$p - m + (m - n)$ equals $p - n$ equals the volume of oxygen retained by the frog during the respiration period.

R. Q. equals $\frac{CO_2}{O_2}$ equals $\frac{p - m}{p - n}$

A series of nine experiments carried out in the manner described on the same frog gave the following values for the respiratory quotient: 0.71; 0.72; 0.76; 0.80; 0.65; 0.69; 0.72; 0.70; 0.78. Of course the method has its obvious limitations as to accuracy and must not be urged, in that respect, in comparison with those methods which permit the animal to breathe fresh air throughout the experiment and also allow the respiration period to be terminated on an exact moment. Nevertheless, the results obtained are fairly uniform and the method does afford some advantages as a laboratory experiment for illustrating the facts involved in the respiratory exchange. The manometer visibly impresses the student with the fact that in case of an animal oxidizing protein and fat the volume of the oxygen used in respiration is greater than the volume of the carbon dioxide given off. The experiment may be carried out in a comparatively short time and the operation is simple—only one absorbent fluid being necessary. A "cold blooded" animal is made use of, so that the temperature of the respired air is so slightly above that of the surrounding air as not to interfere with the immediate volumetric work, as may be the case when a mammal is used.

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LABELING MICROSCOPE SLIDES

THE method developed by the writer of preparing labels for microscope slides has been used sufficiently by the departments of plant pathology and botany at the University of Wisconsin to warrant the hope that it will prove of value to others.

In the preparation of a large number of, or even a few, microscope slides for class use satisfactory labeling of the finished slides is often an important problem. Printed labels are expensive, while printing or writing even a few duplicate labels is both time-consuming and irksome, and requires unusual skill for satisfactory results.

The method herein described produces in any quantity neat, accurate labels in the form of photographic prints the exact size of a standard slide label and gummed ready for use. In addition the process is simple, rapid and inexpensive, and requires very little special equipment.

The original copy from which the negative is made may be drawn to any scale, preferably two or three times the desired size. The standard slide label is fifteen sixteenths of an inch square. A piece of white bristol board or drawing paper is ruled with a 3H pencil into squares of three times the linear dimensions of the slide label. As a matter of economy of time and materials 12 or 24 different labels are prepared at one time on a single large sheet of paper. Twelve labels arranged in three rows of four each can be photographed on a 4 x 5 plate, leaving about one half inch margin all around for convenience in handling. Similarly, 24 labels in four rows of six each will go on a 5 x 7 plate.

The data are now lettered in the squares in pencil, using penciled guide lines which may be ruled for the entire sheet at one time. After having been checked for errors, the labels are inked with black waterproof ink, using a ruling pen for straight lines and Barch-Paysant lettering pens (Keuffel and Esser Co.) for the lettering. Pens No. 4 and No. 5 are suitable for lettering a label enlarged three times (Fig. 1, A), while No. 5 and No. 6 are suitable for a label enlarged two times (Fig. 1, C). The necessity of allowing for reduction in the width of lines is emphasized by Fig. 1 in which B and D are photographic reductions of A and C. It also shows that slight imperfections in the lettering are minimized by reduction.

The completed sheet of labels is cleaned with art gum, photographed on a process plate, and developed in a contrast developer (hydroquinone). To avoid distortion of the image on the plate the center of the copy should be approximately on the optical axis of the camera lens, and perpendicular to it. The image is easily tested for size by measuring with a slide labeled on the ground glass, or for squareness, by measuring the diagonals, which should be equal in length. As many prints as are desired can now be quickly made from the negative, which may be preserved for future needs. A dull or semi-gloss printing paper is preferred by the writer to a glossy paper. Solar, a thin, matt-surfaced printing paper made by the Defender Photo Company, gives labels of practically the same thickness and surface as the commercial labels.

The adhesive is applied to the back of the prints before the labels are cut apart. An adhesive prepared from animal glue was found superior to the various commercial liquid glues tested. The following formula is a slight modification of one suggested by Mr. Wilbur Jones, of the Forest Products Laboratory, Madison, Wisconsin. A good grade of animal glue, which comes in small flakes, is dissolved in twice its weight of water in a water bath. When the glue is thoroughly dissolved, ten per cent. of glycerine (by volume) is added to make it flexible when dry, and one half per cent. of betanaphthol as a

