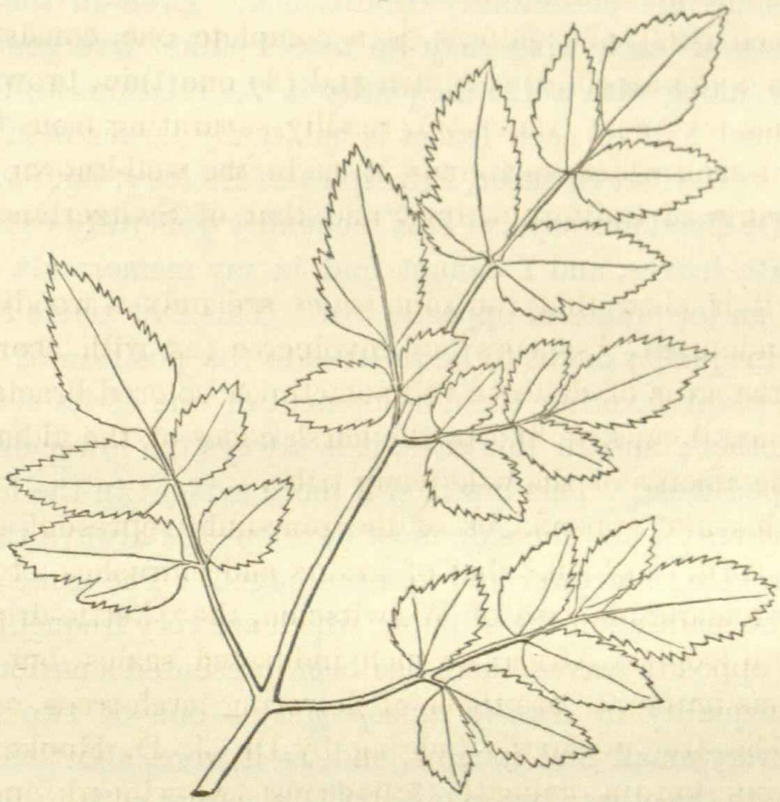
system of mutual typical affinities or correlations, to be discussed in detail in a subsequent paper.

INEQUILATERAL LEAVES.—BY PROFESSOR W. J. BEAL.

THE leaves of most plants, such as those of the white oak, sugar maple, and tulip tree are equilateral, *i. e.*, the right and left sides are of the same size and match each other, as the two sides of the

Fig. 100.



Compound leaf. After Spencer.

nose and chin, or the right hand and foot match the left. Some simple leaves and many leaflets of compound leaves show a marked

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denomination of an "endopleura", — and an "*albumen*" *besides*, which contains the embryo.

The true solitary seed-coat adhering to the pistil, the shrunken albumen will often be found lying loose inside.

The contended fruit of the well-known yew-tree contains (1) an embryo, imbedded within (2) an albumen, which is surrounded (3) by a tawny seed-coat. The latter loosely adheres to a thickish *capsule*, which is itself *covered by a thick, calycine layer!* — in the exact likeness of an acorn, a hazelnut, or the nut of the sweet gale (Myrica; the wax-myrtle or bayberry) which indeed seems to reproduce the true (*epigynous*) structure of the former on a reduced scale; as the (Composite) *Polymnia Uvedalia* or "nutted leaf-cup."

The cup of the yew-tree thus remains to be properly interpreted as a fleshy cup partly of dry scales, like those of the acorn and wax-myrtle on the one, and the succulent Euphorbia-involucres on the other hand.

want of symmetry in their lobes. The *Begonia* is often cited as an example. The hickory, bean and poison ivy, may illustrate the same thing in compound leaves. In figure 100, "The homologous parts a, b, c, d, while they are unlike one another, are, in their main proportions, severally like the parts with which they are paired. And here let us not overlook a characteristic which is less conspicuous but not less significant. Each of the lateral wings has winglets that are larger on the one side than on the other; and in each case the two sides are dissimilarly conditioned. Even in the several components of each wing may be traced alike divergence from symmetry, along with a like inequality in the relations to the rest; the proximal half of each leaflet is habitually larger than the distal half." (Herbert Spencer, Principles of Biology, fig. 65, p. 31.)

