THE VALUE OF PLANT ANATOMY

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Abstract: A survey of some of the important uses that have been made of our knowledge of plant anatomy in such fields as: criminology, climatology, taxonomy, paper making and other industrial processes.

The general public is quite aware of the fact that a knowledge of the anatomy of animals is very important in understanding life processes and, in the veterinary and medical fields, for the treatment of certain diseases including surgery.

The value of plant anatomy to mankind is not so apparent. But it is not an exaggeration to claim that the study of plant structure is at least as important, if not more so, than is the study of animal anatomy. It is our belief that the teacher of anatomy will be able to use some of the following examples, culled from many sources, in his teaching.

CRIMINAL CASES

I. Charles A. Lindbergh in 1927, made the first solo flight across the Atlantic Ocean. In 1932 his son, Charles, Jr., was kidnaped and killed, and a man by the name of Bruno Hauptman was convicted and executed for the deed. As an aftermath of the crime, strict federal laws were passed in regard to kidnaping.

Although many pieces of evidence were introduced at the trial, the most damaging was that concerned with the ladder used in the kidnaping. It was determined by Arthur Koehler of the Forest Products Laboratory, U. S. D. A., that the ladder was home-made, had no previous usage, and consisted of birch, douglas-fir and two kinds of pine. A rail on the ladder used in the kidnaping was matched up with a floor-board in Hauptman's attic thus showing that the rail and the board had originally been one. Other clues which were used in pinning the kidnaping on Bruno Hauptman were—types of planers used to dress the lumber, the hand plane and chisel used by the suspect, the nails in the ladder and the type of saw used.

II. Fragments of wood a few hundredths of an inch long helped Forest Products Laboratory experts including Dr. B. Francis Kukachka clinch the identification of a tree limb used to kill Mrs. Lillian Oetting, one of three women slain March 15, 1960 in a secluded cliffside glen of Starved Rock State Park, Illinois. The findings of Dr. Kukachka led to his eventually taking the witness stand in Circuit Court at Ottawa, Illinois, to testify in the trial of Chester Weger for the murder of Mrs. Oetting.

DENDRO-ARCHAEOLOGY

The number and architecture of annual rings in trees can tell us a number of facts. Annual rings have been used for years to date extinct cultures. This is accomplished by matching up the rings found in logs at abandoned localities with master tree ring chronologies from living trees. Some specific cases were the dating

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of Cliff Dweller's ruins, Mummy Cave and Pueblo sites. Hundreds of areas have actually been dated by the above methods.

DENDRO-CLIMATOLOGY

Some idea of climates and consequently, growth conditions can be ascertained by studying the width of the annual rings after having learned the approximate age of the tree by counting the number of rings. It is, of course, well-known that the rings are widest in years which have a favorable climate for growth and narrowest in poor years. Indeed, these facts were known to Leonardo da Vinci near A. D. 1500. By comparing tree ring widths over large areas one can thus gain information about climates not possible by any other method.

TAXONOMY

The differing anatomy of stems and roots is one of the ways by means of which we distinguish angiosperms from gymnosperms and monocotyledons from dicotyledons. There are so many additional specific examples where anatomy has illuminated taxonomy that it will be possible to list but a few, such as—

1. The taxonomic classification of the *Juglandacae* has been supported by anatomical studies.
2. The *Hypericaceae* and the *Guttiferae* are combined into one family by some but their anatomical differences suggest that two entities are involved.
3. The genus *Biota*, on the basis of the transverse wall of the axial parenchyma, has been separated from the genus *Thuja* where it had been formerly placed.
4. The East Indian Satinwood, *Chloroxylon swietenia* had been placed in the *Meliaceae* family and the West Indian Satinwood, *Xanthoxylum flavum* in the *Rutaceae*. Since their anatomy is similar, they are now both placed in the *Rutaceae*.
5. *Copaifera hymenaefolia* has now been removed from this genus and transferred to *Pseudocopaiva* on the basis of floral structure.
6. The genus *Calophyllum* in Latin America formerly held four species but now these have been all accomodated within one species.
7. The number of vascular bundles in the stipe is sufficient to distinguish members of the genus *Thelypteris* from those of *Dryopteris*.
8. The stipe anatomy of members of the genus *Aspidotis* is sufficiently different from that found in the closely—related genus *Cheilanthes* to justify the separation of the genera, especially if used in conjunction with other characters.
9. Taxa of the *Restionaceae* family can be more easily identified by stem anatomy than by exomorphic characters.