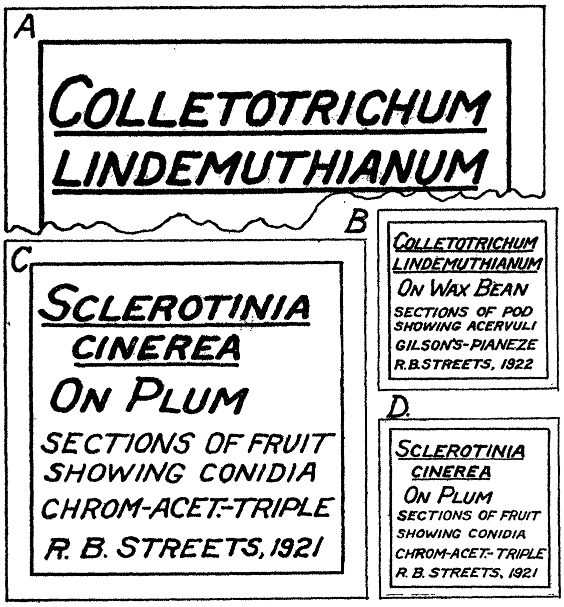

FIG. 1. Figures showing scale to which originals (A and C) are drawn to produce finished microscope slide labels (B and D) by photographic reduction. A is drawn three times size of finished label B; C is drawn twice size of D. Either scale can be used with good results.

preservative. This adhesive is a firm jell at room temperatures, but of the consistency of mucilage when heated to 60° C. in a water bath.

The adhesive is applied to the back of the prints in an even layer using a small flat brush. To facilitate a quick, even coating of the prints they should be placed upon a warm surface (an electric slide warmer is very satisfactory). The adhesive dries in about fifteen minutes, and the labels may be cut apart along the penciled guide lines. A trimming board gives very straight even margins. Both printed and gummed surfaces of the labels are fully equal to the commercial product in permanence either before or after they have been moistened and rubbed into good contact with the slides.

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SPECIAL ARTICLES

A GENETIC LINKAGE BETWEEN SIZE AND COLOR FACTORS IN THE TOMATO[1]

GENETIC factors responsible for size characters are notoriously elusive, and their actual presence in the germinal complex is largely hypothetical. They can not be isolated singly and studied as units, a mode of procedure that has led to some tangible results in the case of equally complex factors for qualitative characters. One of the most direct methods of actually proving the existence of definite size (quantitative) factors is that of linking them with the well-known system of chromosomal factors in any species. Such a method should give proof of the genetic similarity of the two types of genes.

In a large series of crosses between commercial varieties of tomatoes, involving various sizes (weights) and colors of the fruit, a definite linkage between these two types of genetic factors has been established. Color in tomato fruits is mainly determined by two different pairs of genes. One pair, *Rr*, controls the red and yellow flesh color, the former being dominant. The other pair, *Yy*, determines skin color, *Y* producing a yellow pigment in the cell walls of the epidermis of the fruit, and *y* giving a colorless condition in these cells which is recessive in inheritance. Size of fruit in tomatoes is perhaps best interpreted by the multiple factor hypothesis.

Crosses involving these two pairs of color genes and different sizes of the fruit were made reciprocally. The F_2 generations and reciprocal crosses of the F_1 plants with pure varieties of the double recessive color phase (*rr yy*), were grown with extraordinary precautions as to uniformity of treatment, replication, etc. Measurements for each plant were taken of average weight of fruit, time of flowering, two diameters of the fruit, and number of seed locules. In every case, the P_1, F_1, F_2 and backcrosses under consideration were grown during the same season.

One series of crosses and backcrosses has given some very outstanding results. In this case, the parents were the varieties Red Cherry (*RR YY*, mean fruit weight 7.3 ± 0.3 grams) and Golden Beauty (rr yy, mean fruit weight 166.5 ± 6.4 grams). The F_1 of this cross and its reciprocal, grown the same season as the P_1 and F_2 generations, had a mean fruit weight of 23.9 ± 0.4 grams indicating a noticeable dominance of the smaller fruit type. This F_1 was crossed back to the pure Golden Beauty parent and also to an unrelated variety, Yellow Peach (*rr yy*).

The F_2 data, with respect to color of fruit, showed the di-hybrid distribution of four color classes, *RY*, *Ry*, *rY* and *ry*. The mean weight of fruit in grams for these four kinds of fruits was as follows:

	Red Fruits—R		*Yellow Fruits—r*	
	Y	*y*	*Y*	*y*
F_2 means—	22.0 ± 0.7	37.3 ± 1.8	21.9 ± 1.4	46.6 ± 5.6
Differences—	15.3 ± 1.9		24.7 ± 5.8	

It is perfectly obvious that the types with colorless skin (*y*) are consistently heavier than those with

[1] Paper No. 4, Department of Genetics, Iowa State College, Ames, Iowa.