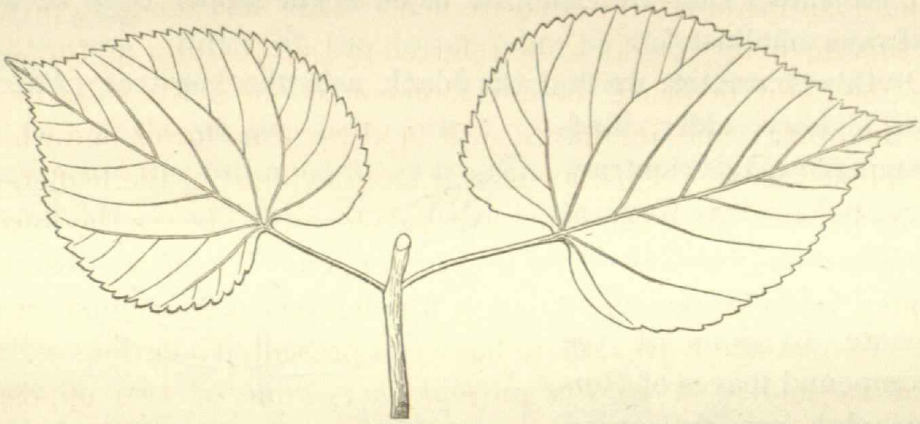
A. P. De Candolle says, "This inequality generally exists only in alternate leaves, and I cannot find in my memoranda any example of an inequilateral opposite leaf. This fact tends to prove, that this inequality ought to be referred to the position of the leaf upon the plant favoring the development of one of its sides more than the other; and in this case, it is always the lower one which is developed most. This law is still more evident in the leaflets of pinnate leaves . . . . the side most developed is always the lower, the upper being narrower and less prolonged. The same observation may be made upon the stipules, which are very frequently irregular. In opposite leaves, there has been presented a curious example of inequality in *Ruellia anisophylla;* — one of two opposite leaves is very small and narrow, and, as it were, abortive in comparison with the other; but symmetry is also met with in this irregularity, for on comparing the successive pairs, the small leaf is found alternately on both sides. Stipules [sometimes] present analogous phenomena."

Dr. Wilder has shown that "Elm leaves have the *inner* or *upper* side much larger," thus upsetting De Candolle's theory that the inequality is due to the position of the leaf upon the stem. Various other reasons have been assigned for this inequality, all of which seem to fail when applied to numerous examples in their various stages of development.

Schleiden believes that this want of symmetry is due to unequal pressure in the bud. Spencer seems in doubt about the true cause, for he says, "How far such differences are due to the positions of the parts in the bud; how far the respective spaces available for the parts when unfolded affect them; and how far the parts are rendered unlike by unlikenesses in their relations to light, it is difficult to say. Probably, these several factors operate in all varieties of proportion." He attributes the want of symmetry in the leaves of the Lime tree or basswood to the shading of the smallest lobes. That this cannot be the case is proven by an examination of the conduplicate leaves of the basswood and elm while in the bud. When less than half an inch in length, the lobes are plainly unequal. When much less than a fourth of an inch long they are nearly or quite equal lobed. Since noticing these facts, the writer was pleased to find the same views recorded by Dr. Wilder.

On the basswood, the leaves are alternate and two ranked, having the upper lobe fullest. This is the case even where the

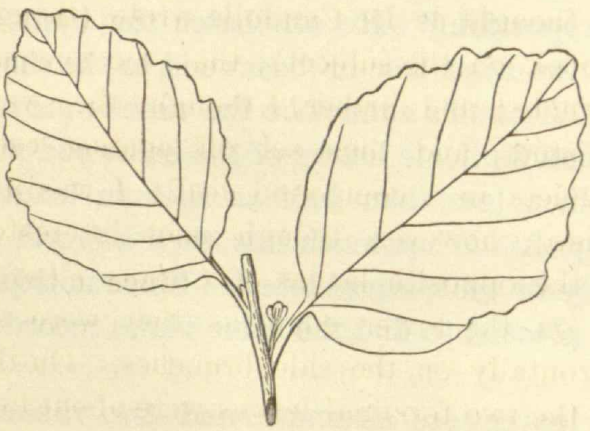
Fig. 101.



