surpassed. What our impression of Sitka might have been had we had the use of a launch for dredging can only be inferred; from the nature of the littoral fauna and from the pelagic forms it seems as though we might have found great richness at depths from five to twenty fathoms.

Owing to our limited resources for collecting at Sitka, and to the desire to get back to Puget Sound in time for embryological investigations, we decided to return to Port Townsend at the end of three weeks. Here we were met by an unforeseen difficulty. It was in the very midst of the tourist season, and in addition to the usual tourists many Christian Endeavorers had taken the opportunity to visit Alaska. The result was that the regular boats were overcrowded, and our only chance of getting away at the time desired was on some steamer coming north with miners and returning light. Such a chance was offered by the 'Mexico,' an extra boat put on to meet the rush to the Klondike. The 'Mexico' arrived at Sitka August 3d, after leaving about 300 miners at Skaguay and Dyea, and, as anticipated, she was practically empty for the return trip.

The captain of the 'Mexico,' who had lost time on the trip north, wanted to save time on the return trip, and decided to take the outside passage from Sitka, thereby saving sixteen hours on the usual time of the inside passage. It was the intention at first to enter the inside passage north of Mary Island, but later it was decided to run down to Dixon Entrance before leaving the open Pacific. We reached the entrance about midnight, but a light fog had settled, and for some hours the pilot caused the vessel to beat around at half speed or else to lie quiet. The water was too deep to anchor, and the effect of the strong currents on the vessel's course was not properly reckoned, for at four o'clock in the morning of August 5th the order was given to go ahead at full speed, and twenty minutes later the 'Mexico' crashed into West Devil Rock, a charted rock some distance (3–7 miles) out of the regular course. The hole made in the bottom of the vessel was beyond question of repair, and at 6.30 a. m. she sank out of sight in 500 feet of water.

After eighteen or twenty hours in the open boats the passengers were landed at the Indian village of New Metlahkatlah, where they were taken care of by the Indians and their chief, Father Duncan, until the 'Topeka' called for them, two days later, and carried them back to Puget Sound. Nothing was saved but the hand baggage; most of the instruments and all of our scientific material, reagents, notes, books and theses, representing not alone the summer's work, but unfortunately also much work of the previous year, now lie at the bottom of Dixon Entrance.

Without reagents and instruments and feeling more or less upset by the shock of the wreck, the entire party found it difficult to settle down again for work. A few dredging trips, however, enabled Mr. Harrington to renew his supply of *Entoconcha*, while turbellaria, molluscs and some cœlenterates were found in full maturity. The party soon broke up, and the material collected at Port Townsend and Port Orchard alone represents the work of the expedition of 1897.

Gary N. Calkins.

*MIMICRY IN BUTTERFLIES OF THE GENUS HYPOLIMNAS AND ITS BEARING ON OLDER AND MORE RECENT THEORIES OF MIMICRY.**

The theory of mimicry suggested by H. W. Bates, in 1862, explained the superficial resemblance of a rare to a common species in the same locality by supposing that the latter possessed some special means of defence (such as unpleasant taste, smell, etc.),

* Abstract of a paper presented by E. B. Poulton before the Section of Zoology of the American Association for the Advancement of Science.

and that the former, without the special defence, was mistaken by enemies for the latter, and thus escaped a considerable amount of persecution. The relation may be compared to that existing between a successful well-known firm and another small unscrupulous one which lives upon its reputation. On the other hand, Bates thoroughly recognized the existance of resemblances between the specially defended forms themselves. These he could not explain by his theory of mimicry, and suggested that they were a result of the influence of locality. Many years later Fritz Müller satisfactorily explained this difficulty by suggesting that a common type of appearance simplified the education of enemies and thus was the means of saving life. The lives of many individuals must be sacrificed before enemies have learned to recognize and to avoid the colors and patterns which indicate some special means of defence, and the fewer such patterns in any locality the smaller the sacrifice. The relation may be compared to that between two successful firms which combine to use a common advertisement.

This latter theory, although received rather coldly at first, has gradually made way, and seems now likely to occupy a good deal of the ground formerly believed to be covered by the former theory. Thus, Dr. F. A. Dixey, of Oxford, has recently shown that South American *Heliconinæ* are affected by the color of certain *Pierinæ* which have hitherto been looked upon as true Batesian mimics of the former.

The Old World Nymphaline genus *Hypolimnas* has been regarded as one of the best examples of mimicry, but an unbiased examination leads to the opinion that it affords a case of Müllerian rather than Batesian resemblance.

