Inspection of compounds 1 through 9 in Table 1 in general shows that substitution in the benzene ring has a tendency to emphasize the bitter component in the taste. This is especially true with an electron-withdrawing group such as the nitro group. For example, 6-nitrosaccharin has a slightly sweet first taste and then an extremely bitter after-taste. Noyes (*9*) has shown that reduction of the nitro to the electron-donating amino group in 6-aminosaccharin results in a sweet-tasting compound. According to Finzi and Colonna (*2*), conversion to the 6-acetamidosaccharin gives a tasteless compound. My results with the 4-, 5-, and 7-nitrosaccharins, which are somewhat comparable, show them to be either slightly sweet or moderately bitter in taste. The 4- and 5-aminosaccharins are quite sweet and tasteless, respectively. The 4- and 5-acetamidosaccharins are tasteless.

In addition to the inductive effect of a group attached to the ring on taste, resonance may play a part in taste. The 4- and 6-nitrosaccharins, which are ortho and para, respectively, to the carbonyl group, have slightly sweet components to the taste. The 5- and 7-nitrosaccharins, which are meta to the carbonyl group, have no sweet components and show only the bitter taste. The ortho and para substituted 4- and 6-aminosaccharins are quite sweet, while the meta substituted 5-aminosaccharin is tasteless. Perhaps the resonance contributions of these groups to the relative acidity of the molecule, or to the relative ease of formation of the lactim form, is responsible for the differences in taste of the above saccharin derivatives.

Substitution in the 3-position has the same effect as substitution in the 2-position; tasteless compounds are produced (Nos. 48 to 50 in Table 1).

As previously reported (*5*), opening of the heterocyclic ring destroys the sweet (and bitter) taste (compounds not included in Table 1).

It is interesting to note that doubling the saccharin molecule results in lack of taste (Table 1, Nos. 40 to 47).

It will be noticed that many of these saccharin derivatives have a bitter taste. Indeed saccharin itself has a bitter after-taste (*10*). It then appears that the bitter taste is widespread in saccharin-like compounds. Thus, the saccharin moiety may basically possess a bitter taste component.

GLENN H. HAMOR
Pharmaceutical Chemistry Department, School of Pharmacy, University of Southern California, Los Angeles

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Recent Change in the Pattern of Tree Growth in Northern Arizona

Abstract. A significant change in growth pattern among the ponderosa pines (*Pinus ponderosa* Laws.) of the Flagstaff region, northern Arizona, occurred in 1947–1948. This is the first such change since 1904–1905. Evidence appears to verify the existence of a tension zone which fluctuates in altitude as a result of changes in the distribution and quantity of the rainfall as recorded through soil moisture.

Recent reports (*1*) of glacier advances during 1948–1949 in Washington and during 1950–1954 in British Columbia suggest the importance of a change in the pattern of tree growth at the same time in northern Arizona.

Field work in the American Southwest has revealed (*2*) three definite growth patterns associated with three rainfall or soil moisture types. A predominantly winter rainy season characterizes the Central California, or Sierra, type, and the pattern consists of growth layers which are rather uniform in thickness, single within the annual increment, and entire around the circuit of the trunk.

Under the West Texas type, rainfall occurs chiefly during the long summer season, and the West Texas pattern consists of growth layers of great variability in thickness, of much lenticularity, and of multiplicity within the annual increment.

The Northern Arizona type has a double rainy season, one in winter and one in summer, which promotes, in general, two intervals of major soil-moisture replenishment and two of depletion. The Northern Arizona pattern consists of a combination of the other two patterns: a sequence of growth layers characterized by the uniformity and simplicity of the Central California pattern alternates with a sequence characterized by the variability and complexity of the West Texas pattern.

Studies of soil moisture and rainfall, temperature, length of growing season, growth-layer anatomy (*3*), and daily growth have given strong support to two earlier concepts concerning the causes of the Northern Arizona pattern. First, the West Texas rainfall type and growth pattern apparently extend westward at low elevations, whereas the Central California type and pattern extend eastward at high elevations. At the contact in northern Arizona a tension zone is set up, and it is in this zone

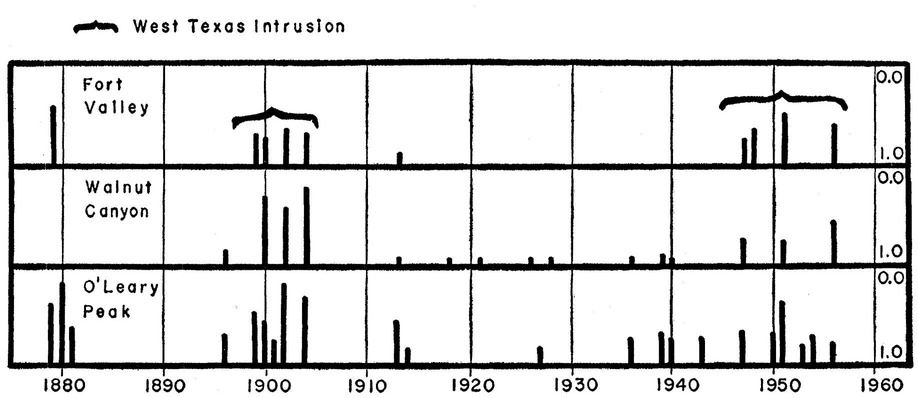

Fig. 1. Migration of the tension zone in the ponderosa pine forest of northern Arizona. Height of lines indicates degree of variability and lenticularity based on a qualitative ratio scale. The plot for Fort Valley includes 32 trees from Fort Valley high in the tension zone, 7300 to 7500 ft elevation, 6 to 7 miles southwest of the San Francisco Peaks; the plot for Walnut Canyon includes 14 trees from Walnut Canyon National Monument, low in the tension zone, 6800 to 6900 ft elevation, some 17 miles southeast of the San Francisco Peaks; and the plot for O'Leary Peak includes 41 trees near O'Leary Peak at the lowest edge of the tension zone, 7150 to 7300 ft elevation, some 6 to 7 miles northeast of the San Francisco Peaks.

that the Northern Arizona pattern exists. Second, the fluctuations of the tension zone depend upon a change in the distribution and quantity of rainfall as transmitted through soil moisture. Upward penetration of the West Texas type and downward migration of the Central California type produce the alternation of conditions yielding the Northern Arizona pattern.