Alternate two ranked leaves of *Tilia Americana*, Basswood, fullest at the base on the inner side.

full lobe is shaded or where the whole leaf is well exposed to the light. Spencer gives an illustration showing the arrangemennt of basswood leaves, exposing nearly all their upper surface to the light. If he should turn a young branch over, of this or almost any other plant, he might be surprised to see how soon the leaves would turn back again, and how nicely they would adapt themselves to each other, economizing all the available space. The leaves of red elm and the American elm are sessile, broad at the base, two ranked with the upper lobe fullest. The same is true of the blue beech, *Carpinus Americana*, though the lobes are often equilateral. *Celtis occidentalis* has two ranked leaves with petioles half an inch long. The upper lobes of the leaves are very full when compared with those of the elm. Begonia leaves are two ranked with the upper lobe fullest, no matter whether they are nearly sessile or on petioles a foot in length. The witch hazel has two ranked leaves with a broad base on short petioles and the lower lobe much the fuller. The common beech, hazel, mulberry, and grape have two ranked, equal lobed leaves.

Fig. 102.

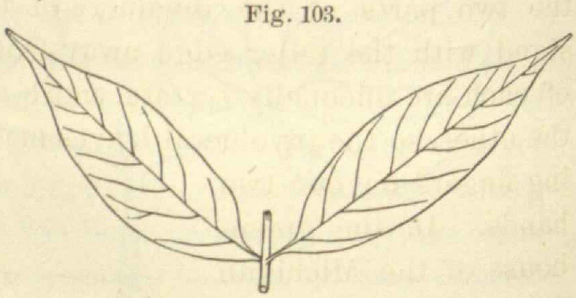


Alternate two ranked leaves of *Hamamelis Virginica*, Witch Hazel, fullest at the base on the lower side.

It is a very common thing to see a want of symmetry in the lobes of leaflets of compound leaves. The reader will remember that De Candolle says, "The upper edge of such is always smallest."

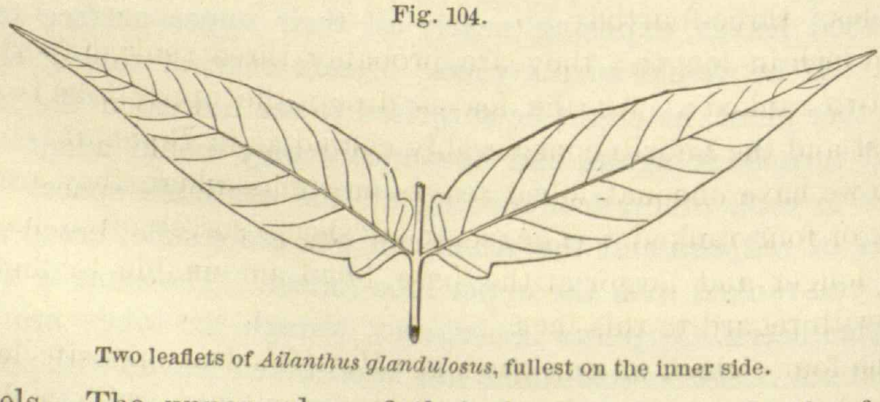
Of this character, we find the black ash, the hop-tree (*Ptelea*), bean, hickory, elder, bladder-nut (*Staphylea*), strawberry, poison ivy, fragrant sumach, and Jack in the pulpit (*Arisœma*). The ultimate divisions of the decompound leaves of Hercules club are fullest on the lower side, while the leaves of the Kentucky coffee-tree reverse the above example. The leaflets of Ailanthus are broad at the base, and raised on very short

Fig. 103.



Two leaflets of *Fraxinus sambucifolia*, Black Ash, fullest on the outer lobes.

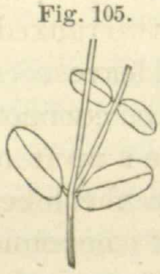
Fig. 104.



Two leaflets of *Ailanthus glandulosus*, fullest on the inner side.

