INTERCELLULAR CAVITIES IN THE RAYS OF DICOTILEDONOUS WOODS

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RESUMEN

Cavidades intercelulares en los radios de maderas de dicotiledóneas. — Una cavidad intercelular dentro de un radio se diferencia de un canal gomífero radial porque tiene relativamente corta longitud. Tales cavidades pueden ser normales o traumáticas. Ellas han sido observadas por la autora o anteriormente citadas para el leño de tallo de : *Araliaceae : Arthrophyllum diversifolium ; Compositae : Artemisia tridentata, Chrysothamnus nauseosus,* e *Hymenoclea salsola ; Malvaceae : Gossypium Armourianum, G. mexicanum, G. Morrillii, G. peruvianum* y *G. Schottii ; Myrsinaceae :* Varios géneros para los cuales no existen citas ; *Rutaceae : Citrus Limoni ; Simarubaceae : Ailanthus altissima, Klainedoxa gabonensis,* y *Odyendea ovalis.*

The term intercellular spaces as defined by the committee on nomenclature of the International Association of Wood Anatomists (1) includes not only the openings between rounded corners of cells, designated as interstitial spaces, but intercellular canals and cavities of schizogenous, lysigenous and schizo-lysigenous origin. Although the aforementioned committee defined an intercellular canal as an intercellular space of indeterminate length, it gave no definition of an intercellular cavity. However, in general histological descriptions the term intercellular cavity is generally used to designate any non-interstitial intercellular space of relatively short length. Accordingly, an intercellular cavity differs from an intercellular canal only in lacking one diameter of much greater length than its other diameters. This being the case, while many intercellular canals and cavities are easily distinguishable, any distinction

between a short canal and a long cavity must be purely arbitrary.

Intercellular canals may be either vertical or horizontal. Although vertical intercellular canals of normal or traumatic occurrence have been reported (4) in the woods of twenty-one dicotyledonous families, such canals rarely if ever involve the ray cells (Plate 1, figures 1 & 2) and hence could not be confused with intercellular cavities in the rays. On the other hand, in tangential sections and in some radial and cross sections ot woods, certain greatly elongated intercellular canals may be indistinguishable from very short intercellular cavities in the rays. These canals are of the type generally known as gum ducts (Plate 1, figures 6 & 7) which have been reported (4) within the xylem rays of certain *Amygdalaceae*, *Anacardiaceae*, *Araliaceae*, *Burseraceae*, *Crypteroniaceae*, *Euphorbiaceae*, *Guttiferae*, *Hamamelidaceae*, *Julianaceae* and *Myrtaceae*. They are distinguishable from latex tubes in rays (Plate 1, figures 3 & 4) since the latter are cells or vessels in contrast to intercellular spaces, and are usually distinguishable from radial canals resulting from the disintegration of leaf trace tissues (Plate 1, figure 5) by their greater abundance, smaller size, and the nature of their contents. Although the repeated mention (2), (3), (4) of the diagnostic value of radial intercellular canals has led to a greatly increased knowledge of their distribution in the plant kingdom, intercellular cavities in the rays of dicotyledonous woods have generally been overlooked.

In contrast to radial gum ducts which are generally of normal occurrence (3), intercellular cavities in rays are often of traumatic origin. Among the *Rutaceae*, in *Citrus* trees affected by the physiological disease described as xyloporosis (5) both intercellular cavities in hyperplastic rays and vertical intercellular canals between the rays occur in the wood. Intercellular cavities in the xylem rays of *Citrus Limoni* Osbeck are shown in Plate 2, figures 1, and 2. These sections were taken a short distance above the graft union of an Eureka lemon scion on a sour lemon stock. Among the *Simarubaceae* a condition approaching that of xyloporosis in *Citrus* was observed in the wood of *Ailanthus altissima* Swingle. In this case (Plate 2, figure 5)

a greatly swollen ray containing an intercellular cavity accompanies vertical gum ducts between the rays. In woods of other members of the *Simarubaceae,* intercellular cavities have been reported by Spiekerkoetter (7) in unusually broad rays of *Odyendea ovalis,* and by Webber (10) in rays of normal width in *Klainedoxa gabonensis* Pierre.