The last major intrusion upward of the West Texas type and pattern ended in 1904–1905. It was realized in 1946 that the tension zone had been dominated for 40 years by the Central California pattern and that this period was one of the longest, if not the longest, during the last few centuries. A long-range program was begun: 12 permanent stations were established in the vicinity of Flagstaff and, except for 1948, increment cores were taken annually from some 70 to 90 trees. We hoped to observe actual migration of the tension zone. Later study proved that our collections span such a period of migration.

A major change in pattern apparently began in 1947–1948 among the trees in the heart of the tension zone. During the past year a thorough study of all cores has emphasized the intensity of the upward intrusion of the West Texas type. Figure 1 shows the alternation of growth patterns: West Texas, 1899–1904; Central California, 1905–1946; and West Texas, 1947–1956. In addition to variability the figure shows lenticularity, which is characteristic of the growth layers for 1899, 1900, 1902, 1904, 1947, 1951, and 1956.

The upward intrusion since 1947 of the West Texas pattern, caused by a shifting rainfall regime, appears to be a major migration and, in conjunction with glacier advances (*1*), may reveal evidence of a widespread climatic fluctuation.

Future collections will reveal whether the intrusion has ended or will continue over a span of years approaching the length and intensity of intrusions recorded during recent centuries (*4*).

WALDO S. GLOCK
SHARLENE R. AGERTER
DAVID G. SMITH*
Tree-Ring Research Laboratory, Macalester College, St. Paul, Minnesota

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4. Deep appreciation is due the Smithsonian Institution for its support during the early phases of the work from 1946 to 1953, and the National Science Foundation for its support from 1954 to the present through grants G610, 4398, and 14262. One of us (D.G.S.), as undergraduate research participant, studied the tension zone migration under NSF grant G7847. For a majority of the years, Mr. and Mrs. John Bieber of Los Angeles gave invaluable assistance throughout the field season. The cooperation of the personnel of the Rocky Mountain Forest and Range Experiment Station (Fort Valley Research Center), the Walnut Canyon National Monument, and the Coconino National Forest is most gratefully acknowledged. We are grateful to Macalester College for providing time and facilities and to the College Research Committee for funds to carry on supplementary studies.
* Present address: University of Arizona, Tucson.

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Interocular Transfer of Pattern Discrimination without Prior Binocular Experience

Abstract. Interocular transfer of a learned, differential pattern discrimination, as measured by an avoidance response, occurs in the goldfish. Since the stimuli, both during training and testing, were always presented in the lateral or caudal visual field, the parts of a retina involved could not have participated in prior, binocular experience.

There is as yet no sure answer to the perplexing problem of how the central nervous system is capable of responding appropriately to the relative configuration of a stimulus without regard to variations in its detailed, sensory characteristics. Interest in this problem continues to prompt numerous studies of interocular transfer in a wide range of species, including mammals, fish, and invertebrates (for example, see *1* and *2*). The relevance of interocular transfer for this problem area lies in the fact that when an organism learns a visual problem exclusively with one eye and then performs it, *de novo*, with the sole guidance of the other eye, the nervous system is clearly demonstrating its ability to respond correctly to a given stimulus even though the specific afferent characteristics of the related sensory input have been dramatically altered (namely, during the transfer test, the sensory input is arriving centrally by way of a different afferent pathway).

Hebb, in his scholarly effort to explain this phenomenon and related problems (*3*), suggested that early, binocular, perceptual experience is responsible for developing such binocular equivalence in the related neural centers.

The present study affords a test of Hebb's suggestion, since training and test stimuli can be presented to the fish in such a way that only monocular retina is involved in either eye.

The behavioral apparatus consisted of a clear plastic starting box and goal box of identical construction, suspended from two rails in a test aquarium. Suitable electric connections allow shock to be introduced into the water inside either box. When the positive stimulus is presented monocularly, the fish has 10 seconds to swim forward from the starting box to the goal box, thus avoiding shock. When the neutral stimulus is presented, the fish must learn to remain stationary in the starting box, or else shock is administered in the anterior goal box. After the fish moves to the goal box, either correctly or incorrectly, the starting box is lifted from the water and the goal box (with the fish inside) is slid back into the starting position. The original starting box is then placed in front of the fish where it then becomes the goal box for the next trial. The fish were trained through one eye to a criterion of nine out of ten correct trials and then immediately tested for the differential response through the opposite "naive" eye. Further details of the training and testing, as well as an illustration of the apparatus used, in a series of experiments that involved the same procedure have already been reported (*2*). Also included in this previous report is a description of a control procedure demonstrating that there are no reflections within the test aquarium that permit the contralateral eye to view the stimuli.

The two stimuli (Fig. 1) were attached to the end of separate, thin, transparent rods so that they could be presented to the fish by being gently bobbed in front of one or the other eye. Whether the stimuli were being presented to the one eye during training or the contralateral eye during the test for transfer, the patterns were always presented either in the lateral or caudolateral part of the monocular visual field. (It should be mentioned that the goldfish is not capable of making sufficiently large eye movements to enable binocular retina to be directed laterally.) In other words, the stimuli were consistently presented in a way that involved only that portion of either retina that could never have participated