Philippine Islands. In southern Negros, about a mile south of the little fishing village of Manjuyod, along the sides of the road to Bais, I noticed many of these butterflies; but to my surprise they were frequenting bushes whose leaves they in no way resembled. The leaves were bright green, magnolia-like, much larger than the butterflies, perfectly elliptical, glossy, turning bright orange yellow when dead, and falling to the ground. There were no brown leaves, pointed leaves, conspicuously veined or fungus-covered leaves in the neighborhood, say within a hundred rods. In this instance I could not help concluding that the dark-colored butterflies were conspicuous instead of inconspicuous, as they alighted on the *leaves* and not on the stems of the bright green bushes. And I observed the behavior of the butterflies with considerable interest at several favorable stations; their movements and flight reminded me of our Vanessas, more nearly perhaps of *Grapta;* they could be approached almost within reaching distance and could not be mistaken generically. I intended, however, to return that way and examine the shrub and collect the insects and if possible their eggs and larvæ, but by an unfortunate accident I was obliged to cut short my stay and thus miss my chance. From the behavior of the butterflies, my impression is that they were breeding then and there, and on one leaf of the shrub I noticed a patch of eggs which might well have belonged to *Kallima.* At that time my faith was strong and I was inclined to believe that the butterflies were migrating or had even for the moment become careless as to their surroundings, and I felt that had I looked further afield I might have found the leaves which were so admirably mimicked.

For the rest the question is whether it is just for the naturalist, the preparateur and *Kallima* to compound such museum preparations as we have above described, on present evidence. I for one would be glad to learn of additional observations, for, like many others, I am not able to repress a suspicion that in *some* cases (who knows in how many, even perhaps in the case of these classic butterflies?) our idea of the mimicry may be preconceived, rather than truthful. The fact that a butterfly looks strikingly like a given dead leaf is no adequate proof that it was evolved in mimicry—it must be proven a mimic in all details. Otherwise it should be kept in limbo with those creatures which to our eyes and to our eyes only suggest natural objects—such creatures as moths with skulls pictured on their backs and Taira-headed crabs.*

BASHFORD DEAN.

'ROOT-PRESSURE' IN BEGONIA (FLETCHER'S SEEDLING).

ON July 15, a vigorous *Begonia* was selected from the greenhouse plants at the Harvard botanic gardens with a view to illustrate, to the students in botany at the summer school, some of the phenomena in connection with the so-called 'root-pressure.'

The stem of the plant was cut off about three inches above the surface of the soil in the flower-pot, and a firm rubber tube was fixed to the stump and connected with a glass tube held in a vertical position. A small amount of water—about one cubic centimeter—was poured in upon the cut end of the stem. The glass tube first attached was about two and a half feet long and the diameter of the bore was three millimeters. In twenty-four hours after arranging the experiment the sap had ascended to a height of two feet one inch, and in twenty-four hours later the tube was overflowing. Another tube was then added, the connection being made with a short piece of rubber tubing.

* In the twelfth century the famous sea fight off Dannoura saw the destruction of the dominant Taira family of Japan; it is recorded that upward of twenty thousand of this clan and their adherents lost their lives; and their bodies were washed up on the neighboring beaches in wind rows. Each Buddhistic soul, however, was said to have passed into the crab, *Dorippe,* which to this day retains its imprint. The carapace bears in bas-relief a striking likeness to the face of an Oriental, and the fishermen, in 'proof' of the accuracy of the legend, point out further details in resemblance—the eyes and mouth are open, and the face is swollen, after the fashion of the drowned!

The sap rose steadily, and when the tube added was filled, another was attached in the same way, until the upper tube reached the ceiling of the room. In making attachments a break occurred at the first joint above the stem, resulting in a loss of sap down to that point. The break was repaired and the experiment continued. Another accident happened at the same joint when the sap was over six feet high, resulting in a further and more considerable loss of sap. On August 14 the sap stood nine feet ten inches high in the tube. The total amount of sap that passed through the plant into the tube was 165 c.c., taking into consideration the loss by accident, and estimating the whole tube as of uniform bore, making no allowance for the greater volume where the sap was in contact with the rubber tube. The flower-pot stood in a plate in which a little water was poured every other day. The soil in the pot was watered from time to time, so as to keep it moist, and in a condition under which the plant would most likely thrive best. It will be noticed that the plant was under these abnormal conditions thirty days, and that, so far as could be learned from the appearance on August 14, and from the fact that the sap in the tube kept rising, the plant seemed to be alive. The force that caused the ascent of sap in the tube, and that which kept the column at the height mentioned, is certainly due to some property of the living *Begonia*. A plant under similar conditions, but first killed by heating, will produce no ascent of liquid, and since it can not be produced by soil and the tubing, we must look for the causes in the living plant. This ascent is probably due to what we call 'root-pressure,' and, as root-pressure is accounted for by an osmotic pressure resulting from the sap in the cells of the roots and root hairs, the conclusion is that the sap in the tube was forced nine feet ten inches high and kept there by an osmotic pressure of the cell sap. But it can scarcely be wholly due to osmotic pressure, because the sap in the glass tube proved to be a solution too dilute, and this in the tube must be more concentrated osmotically than that in the roots, in order that sap may be transferred from cell up through the plant. When we say too dilute we are estimating concentration and pressure from van't Hoff's law relating to substances in solution.