In addition to obviously traumatic intercellular cavities such as occur in the rays of certain Rutales, both obviously normal intercellular cavities and those which may or may not be normal are known to occur in xylem rays. Normal oblate or spheroidal intercellular cavities, which closely resemble those found in other parts of the plant, have been observed in the multiseriate xylem rays of *Gossypium mexicanum* Tod., *G. Morrillii* Cook, *G. peruvianum* Cav., *G. Schottii* Wat. (9) and *G. Armourianum* Kearney (11) (Plate 2, figures 3 & 4).

Intercellular rays of possible normal ocurrence are present in the xylem rays of some *Myrsinaceae* and *Compositae.* In the former family Record (3) reported the frequent ocurrence of lysigenous gum cysts in the rays of many of the woods, but did not mention the genera in which they occur. Among the *Compositae* the writer has observed intercellular cavities in the xylem rays of the stems of *Artemisia tridentata* Nutt. (Plate 2, figures 6 & 7), *Chrysothamnus nauseosus* (Pall) Brit. (Plate 2, figure 8), and *Hymenoclea salsola* T. & G. Similar intercellular cavities occurring in this family in the xylem rays of roots of *Anacyclus pyrethrum* and *Carlina acaulis* L., and in the root and rhizome of *Inula Helenium* L., were regarded by Solereder (6) as normal.

The possible occurrence of intercellular cavities in the rays of *Arthrophyllum diversifolium* Bl. of the *Araliaceae* is also noteworthy. Although Viguier (8) reported « poches sécrétrices » in the multiseriate rays of this species, Soleder (6) suggested the possibility of the structures in question being resin canals. Record's (4) inclusion of the genus *Arthropyllum* in his list of woods containing radial gum ducts tends to confirm Solereder's suggestion. However, the unquestioned occurrence of gum ducts in the rays of any genus or species should not be construed as evidence that intercellular cavities do not also

occur. Solereder (6) mentioned the vicarious occurrence of intercellular canals and cavities in the pith and cortex of the *Sterculiaceae* and in the pith and pericycle of the *Compositae*. Webber (11) recently called attention to intercellular spaces in the pith of certain *malvaceous* species which range in form from spherical cavities to canals. Cases of this sort suggest that further investigation may reveal a parallel situation occurring in the xylem rays of some dicotyledons.

Because of the diagnostic importance which has been attached to radial intercellular canals and the similarity, particularly in tangential sections of wood, of intercellular canals and cavities, it is hoped that this note concerning the latter will impress upon investigators the desirability of carefully determining the nature of non-interstitial intercellular spaces in rays. At present, the practice of using only tangential section to illustrate occurrence of radial canals in wood is rather widespread. While the length of a radially elongated intercellular space may be determined from a series of tangential sections, the single tangential section used for illustrative purposes can not convey any impression as to the length of the intercellular space. Although a single tangential section may be of greater value in showing other ray characteristics, a carefully chosen radial or cross section gives a much better idea of the nature of a radial intercellular space. In selecting such a section for illustrative purposes, care must be used in choosing a section taken at or near the middle of the intercellular space, for irregularities in the contour of an intercellular canal might at times make possible the obtaining of sections at its edge which would resemble a section through the middle of an intercellular cavity. While the obtaininig of a radial or cross section of this type involves considerably more work than procuring a suitable tangential section, it necessitates a study of the nature of the iutercellular space, and this should make for greater accuracy in describing woods and consequent increased diagnostic value of intercellular spaces.

