since its existence could not be explained on the basis of admixture with Negroid populations, we considered that this transferrin might either be different from those described to date or identical to transferrin D_{Chi}, recently found in Chinese natives of the province of Kwantung in southern China (*13*). It was then demonstrated by Parker (*14*) that the slow-moving transferrin found in the Yupa Indians is, in fact, electrophoretically indistinguishable from transferrin D_{Chi}.

If this finding is confirmed in future studies, it will constitute additional evidence that a racial link exists between Asiatic Mongoloids and South American Indians. Such a relationship was suggested previously by studies of physical anthropology and blood groups, especially of the Rh and Diego blood group systems (*15*).

The high percentage of Yupa Indians (58 percent) in which this slow-moving transferrin has been found places this population among the few with a noticeable frequency of aberrant transferrins (Table 2), and makes it very appropriate for genetical and biochemical studies. Of the possible mechanisms that may explain the high concentration of this transferrin in the Yupa Indians (mutations, selection, genetic drift, and endogamy), endogamy and genetic drift are probably the most important, although plans are being made to test thoroughly the possibility of a local selective agent.

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Cesium in Liriodendron and Other Woody Species: Organic Bonding Sites

Abstract. *In trees labeled with cesium-137, the isotope in the sap streams is primarily in the free ionic form. Much ionic Cs^{137} also appears to occur in intracellular fluids other than the sap streams. However, a small quantity of Cs^{137} forms ionic bonds with organic compounds (probably as salts of carboxylic acids). Even though most of the activity appears in the phloem tissue, some activity is dispersed in much of the sapwood and even in the dead xylem tissue of the heartwood. Some of this Cs^{137} is retained, at least temporarily, by the numerous carboxylic groups of the natural plant compounds of cell walls, cytoplasm of living cells, and cell debris of heartwood.*

Recent studies on mineral cycling in trees have stimulated interest in the possibility that mineral-organic bonding is related to mineral translocation (*1*). A forest on the Atomic Energy Commission Reservation at Oak Ridge National Laboratory has been used for investigating the seasonal cycling of cesium-137 in trees. Because some of the Cs^{137} appeared to be retained by woody tissue instead of being transported freely in the sap stream, the occurrence of organically bound cesium in both the sap stream and woody tissue was investigated. The possible sites at which cesium might become bound with organic compounds, and the degree to which cesium is retained by wood might well influence the rate of movement of the isotope throughout the tree and in whole ecosystems.

Stem sections (ranging from 15 to 20 cm in length and 0.6 to 2 cm in diameter) were removed from tulip poplar trees (*Liriodendron tulipifera* L.) labeled with Cs^{137} by means of a semigirdle around the base of the trunk (*1*). Each section was weighed at the time of collection and placed in geometrically controlled positions in cartons where radioactivity was determined with a scintillation counter (*2*). After counting, the sap was removed from each stem section by vacuum suction as suggested by Bollard (*3*). This was followed by vacuum suction of distilled water through the stems. The sections were weighed again and their activity determined by the same method. Finally, the stem sections were dried in an oven and reweighed.

Between 1 and 10 percent of the fresh weight of the stem sections was removed with the sap, while 10 to 20 percent of the original radioactivity was removed. The percentages of loss of both weight and activity resulting from sap extraction were inversely related to the original weight of the stem sections. These data suggest that the bulk of activity was retained in the woody tissue. Since the sap weight accounted for only about 10 percent of the loss in weight of the total moisture upon oven drying, a relatively high percentage of moisture, not removed with the sap, appears to exist. This moisture could account for much of the Cs^{137} retained by the woody tissue after sap removal.

The sap was concentrated by evaporation at 40°C and used for paper chromatography. Two solvent systems were used [71 percent phenol and butanol-acetic acid (*4*)] on Whatman No. 1 paper. Standard chromatograms also were made with Cs^{137} only. The paper chromatograms were air dried and scanned for locations of activity using a Geiger-Mueller tube.

The R_F values of the radioactive spots determined by paper chromatog-

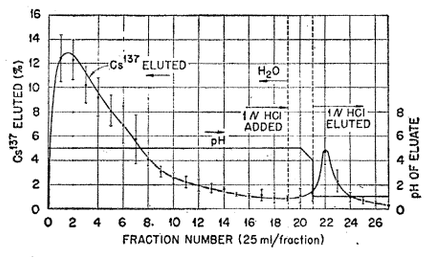

Fig. 1. Elution of Cs^{137} from columns of pulverized wood. (Means ±2 standard errors.)

