WALNUT MUTANT INVESTIGATIONS

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About fifteen years ago there appeared in a nursery of Southern California Black Walnut seedlings a new and very distinct form of *Juglans*. Two of the original trees still stand where first transplanted from the seed bed. These are the type specimens which I described[1] and named *Juglans californica* var. *quercina* because of their general resemblance to a small-leaved oak. Similar seedlings have been secured from two other trees of *Juglans californica* Wats. In 1914 seedlings of this same oak-like type appeared in a nursery of the Northern California Black Walnut, *J. californica* var. *hindsii* Jepson. This is a very interesting parallel mutation because *hindsii* was originally described as a species[2] and is separated from *californica* by several distinct features. However, this occurrence of parallel mutations does not in itself necessitate any change in nomenclature other than to designate *quercina* as mutation rather than variety. Therefore I propose to designate *quercina* individuals produced from seeds of *J. californica* as *J. californica* mut. *quercina* and to similar individuals produced from *hindsii* seeds as *J. californica* var. *hindsii* mut. *quercina*.

In 1910 I discovered that many otherwise normal trees of Southern California Black Walnuts produce a second crop of flowers, from one to two months later than the first crop and that these nuts are invariably teratological.[3] However, up to 1913 all the plants produced by the teratological nuts collected resembled *J. californica*, i.e., there was no evidence that teratology was the cause of the origin of *quercina*.

In 1912 I was able to locate an apparently normal tree of *Juglans californica* Wats., which produces a small percentage of *quercina* seedlings each year and to learn that these grew from normal nuts. This tree is designated as Garden Grove No. 16. It is probably the only perennial mutating individual accessible for experimentation. That the mutation always occurs in the pistillate flowers is shown by the fact that Garden Grove No. 16 is the only tree in a row of 21 (all of which were tested in 1912) that produced *quercina* seedlings. An objection has been raised to the designation of Garden Grove No. 16 as a mutating individual. The argument advanced is based on the assumption that all new types of organisms are due to recombinations of genetic factors and hence that if Garden Grove No. 16 produces two types of seedlings it must be a hybrid. To this objection I can only reply that thus far I have been unable to discover any morphological evidence that Garden Grove No. 16 is a hybrid.

In 1913 I gathered about 350 clusters of nuts from this tree and grew each lot separately. Among them were several clusters of teratological nuts. A single *quercina* seedling appeared in each of 42 of the normal clusters while three of the teratological clusters produced two or more *quercina* seedlings in each cluster. These results indicate that, while teratology *per se* is not the cause of the mutation, yet in a tree capable of producing *quercina* seedlings the mutation occurs more frequently among teratological than among normal flowers. The fact that in all the normal clusters producing *quercina* seedlings only one mutant came from each cluster, at once raised the question as to whether a certain location of the flower in the pistillate catkin might be associated with the occurrence of the mutation. This question is not yet fully answered but it is known that at least two different locations in the catkin are associated with the mutation and hence it can be stated definitely that no certain location of the pistillate flower is exclusively associated with the occurrence of the mutation.

On account of the interesting differences in chromosome numbers found among some of the evening primroses, we have determined the number in the somatic cells of both types of seedlings produced by Garden Grove No. 16. By planting one seed in a small pot excellent root-tips for cytological study are thrust out through the hole in the pot. The chromosomes are very small and cells that show satisfactory figures for counting chromosomes are comparatively rare. However, I am satisfied that the number of chromosomes in both types of seedlings is thirty-four. If further study reveals the same number of chromosomes in both *quercina* and *californica* seedlings secured from other sources, we must conclude that the mutation producing *quercina* is not due to a change in the number of chromosomes. The chromosome numbers for *hindsii* and its *quercina* mutants have not yet been determined.

Meanwhile, efforts have been made to test the genetic relation of *quercina* to *californica* by crossing. I have eight F_1 trees of the cross *J. californica* ♀ × *J. californica* mut. *quercina* ♂, all of which resemble *J. californica*. They produced some open pollinated nuts in 1914 and among the progeny of one of these eight (08 H_1F_1P8c) there has appeared one *quercina* seedling. This indicates that at least one of the eight is a veritable hybrid and not a parthenogen as might be the case judging from the results of certain crosses with oak pollen also made in 1908. Hence it is possible that the ratios produced in future tests of this individual will throw some light on the nature of the mutation which produces *quercina*. Efforts are being made to secure self-pollinated nuts from each of these trees and in 1916 I hope to secure sesqui-hybrids from the cross *J. californica* mut. *quercina* ♀ × 08 H_1F_1P8c ♂. The completion of these breeding tests is especially desirable in view of the diverse behavior of certain of the original *quercina* trees. One of the type individuals breeds true, while a cotype individual produces both *quercina* and *californica* seedlings and another cotype individual produces nothing but *californica* seedlings.

The facts reported in this paper may be interpreted in part as meaning (1) that the mutation takes place in female flowers only and appears in the first generation after the mutation occurs but upon crossing with the species type it is completely recessive in the F_1 generation; (2) that the nature of the mutation is such that only certain genetic factors are affected without having the chromosome number disturbed.

Another walnut mutant has appeared in the form of a laciniate-leaved type of *Juglans regia*. Open pollinated nuts occasionally reproduce the new type. It is expected that self- and cross-pollinations will be made in 1916 and possibly cytological investigations.

[1] Babcock, E. B., Studies in Juglans I. Study of a New Form of *Juglans californica* Wats., *Univ. Cal. Pub. Agr. Sci.*, **2**, no. 1 (1913).

[2] Jepson, W. L., in *Bull. So. Cal. Acad. Sci.*, **7**, 23 (1908).

[3] Babcock, E. B., Studies in Juglans II. Further observations on a New Variety of *Juglans californica* Wats., and on Certain Supposed Walnut-Oak Hybrids, *Univ. Cal. Pub. Agr. Sci.*, **2**, no. 2 (1914).

HEREDITARY FRAGILITY OF BONE

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While a weakness or brittleness of the long bones may arise from a number of pathological conditions affecting the bones, yet there has been recognized for 80 years a constitutional tendency to brittle bone that runs through families in such fashion as to demonstrate the presence of an hereditary factor. To it has been given the name fragilitas ossium or osteopsathyrosis.

In a classical case of osteopsathyrosis the femur is frequently found fractured at birth, but it mends quickly and smoothly. Repeatedly in life a slight knock causes a bone of the leg or arm to break; and sometimes before puberty the individual has suffered a score or more of