In conclusion, for providing me with the wood specimens upon which this paper is based, I wish to thank Prof. Emanuel Fritz and Dr. H. J. Webber of the University of California,

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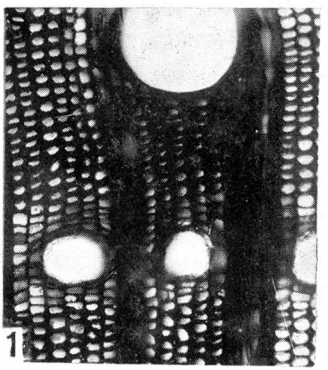
EXPLANATION OF PLATES

PLATE I

1. Cross section of the wood of *Gymnostemon zaizou* Aubrev. et Pellegr., family *Simarubaceae,* showing traumatic vertical intercellular canals between the rays. × 64.
2. Tangential section of the wood of *Simaruba amara* Aubl., family *Simarubaceae,* showing traumatic vertical intercellular canals between the rays. × 96.
3. Radial section of the wood of *Allaeanthus* sp., family *Moraceae,* showing branched latex tube within the rays. × 96.
4. Tangential section of the wood of *Allaeanthus* sp. showing latex tubes in the rays. × 96.
5. Cross section of the stem of *Ambelania laxa* Muell., family *Apocynaceae* showing large intercellular radial canal formed by disintegration of leaf trace tissues. × 7.
6. Tangential section of the wood of *Garuga littoralis* Merr., family *Burseraceae,* showing gum duct in ray. × 64.
7. Radial section of the wood of *Bursera gummifera,* family *Burseraceae,* showing gum duct in ray. × 21.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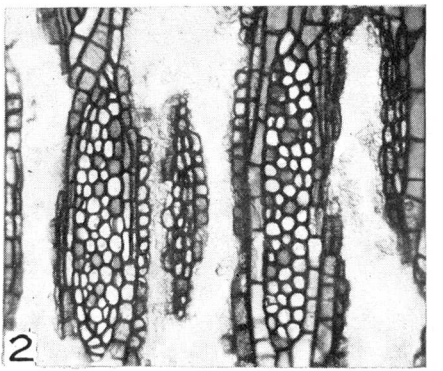
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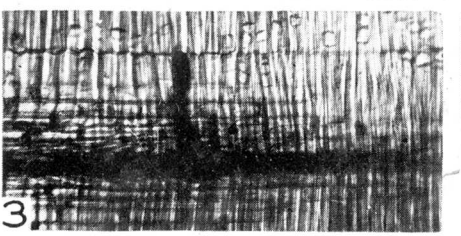
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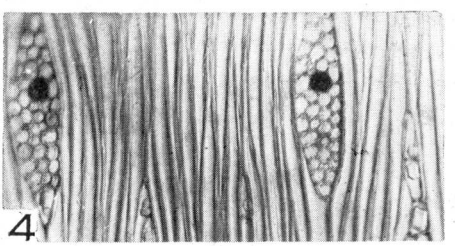
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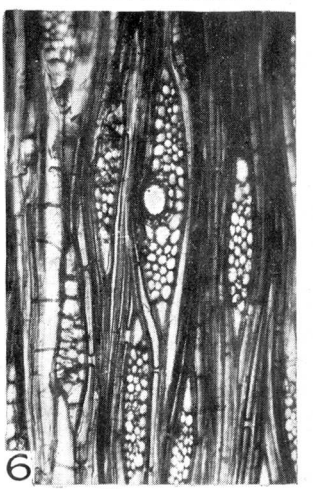
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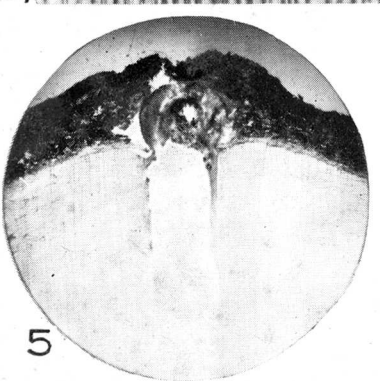
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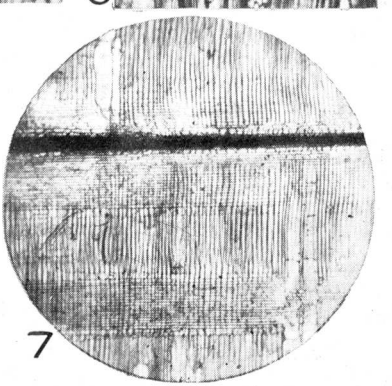
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PLATE II