This ascent of sap in the *Begonia*—a plant about fourteen inches high—is an illustration, to some extent, of the tension to which the cells of plants are subjected in the normal condition of life. If there be a pressure in the plant equal to a column of water nine and three fourths feet high, and the plant be only fourteen inches high, the cell tension in the top leaves would be a pressure of eight feet at least.

Reasoning from this condition of affairs in this plant, it may be that—if the turgor in the leaves of tall trees is as great as that in the *Begonia*—the forces have to be sufficient to sustain a column of water eight feet higher than the top leaves of the plant. Moreover, in view of experiments of Morse and Frazer,* plant sap may exert an osmotic pressure far in excess of that which it would have, according to van't Hoff's law: 'The osmotic pressure of a sugar solution has the same value as the pressure that the sugar would exercise if it were contained as a gas in the same volume as is occupied by the solution.' Morse and Frazer have shown that a normal solution of cane sugar exerts a pressure of 31.5 atmospheres at least. They estimate that the pressure could not be less than 33 atmospheres, their cell having been shattered at a pressure of 31.5.

Now, according to van't Hoff's law, a normal solution of cane sugar should exert a pressure of not more than 23 atmospheres, unless sugar dissociates; but, as far as is known, sugar does not dissociate in aqueous solutions. The results of Morse and Frazer present to the botanist some very striking suggestions, and it may throw some light upon the ascent of the *Begonia* sap in the glass tube in our experiment.

That there is some force beyond that indicated in van't Hoff's law seems evident, from Morse and Frazer's experiment. Osmotic pressure, according to this law, does not ac-

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count for 33 atmospheres pressure in a normal solution of cane sugar, nor does it, in our opinion, account for the ascent of sap in the tube attached to the *Begonia*.

Van't Hoff's law is based upon Pfeffer's researches, and Pfeffer states: 'The same pressure (22.4 atmospheres) must be exerted by a solution of 342 grams of cane sugar in one liter of water;' and further: 'Hence it follows that osmotic values may be calculated directly with perfect safety and accuracy.' It is certain that, if Morse and Frazer's results are reliable, Pfeffer's osmotic conclusions and van't Hoff's theory collapse, and the true osmotic pressures are not yet known.

The experiment with the *Begonia* plant, in the light of the results of Morse and Frazer, leads one to suppose that the actual osmotic pressure—or that force producing pressure—is far in excess of that indicated in van't Hoff's law.

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October 30, 1902.

THE GRAND GULF FORMATION.

THE classification of the formations of the gulf coastal plain more recent than the Vicksburg Limestone, has long presented difficulties to the geologist.

One of the most important of these formations, as regards at least extent of surface outcrop, is the Grand Gulf, classed as Eocene by Dr. Hilgard and by Mr. Kennedy of the Texas Survey; as Oligocene by Mr. Gilbert Harris and Miss Maury; as Miocene by the Alabama Geological Survey ('Coastal Plain Report'). Dr. Wm. H. Hall, who has published much concerning the formation, has at different times referred it to the Eocene, the Oligocene and the Miocene.

These classifications, in the absence of characteristic fossils, have been based largely, if not solely, on the stratigraphical position of the beds, heretofore supposed to be unconformably overlying, and chronologically next succeeding the Vicksburg Limestone, and many sections have been published showing these beds and the Vicksburg Limestone in immediate contact.

Our observations made during the past summer, of the surface distribution of the Grand Gulf beds in Washington, Mobile, Baldwin, Escambia and Covington Counties; an interpretation, in the light of these observations, of some sections recorded in the 'Coastal Plain Report'; and our identifications of some shells brought up from borings recently made at the Bascom Well near Mobile, and at Alabama Port in the southeastern part of Mobile County will, it is believed, help to clear up some of the obscurities which have heretofore beclouded the classification of the coastal plain formations of the Gulf States.

1. From Healing Springs in Washington County southward to within three miles of the coast near Bayou La Batre in Mobile County, the surface formations are Lafayette sands and pebbles, resting *directly* on Grand Gulf mottled clays, overlying cross-bedded sands of the same formation. Along bay, river and gulf margins the more recent Port Hudson strata occur.

2. In Baldwin County, from its northern border down to the Gulf coast, a distance of seventy miles or more, the surface is in like manner formed by the Grand Gulf beds with overlying mantle of Lafayette.

Southward of the line of the L. & N. railroad, this county is a high plateau, 200 feet above tide near the line of the railroad, declining to 75 feet or more on Perdido Bay; with surface, away from the immediate vicinity of the streams and bays, almost perfectly flat, but for the slight sinks or depressions of the hundreds of ponds and savannas which characterize the Grand Gulf in the lower parts of the two coast counties of Alabama, and contiguous parts of Florida. The original plain in Baldwin has been far less modified by erosion than that of Mobile.

The high land in places extends to the water's edge, terminating in high bluffs along Mobile Bay from Daphne down below Montrose, and along Perdido Bay from above Suarez's landing down to Soldier Creek.

These bluffs, 75 feet and upwards sheer height, show in most characteristic exposures the thin capping of Lafayette resting on the clays and cross-beds sands of the Grand Gulf.

3. While in most cases the Grand Gulf along