial and tangential, of two coniferous species, *Picea sitchensis* (Sitka spruce) and *Tsuga heteropylla* (hemlock). The comparative information is limited to just two coniferous species because of the complexity of the number of surfaces that need to be observed. 2nd xylem is presented because it is the commonest tissue of any of the plant parts. Heartwood identification is extensively research and presented in the literature- it is commonly called just wood. There is little in comparative anatomy of sapwood in the literature. It is a complex tissue because it is changing from embryonic to metabolic to transitional to finally forms dead heartwood. Studies of sapwood, despite this continuous change, have some value for species identification. Sapwood in branches contains starch and sugars, and thus they are a conservation concern re insect activity, especially with climate change problems. This chapter also shows that when observing a small fragment from a wood object that no matter what surface is observed there are features that help identify the genera. It also shows that looking for just one structure such as resin canals for identification of Sitka spruce is limiting. In Sitka spruce, radial resin canals are seen easily in heartwood on tangential surface, in roots they are seen easily on the cross section and traumatic resin canals are observed on cross section, but also in many other species.

Chapter 7 is on pith in branches of both dicotyledonous and conifer species. It has great potential for indentifying species of intact branches. The comparative anatomy presented of piths in NWC coniferous trees has not been presented in literature so is new information. Branches are used for a multitude of ethnographic artifacts.

Chapter 8 is on coniferous roots. The anatomy of Sitka spruce and western red cedar(WRC) roots is compared because they are the commonest roots used in NWC artifacts and also in its distribution in north eastern North America and Canada. The complexity of the comparison of the roots has risen because of the differences between true roots and adventitious roots that develop from branches. Photomicrographs of roots of other species are presented.

Chapter 9 discusses the many possible types of deterioration. In conservation it is important if an object is fragile and shows a problem, to know the reason why. It may be due to the inherent anatomy of the wood or environmental issues thus it is a guide for the need of determining conservation treatments.

Chapter 10 is just on spirals. The reason it is a single subject is because there are many types and causes of spirals in wood. This chapter discusses and illustrates their differences, not just the anatomical spirals that are a salient feature in identification but others and their causes.

11 is Appendix i is a glossary of terms used throughout the text .

12 is Appendix ii and is a bibliography that will help if the reader would like more information on a specific subject in the text. .