Sections of dicotiledonous woods showing intercellular cavities in rays

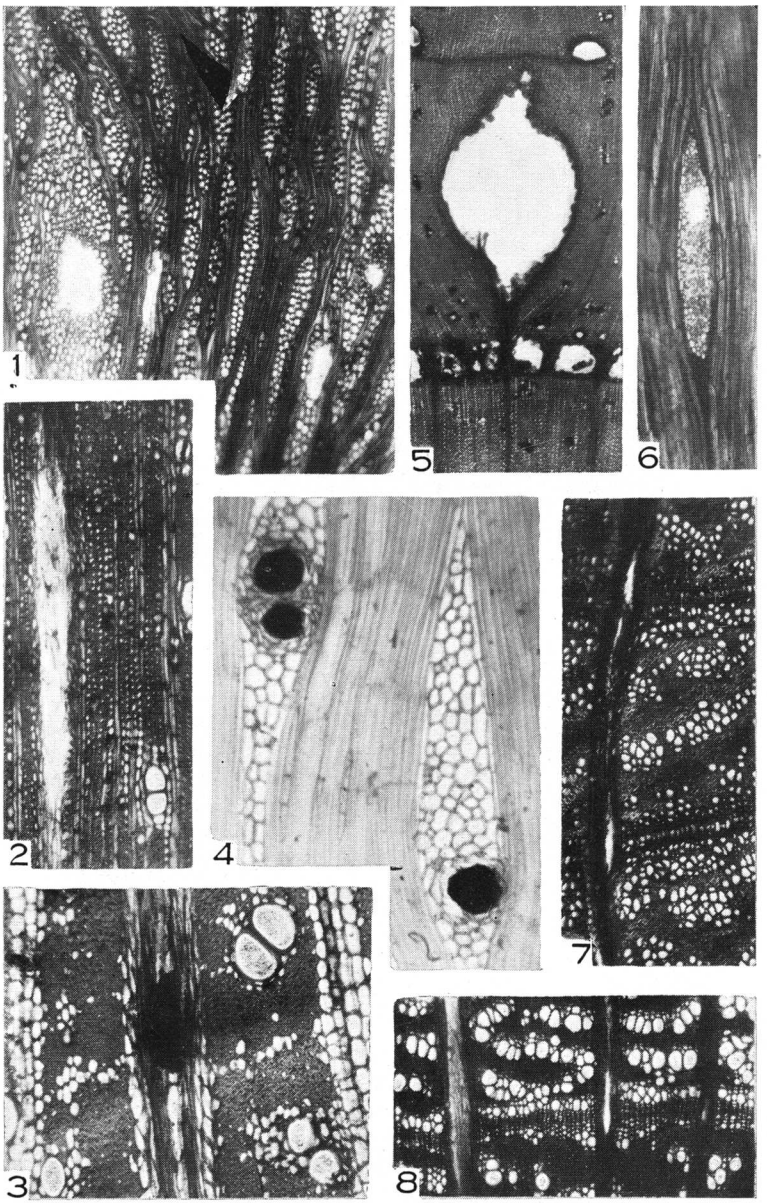
1 & 2. *Citrus Limoni* Osbeck, family *Rutaceae*. 1, Tangential section × 53 ; 2, cross section × 53-

3 & 4. *Gossypium Armourianum* Kearney, family *Malvaceae*. 3, Cross section × 80 ; 4, tangential section × 80.

5. Cross section of *Ailanthus altissima* Swingle, family *Simarubaceae*, × 17.

6 & 7. *Artemisia tridentata* Nutt., family *Compositae*. 6, Tangential section × 53 ; 7, cross section × 53.

8. Cross section of *Dhrysothamnns nauseosus* (Pall.) Brit., family *Compositae*, × 53.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