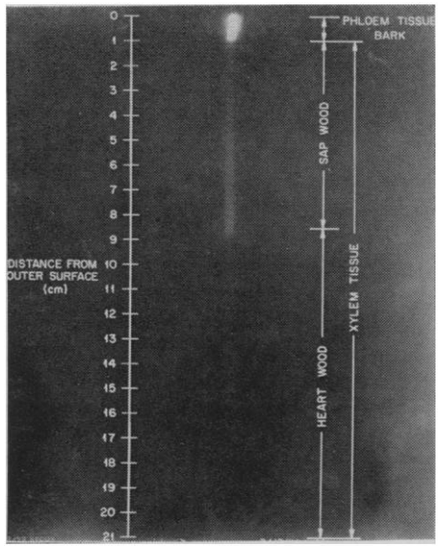

Fig. 2. Autoradiogram of core from a *Liriodendron* tree labeled with Cs^{137}. The core was taken horizontally, towards the center of the trunk.

raphy ranged from 0.65 to 0.75 with the 71 percent phenol solvent, and 0.60 to 0.70 with the butanol-acetic acid solvent. Ionic Cs^{137} yielded an R_F of 0.75 with 71 percent phenol and 0.68 with butanol-acetic acid. Only one radioactive spot was found per paper chromatogram during sap fractionation. Since the R_F values of these spots were always in the range of the R_F values for ionic Cs^{137}, and because only one active spot was found for each sap extract, the Cs^{137} in the sap appears to exist primarily in the free ionic form.

The oven-dried wood was ground to a powder with a Wiley mill. This powder was placed in glass tubes (1 cm in diameter) to form columns 15 cm long. Water was washed through the columns and collected in 25-ml fractions until a negligible amount of Cs^{137} was eluted from the wood columns as determined by counting the activity of the water fractions. Various concentrations of HCl then were washed through the columns and collected in 25-ml fractions to remove the remaining Cs^{137}; 1*N* HCl was found to be an optimum concentration for elution of Cs^{137}.

Water removed 83 to 89 percent of the total Cs^{137} remaining in the ground wood after sap removal, while 1*N* HCl was required to remove most of the residual quantity (Fig. 1). According to Noller (*5*), monovalent cationic salts of carboxylic acids are not appreciably hydrolyzed by water, while the carboxylic groups are displaced from their salts by mineral acids (HCl, for example). When the *p*H of the solvent washed through the columns dropped to *p*H 1, 70 to 80 percent of the Cs^{137} remaining after water elution was released in the first three fractions (Fig. 1).

Other columns of equal size were made with nonlabeled ground wood of various hardwood and softwood species. Twenty-five milliliters of Cs^{137} in solution with water (*p*H 5.0) (0.021 μc/ml) were washed through each column and the eluate collected at the base. All of the Cs^{137} added to these nonlabeled columns was retained by the wood.

These data suggest an ionic bonding between at least some of the Cs^{137} and any organic groups carrying a negative charge (such as carboxylic groups) and available in natural plant compounds. According to Bonner (*6*), plant compounds such as proteins, pectinic substances, polyuronide hemicelluloses, organic acids, and many others fulfill these requirements under certain conditions of *p*H.

Cores, taken horizontally and towards the center of the trunk, were obtained from trees labeled with Cs^{137}, and gross autoradiograms were made to determine the distribution of activity with respect to phloem versus xylem tissue and heartwood versus sapwood.

These autoradiograms showed that the bulk of the radioactivity is in the phloem tissue, even though some activity appears throughout the xylem tissue (Fig. 2). Also, since the Cs^{137} in the extracted sap accounted for such a small percentage of the total Cs^{137}, the bulk of the remaining activity appears to have been in the phloem, either in the sap of the sieve tubes, in the parenchyma, or in other living cells.

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Selenoamino Acids: Decrease of Radiation Damage to Amino Acids and Proteins

Abstract. *Selenomethionine and selenocystine protect amino acid and protein systems from radiation damage. Selenoamino acids are more powerful protectors than the analogous sulfur amino acids and other known —SH protectors. Free-radical scavenger and repair mechanisms by which selenoamino acids react with induced free radicals may be the key reactions in the biological function of selenium.*

The role of sulfhydryl compounds in reducing radiation damage has been extensively studied. These compounds are known to function by mechanisms (*1*) including, free radical scavenger effects, repair of damage sites, and capacity to form mixed disulfides. Electron paramagnetic resonance studies on solid amino acids, peptides, and proteins indicate that radiation-induced unpaired electrons finally localize on sulfur atoms (*2–5*). Gordy and Miyagawa (*2*) suggested that unpaired electrons can migrate through certain segments of polypeptide chains of proteins. Furthermore, Henriksen *et al.* (*5*) showed an intermolecular transfer of unpaired electrons from protein molecules to sulfur protectors. Collectively, this evidence suggests that the ideal radiation protector is a molecule which can release and accept electrons and hydrogen atoms easily without itself becoming dissociated. If this is the case, a selenoamino acid would be a better protector than the analogous sulfur amino acids because the ionization potential and bond energy of selenium compounds are smaller than that of sulfur compounds (*6*), and also because selenium is more metallic and has unique oxidation-reduction properties (*7*).

The biological function of selenium as a trace nutrient can be ascribed to