SCIENCE

NEW YORK, JUNE 10, 1892.

DIRECT REFLECTING POLARISCOPES.

POLARIZATION by reflection is more perfect than by transmission through thin plates, unless a large number of plates are used, and in that case there is difficulty in finding plates free from color. The disadvantages of reflection are (1) the "elbow" angle and (2) the impossibility of rotation of the polarized beam. Both these objections are overcome in the forms here described, which may be attached to the lantern by a sliding collar and rotated almost as easily as a Nicol.

In Fig. 1, *p* is a bundle of thin glass plates, set at the polarizing angle; *m* is a silvered mirror. Either the reflected

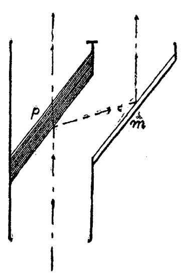

FIG. 1.

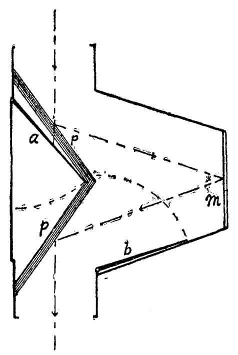

FIG. 3.

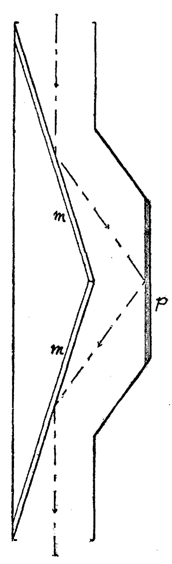

FIG. 2.

or the transmitted beam may be used; or, if the mirror is slightly movable, the two images may be thrown either side by side or superposed upon the screen.

In Fig. 2 the bundle of plates, *p*, has a black backing, and there are two silvered mirrors, *m*, *m*. The reflected beam only is used.

The form shown in Fig. 3 is more complicated and clumsy in appearance, but it has the advantage of keeping either the reflected or the transmitted beam, or both, in the axis of rotation. *a* and *b* are movable blackened screens.

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PROFESSOR A. S. HARDY of Dartmouth, who has been spoken of for president of the college, has decided to leave Hanover and take a new professorship at West Point.

NOTES ON THE FERTILITY OF PHYSA HETEROSTROPHA SAY.[1]

ON the 8th of March, 1886, I collected from a marsh near Wake Forest two specimens of Physa heterostropha Say. On the 16th three thick nidamenta, of some forty eggs each, were seen loosely attached to the walls of the glass aquarium. A few days later four others had been deposited. Up to June 15 the aquarium was examined at intervals nearly every day. After that date it was not seen again until July 12, when the water was changed. The next day both the snails were dead, probably as the result of the change of water.

In the period of four months — say March 12 to July 12 — the pair produced 43 nidamenta, which contained, on an estimate certainly not too high, an average of 30 eggs each, so that the number of their offspring for the period mentioned amounted to 1,290. There was no well-marked decline of the reproductive function toward the close of the period, which is perhaps another indication that they came to their death by violence.

From March 31 to June 6 inclusive, the pair were observed in coitu as many as fifteen times, at hours ranging from 8.30 A.M. to 6.15 P.M., the coitus lasting sometimes but twenty minutes, sometimes more than an hour. The male function was performed alternately by the two snails. The eggs appear to have been laid only during the night.

It was important to determine, if possible, the age at which sexual maturity is attained and reproduction begins. Accordingly, on the 12th of July I took out of the aquarium two of the largest of the young snails and put them into another aquarium. They were presumably members of the first brood, the eggs of which were deposited near March 13. Their age, reckoning from the time they were hatched, was about 3½ months; size, length of shell, 5 millimetres; length of foot, 6 millimetres. In two days one of the snails was dead. On the 25th of July another snail of about the same size was introduced from the first aquarium. The next entry in my notes is under date of Sept. 11, when six nidamenta were observed attached to the fibrous roots of a water plant. They were, however, small, containing only from one to four eggs each, showing that the reproductive function at that age was feeble. Some of the eggs were already hatched, and the tiny grandchildren of my first Physas were going about the aquarium in search of food. Allowing, say, fifteen days for the intracapsular development of these snails of the third generation, I estimate that the isolated pair of the second generation attained sexual maturity at five months of age. The same day — Sept. 11 — in the first aquarium I noticed a confirmation of my observation in the second, namely, the pairing of two of the oldest brood.

The maintenance of a species depends on the equilibrium between the forces tending to its destruction and those tending to its preservation. We may enbrace the former under the general phrase, adverse external conditions. There are two different ways in which the destructive tendency of these adverse external conditions is opposed. The first is by adap-

[1] Abstract of a paper read before the Elisha Mitchell Scientific Society in session at Wake Forest, . ., Oct. 23, 1891.

tations of structure and habit. The second is by the production of new individuals to take the place of those that have been overcome. Now, as different animals exhibit varying degrees of ability to adjust themselves to their environment, so also their reproductive power may be small or great. In estimating this reproductive power four factors, as Herbert Spencer points out,[1] are to be taken account of, namely, (1) the age at which reproduction commences, (2) the frequency with which broods are produced, (3) the number contained in each brood, and (4) the length of time during which the bringing forth of broods continues.

