incubator, operated side down, to be further incubated for six to twelve hours.

For demonstrating the membranes, the shell is broken at the air sac and the entire egg immersed in a suitable dish of cold water. Enough of the shell is then removed to allow the contents to gravitate free into the dish. With a reasonable amount of care this may be accomplished without injury to either the yolk or allantoic membranes. Small tears in the stained allantois will not damage the preparation and dye escaping from the allantoic cavity may be washed away.

After the intact egg membranes have been viewed by the students the allantois is grasped about a quarter of an inch from its edge by means of smooth forceps and slightly tensed to bring into view the chorionic membrane as it stretches across from the allantoic sac to the yolk sac. With small scissors the chorion is cut along the edge of the allantoic sac without injury to other membranes. This allows the allantois to float free, except for attachments at its stalk and sero-amniotic connection, both of which are plainly seen. The freeing of the allantoic sac brings to view the vitally stained[2] embryo surrounded by the amniotic sac resting on the yolk sac. The amniotic fluid is clear. While the embryo is alive filter paper tests are negative for traces of the dye in this fluid. The yellow colored yolk sac, the slate blue embryo in the clear amniotic fluid and the intensely stained allantois give a very beautiful and complete picture of the development and relations of the membranes.

If it is desired to preserve these demonstrations, a piece of glass suitable for mounting in a specimen jar should be placed in the bottom of the dish prior to removing the egg from its shell. The egg contents are oriented upon it and the water replaced with a solution of 10 per cent. formalin and 1 per cent. HCl; fixing for twenty-four hours. The albumen hardens and sticks to the glass, after which the preparation may be mounted in a solution of 4 per cent. formalin and 1 per cent. HCl.

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[2] The capricious staining of the embryo by absorption of the dye from the allantoic fluid is still under investigation.

DEMONSTRATING THE ASKENASY EXPERIMENT

AT the Kansas City meeting of the association a method of repeating the Askenasy experiment to show the raising of a column of mercury by evaporation from a water film as a classroom demonstration was described by Dr. B. E. Livingston. A similar method which has given superior results had been used for four years by me to demonstrate this principle to the classes in plant physiology at the University of Pennsylvania. The important requirements for success are:

(1) To boil the porous porcelain cylinder for several hours to remove all air.
(2) A perfectly clean glass tube which is filled with boiled water.
(3) A tightly seated rubber stopper.
(4) Clean mercury.

The glass tube is filled with boiled water by suction and it is attached to the clay cylinder while the latter is in the cooled boiled water. The water is held in the glass tube by closing with a clamp a piece of rubber tubing previously placed on the upper end (*i. e.,* before inversion) of the glass tubing.

Rises of over ten inches have been secured in an hour. The greatest total height recorded was twenty-eight inches after fifteen hours. A rise of twenty inches in several hours was not unusual when conditions favored rapid evaporation.

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SPECIAL ARTICLES

DEWBOWS BY MOONLIGHT

DEWBOWS formed at night when light from a street lamp fell on small fog particles which had settled to the ground and retained their spherical form were observed by Knott and Lundie.[1] When the source of light was a gas lamp the bow was white, but when a more powerful electric lamp was used the rainbow tints were observed. The bows changed shape when either the horizontal distance from the observer to the source of light or the elevation of the observer's eye above the ground was changed, because the light from the lamp was divergent.

Maxwell[2] described a bow, seen at noon on an ice surface. This bow he attributed to water drops resting on the ice surface. Colors were present.

A. E. Heath[3] described a bow in the shape of a hyperbola produced by the sunlight on dew. This dew had settled on gossamer which covered a cricket field.

Several times during the past year, the writer has observed on the campus of the Rice Institute dewbows which differ from those described in the literature in that they were formed by moonlight shining on dew on a grassy surface. When the bows were seen the moon was always shining brightly from a position well above the horizon and the grass was wet with

[1] Proc. Roy Soc., Edinburgh, 1898.
[2] Proc. Roy. Soc., Edinburgh, 1870.
[3] *Nature,* 97, p. 5, 1916.

freshly formed dew. If the dew had been formed for more than a few hours no bows were seen, very probably because the increased size and weight of the drops caused an appreciable departure from perfect sphericity. The idea that it was necessary for the drops to be small was borne out by an observation made at 2 A. M., November 27. At this time a light shower had covered the grass with fairly large drops, which were by no means perfectly round. When the clouds had cleared away and the moonlight was very bright no indication of a bow could be seen.