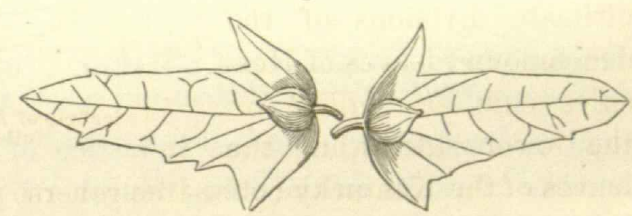
pedicels. The upper edge of their leaflets is much the fuller. Leaflets of the Southern prickly ash are fuller on the upper side, while those of the Northern prickly ash, of the same genus, are usually fuller on the lower side. *Rhus toxicodendron* has the lower edge of the side leaflets fuller; *Rhus copalina* has the upper edge fuller. For some time, I thought as De Candolle wrote (though I had not then read his book on the subject), that the unequal lobed leaves were all alternate; and further, I thought they were all two ranked along the stem, and thus set off against each other, as leaflets in a compound leaf. I was not much surprised, however, though much interested to find that the opposite leaves of *Cornus Florida* were fuller on the lower edge, as they were all turned horizontally on the side branches. On the 4th of July, the two terminal leaves were about half grown and generally equal lobed at the base, though not always so. I find the opposite leaves of several of our Euphorbias, as noticed in Gray's manual, are fuller at the lower edge as they are turned down horizontally. In a somewhat similar manner are the two parts of the involucre of *Carpinus Americana*. These stand with the fuller edge away from the axis. The two edges of each are unequally serrate, more serrate on one edge than on the other, so the involucral leaves match as well as the corresponding fingers on our two hands. In the green-house of the Michigan State Agricultural College, is a plant unknown to me, presented by Dr. Gray. The leaves are on petioles three-fourths of an inch in length; they are probably three ranked (certainly not two ranked). As the leaves droop, the upper lobe is much fullest and the midrib considerably curved as in *Begonia*.

Fig. 105.



Two opposite leaves of *Euphorbia maculata*, fullest on the lower side.

Fig. 106.



Involucre of *Carpinus Americana*. Blue Beech, the upper or inner lobe narrower which grew next the axis.

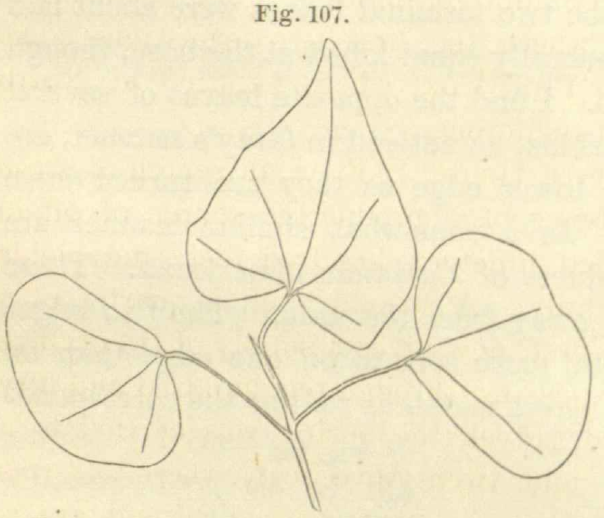
So we have unequal lobed leaves on stems where they are two, three or four ranked. The common sheep sorrel often has one lobe longer and larger at the base, but I am unable to find any rule with regard to this fact.

The four o'clock of our gardens *Mirabilis* has opposite leaves, and when of proper size, terminates each axis with a flower. The axillary bud on each side develops into a branch terminating in the same manner by a flower. Thus we have four leaves in two pairs closely sitting about a flower. As thus arranged spreading each way they are all fuller at the base on the side next the flower, where there is least light and least room. This is contrary to what we should expect according to De Candolle and Spencer. An examination of the plant for a moment will make it clear.

Every botanist is familiar with the unsymmetrical petals on the sides of the pea flower, violet, lobes of mint blossom, and those of other plants.

The strangest thing under *want of symmetry* that I have seen in plants, is found in the cotyledons of our cultivated buckwheat. While in the seed, they are pressed together, and rolled up from one edge. When the cotyledons have acquired their full growth, they have petioles about half an inch long; *each* cotyledon is fullest on its *left* side, so they would not match each other without turning one of them over. Perhaps this is a puzzle analogous to homologizing the hand and foot on the same side of the body. All our theories so far read or imagined, such as influence of heat, light, gravitation, number of ranks on the stem, length of petiole, pressure, natural selection, do not satisfactorily explain all these peculiarities.

Fig. 107.



Cotyledons of *Fagopyrum esculentum*, Buckwheat, each fullest on right lobe.

So far, we agree with Dr. Wilder, "That such peculiarities are true and original characteristics of the plants, and that they are produced by the so-called vital force acting in a definite way."

On the Oil Wells of Terre Haute, Indiana.—By Dr. T. Sterry Hunt.

In previous publications, I have endeavored to show that the source of the petroleum in southwestern Ontario, and probably in some other localities, is to be sought in the oleiferous limestones of the Corniferous and Niagara formations, both of which abound