In India the female of the common species *H. bolina* resembles *Euplœa Core*, while the male is a dark butterfly with a large white spot shot with blue on each of the four wings. Throughout the Malay Archipelago representative species occur with males like that of *H. bolina* and females resembling the local *Euplœas*. Occasionally, as in Ké Island and the Solomons, species of the genus occur in which the male as well as the female resembles a *Euplœa*. In Fiji the male is as in the Indian species, while the female is extremely variable, ranging from forms like the male through intermediate varieties to brown and straw-colored individuals. The *Euplœas* of Fiji are not sufficiently known, but it is very improbable that all the forms of the female *Hypolimnas* are mimetic. A still more instructive case is that of the *nerina* form of female found, with a male like that of *H. bolina*, in Australia, Celebes, New Guinea and other East Indian islands and in many of the Polynesian groups. This conspicuous and abundant butterfly has, in addition to the four white-and-blue spots of the male, a large reddish brown patch upon each forewing. This well-marked form resembles no other butterfly except the *Danais chianippe* of Celebes, and, as this latter appears to be very rare, it is far more probable that the resemblance has come from the other side, and that the *Danais* has approached the *Hypolimnas*.

In Africa the subgenus *Euralia* is represented by several species which resemble in both sexes species of the Ethiopian Danaine genus *Amauris*.

Finally, there is a well-known and widespread *Hypolimnas misippus*, which accompanies *Limnas chrysippus* throughout its range; while the female of the former resembles the latter very closely. In this case it is certain that we have to do with no struggling, hard-pressed form, for the *Hypolimnas* has recently established itself in some of the West India Islands and in Demerara —localities in which its model, *L. chrysippus*, is as yet unknown.

To sum up, the genus *Hypolimnas* is distinguished among Nymphaline genera for the extent to which its numerous and widespread species resemble the local distasteful forms of Euploeinæ or Danainæ.

Upon the older theory of Bates this would be explained by supposing that the genus is very hard-pressed in the struggle, and has thus been driven to mimicry almost everywhere. Upon the newer Müllerian theory it is supposed that the genus is distinguished among Nymphaline genera by some special defense, probably in the way of taste or smell or indigestibility, and that it has been to its advantage to adopt the advertisement of still better known and probably still more distasteful forms in its locality.

The abundance of the various species, the conspicuous *nerina* form of female, and the resemblance of a rare Danaid to it, the recent spread of *H. misippus* beyond the limits of its model, all support this latter interpretation.

NOTES ON ENGINEERING.

THE cost of power in New England cotton mills has been, of late, the subject of some discussion in technical and lay journals. The lowest cost yet reported, with one exception, is that given by Mr. Sheldon for the case of a mill which, paying $1.76 per ton for coal, obtained the horse-power for a total cost per annum, including all items on the treasurer's books, interest, depreciation, taxes, etc., of $11.64.

This figure was challenged and compared with the items generally given for other classes of engine which are usually two or three times as great and often much more. But the latest report comes from the Warren Steam Cotton Mill, where an engine of 1,950 horse-power, a cross-compound condensing machine, with cylinders 32 and 68 inches diameter and of five-feet stroke of piston, making 74 revolutions per minute, steam at 155 pounds at the boiler, supplies power at the cost of 1.35 pounds of coal per horse-power hour. The engine was designed by Edwin Reynolds, the boilers built by the Heine Company. The following are the figures certified to Dr. Thurston by the treasurer of the mill. The engine replaces a quadruple-expansion engine, destroyed by fire, after seven years of excellent service. The change illustrates the fact that the cost of the higher grade of machine may more than compensate its exceptional economy; a fact which has only in late years come to be recognized.

In the following table of the costs of the new engine the figures come from the treasurer's books. Coal costs $2.26 per ton, and in the account includes all costs of all steam used for all purposes, including banked fires, nights and Sundays, and that supplied the mill.

The following is a tabulated statement of the cost of power:

Fuel per horse-power per year of 3,070 hours	$ 4 70
Labor	1 88
Supplies and repairs	42
Total operating expenses	$ 7 00
Interest at 5 per cent	$ 2 05
Depreciation, at 5 per cent	2 05
Taxes	41
Insurance	04
Fixed charges	$ 4 55
Totals cost of power per year	$11 55

According to the Providence (R. I.) *Journal:* "This is lower than anything yet found. It is due to the large size of plant, which reduces the labor and supply account per horse-power, and to low cost of fuel and insurance and low cost of plant, on account of its size. The cost of plant includes a Green economizer, chimney, boiler-house, engine-house and foundations—all first class—and water-tube boilers, whose depreciation ought not to be over 2½ per cent. If steam used for other purposes than power were deducted, it would reduce the fuel 10 per