Accordingly, for the special case of Physa heterostropha we have the following results: —

1. Age at which reproduction begins, 5 months.
2. Frequency of broods, 1 in about $2\frac{7}{10}$ days.
3. Number in each brood, 30 average.
4. Reproductive period, 4 months, March to July.

Some addition ought to be made to this actually observed period, inasmuch as the snails had certainly already entered upon it at the time of their capture, and, further, instead of closing normally, it seems to have been violently interrupted. Just how much the period of reproduction is to be extended I have no means of determining, unless the fact that the young snails of the first brood were observed reproducing themselves in September warrants an extension of at least two months, making it six months instead of four.

Assuming, then, that the reproductive season extends from March to September, and assuming, further, somewhat arbitrarily, that the snail lives but two years, we have, on the basis of facts above mentioned, the following estimate of the total number of the offspring of a single pair: —

At close of first season	1.900
950 pairs at close of second season	1,805,000
Original pair at close of second season	1,900
Total number of offspring in two years	1,808,800

W. L. POTEAT.

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NEBRASKA SUGAR SCHOOL.

PROFESSOR LLOYD has just made the first formal report of the sugar school at the State university, Lincoln, Neb., of which the following is a summary: The school opened on Jan. 5 with an enrollment of twenty-five students. These students were mostly members of other classes in the chemical department of the university; the only preparation required for entrance being a clear conception of the principles of elementary chemistry, such as may be obtained in some of the high schools of Nebraska.

The course consisted of two lectures a week, with five hours of laboratory work. The lectures as given by Mr. Lyon embraced the following subjects: 1. Chemistry of the sugars; 2. technology of beet-sugar manufacture; 3. culture of the sugar beet.

The lectures under the first head were designed to give the students an idea of the position of sugars as a class in the series of compounds of carbon, and their relation to others of these compounds, together with a knowledge of the properties and characteristics of each of the sugars.

The cause and effects of fermentation upon sugar solutions were carefully studied. Other important principles relating to the manufacture of sugar, as the compounds of the sugars with lime, melassigenic action, etc., were taken up in order to prepare the student for the complete understanding of the practical application of these principles in sugar factories.

A discussion of the methods of the analysis used in the laboratory was given from time to time throughout the course.

Under the second head of lectures, the various processes that the beets, juice, and sugars undergo from the washers to the granulator were studied in detail. Both the French and German forms of machinery were described. As each process was studied, the methods of the analysis of its products and by-products was referred to. The study of sugar-house control was in this way presented to the student.

During the latter part of the winter term, Professor DeWitt B. Brace gave the class four valuable lectures on the theory of light. His lectures included the following subjects: 1. The wave theory of light; 2. polarization of light; 3. rotation of the plane of polarization; 4. application of these principles to the polariscope and to the different forms of saccharimeters.

The lectures were finely illustrated by means of the apparatus in possession of the physical laboratory. This course in the physics of light was followed by lectures in the chemical department on the use of the saccharimeter, methods of setting prisms to obtain a clear field, adjustment of the compensating wedges, methods for testing the accuracy of instruments.

The laboratory work of the course consisted in analyses of the various products and by-products of the sugar factory. The samples used were obtained from the Norfolk sugar factory during the last campaign. One of the students did some advance work in the absorption of sucrose by bone black and the volume of the lead precipitates.

The spring term was devoted to a course of lectures on the culture of the beet. This course embraced the following topics:

1. Origin and history of the beet.
2. External characteristics of a good sugar beet, its roots and foliage.
3. Composition and structure of the root.
4. Relation of the leaves to the root.
5. Food of the plant.
6. Relation of the plant to the atmosphere and to the soil.
7. Conditions governing the growth of the plant, and changes during vegetation.
8. Fertilizers, preparation of the soil, planting, cultivating, thinning, etc.
9. Production and improvement of the seed.

These lectures were supplemented by practical work at the station farm, which may be continued throughout the summer at the option of the student. The course closed May 6.

Encouraged by this prosperous beginning of the first beet-sugar school in the United States, it is hoped that in the coming year the work may be greatly extended. Several students who have taken the course outlined are thoroughly prepared to do polariscopic work in sugar factories.

SECONDARY BATTERIES.[2]

WHEN a lead-peroxide cell is discharged, sulphate of lead is the ultimate product on both plates, and when it is charged again this lead sulphate is oxidated on one plate and reduced on the other. This fact was published in 1882 by Dr. J. H. Gladstone and the late Mr. Tribe in *Nature*. Taken by itself, however, it does not explain how it is that during charge the potential difference of a cell will rise rapidly from 2.1 volts to 2.13 volts, then slowly to 2.2 volts, and

[1] Biology, Vol. II., p. 395.

[2] From Engineering of May 20.