The dewbows appeared as faintly defined streaks of white light tracing ellipses in the grass. The size and shape of the ellipses depended upon the angle of incidence of the moonbeams and the height of the observer's eye above the ground. The bow moved with the observer and different observers saw different bows.

We can calculate the size and shape a bow should have if it is formed by deviation through an angle β of parallel light rays making an angle α with the horizontal. Take the stance of the observer as the origin and let the $x-y$ plane lie on the ground with the x-axis along the shadow of the observer. The beam AP is reflected to the eye of the observer E after being deviated through the angle β, so that the point P appears to be illuminated more strongly than the surrounding points. The locus of P is found as follows:

EB is a ray of incident light parallel to the ray AP. Draw PD and CD perpendicular to EB. Let h represent the height of the observer's eye above the ground. Then

$$BC = \frac{h}{\tan\alpha} - x;\quad CD = BC\sin\alpha$$

$$= h\cos\alpha - x\sin\alpha;\quad PC = y,$$

whence

$$PD = \sqrt{y^2 + h^2\cos^2\alpha - 2hx\cos\alpha\sin\alpha + x^2\sin^2\alpha};$$

$$PE = \sqrt{x^2 + y^2 + h^2}.$$

Thus

$$\frac{PD}{PE} = \sin\beta = \frac{\sqrt{y^2 + h^2\cos^2\alpha - 2hx\cos\alpha\sin\alpha + x^2\sin^2\alpha}}{\sqrt{x^2 + y^2 + h^2}}$$

from which we obtain

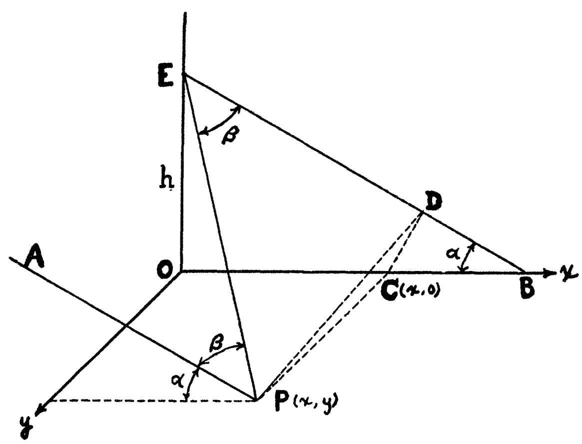
$$\frac{\left(x - \dfrac{h\cos\alpha\sin\alpha}{\sin^2\alpha - \sin^2\beta}\right)^2}{\left(\dfrac{h\sin\beta\cos\beta}{\sin^2\alpha - \sin^2\beta}\right)^2} + \frac{y^2}{\left(\dfrac{h\sin\beta}{\sqrt{\sin^2\alpha - \sin^2\beta}}\right)^2} = 1$$

This equation is seen to represent a circle when the angle α is 90°, an ellipse when α is between β and 90°, a parabola for $\alpha = \beta$, and a hyperbola for α less than β.

All the bows observed were ellipses. It was possible to measure the lengths of the major and minor axes by having an assistant walk around the bow, this assistant, of course, being continually directed by the observer. The track left by the assistant in the dew was an ellipse and its axes could easily be measured. To calculate the lengths of the axes from the equation given above we may take $\beta = 42°$ and $h = 5.4$ ft. To get α the length of the shadow of a tall tower, of known height, was measured immediately after the assistant had traced out the dewbow in the grass. Results of this calculation are compared in the table below with the results of direct measurement for bows seen about 11:30 P. M., November 30 and December 1, 1925.

		Major axis (feet)		Minor axis (feet)	
	α	Obs.	Calc.	Obs.	Calc.
Nov. 30......	69.3°	11 to 14	13.5	10 to 13	11.8
Dec. 1......	59.0°	19	19.9	13	14.3

The agreement is as good as could be expected because the bows were not very sharply defined.



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THE NATIONAL ACADEMY OF SCIENCES

(*Continued from page 506*)

The acceleration of growth: Professor Thomas B. Osborne and Lafayette B. Mendel.

The factors which determine the possibility of growth may be classed, with respect to the organism involved, as internal or external in character. The internal factors include the real impulse to grow, of whatever nature it may be; in part they are inherited, they belong to the permanent biological characteristics of the individual. Heredity, with all that it involves, determines the most potent of these internal, constitutional incentives and conditions of growth. These are the determinants which are largely beyond our immediate control, yet must be reckoned with when defects of growth appear. The ex-