PHYSIOLOGY

It is axiomatic that a knowledge of structure is essential to a full understanding of function. Experimental results may easily be mis-interpreted unless the investigator is familiar with the anatomy of the test organism. For example, the downward movement of food in the plant requires a knowledge of the type and location of the phloem. Other related areas where the plant anatomist's help is sought are: assessing immediate effects of radiation, fungal, bacterial and insect damage on various crop plants, assessing the effects of air pollutants on plants and, assessing the effects of genetic and environmental factors on tree growth, commerical flower production and in similar areas.

PAPER MAKING

When strenth is required, the long, tough tracheids of gymnosperm wood are preferred over the shorter elements of angiosperm xylem. On the other hand, wood with numerous vessels as in the angiosperms makes better blotting paper than gymnosperm wood which only has the small-lumened tracheids.

OTHER COMMERCIAL USES

The wood of different species of trees varies greatly in its structure and hence its properties and values. The presence or absence of fibers, the length and extent of the overlapping of the fibers, the fiber wall thickness, the absence or presence of large vessels, the abundance and distribution of wood rays and the presence or absence of tyloses, occluding structures in the vessels, are some of the factors determining the use to which a particular wood may be put.

The weight of wood depends upon the ratio of thick-walled cells to the air spaces or lumens within the cells. The thicker the walls, the less the air space and hence we are dealing with a dense, heavy wood. The opposite conditions make a wood light. A very light wood is balsa and because of its properties can be used for insulation and rafts.

Aside from weight, strength is a desirable characteristic in some cases. A wood with a high proportion of thick-walled fibers and/or fiber tracheids is strong. Heavy woods usually have many fibers and so are, additionally, very strong.

If a wood has large amounts of tannins, resins, or oils in its cells, the wood will resist decay better than those woods without these substances. Sequoia, chestnut and black locust are therefore durable woods whereas poplar, basswood and maple are not.

If the fibers interlock the wood has strength *and* pliability. *Ostrya* wood for this reason, can be used for tool handles. If tyloses occlude the vessels, as in some oaks, water cannot readily pass through the vessels and therefore such a wood is useful for making leak-proof containers.

In conclusion, the above examples, although not exhausting the list, go far toward confirming our belief that plant anatomy can be both interesting and rewarding.

REFERENCES

Bailey, I. W., 1951. The Use and Abuse of Anatomical Data in the Study of Phylogeny and Classification. Phytomorphology, **1**: 67-69.

Claus, Edward P., 1965. Pharmacognosy. 5 ed., Lea and Febiger. pp. 565.

Dadswell, H. E., 1941. Does a Study of Wood Anatomy Have Practical Value? J. Counc. Sci. & Industr. Res. Australia, **14**: 11-15.

Fahn, A., 1967. Plant Anatomy. New York, Pergamon Press (see preface).

Jane, Frank W., 1963. Botanical Aspects of Wood Science. Vistas in Botany, II; 1-35.

Koehler, Arthur, 1958. Technique Used in Tracing the Lindberg Kidnaping Ladder. Rept. No. D 1420, Forest Products Laboratory, Madison, Wisconsion.

Metcalfe, C. R., 1967. Some Current Problems in Systematic Anatomy. Phytomorphology, **17**: 128-132.

_____ and L. Chalk, 1950. Anatomy of the Dicotyledons. Vol. 1 (Introduction). Oxford, Clarendon Press.

Record, S. J., 1934. Role of Wood Anatomy in Taxonomy. Tropical Woods, **37**: 1-9.

Vestal, P. A., 1940. Wood Anatomy as an Aid in Classification and Phylogeny. Chronica Botanica, **6**: 53-54.