When these flaps are brought into opposition they serve to separate the receiving atrium from the forwarding ventricle. Tendinous cords (*chordae tendineae*) attached to the margins of the valves at one end are anchored at the opposite end to finger-like muscular projections of the inner wall of the ventricle. These cords prevent the valves from reversing under the pressure of the contracting ventricle. Sever them and again place the atrio-ventricular orifice under the tap. The valve flaps now float into the atrium and are no longer competent. With a sharp scalpel cut between two of the valves flaps through the cardiac muscle to the apex of the ventricle. Observe the internal meshwork of muscles and the transverse *moderator band* extending from the *interventricular septum* to the lateral wall and serving to prevent over-distention of the chamber.

Expose the cavity of the left atrium in the same manner as the right. Note the two flaps of the *left atrio-ventricular valve* (*bicuspid, mitral valve*). Repeat the experiment for valvular action and incompetence. Small moderator bands are present rather than the single large one typical of the right side.

Make a transverse section across the pulmonary artery about 3 cm. above its base and pour water into it. Three cup shaped, crescentic, *semilunar valves* (Fig. b) close the aperture of the artery and prevent the water from passing into the ventricle. In life they prevent blood from regurgitating into the ventricle at the termination of the heart beat. Pin one or more of these valves to the arterial wall and repeat the experiment. The valve is now incompetent and water passes back into the ventricle. The structure and the function of the aortic semilunar valves may be illustrated in the same way.

Examine the heart wall noting its three composite layers, the *epicardium,* a fibrous outer coat, the thick muscular *myocardium,* and the smooth lining layer or *endocardium.* The valves are composed of double layers of endocardium. Make a transverse section across the ventricles about 3 to 4 inches from the apex. (Fig. c). Compare the thickness of the left ventricular well with that of the right. The heavy musculature of the former may be correlated with the extra work required in forcing blood to all parts of the body as compared to the lesser task of the right ventricle in pumping it to the lungs.

A Modern Biology Program for the High School

MELVIN A. HINTZ
South Milwaukee High School, South Milwaukee, Wisconsin

Today the biology course in the high school curriculum has largely replaced the traditional courses in botany and zoology. During the past fifty years biology has increased in prominence and is emerging as a vital high school subject. Biology should be included in the training of every educated person—not set apart to be taken by a few select students. Our progressive biology teachers are heartily in favor of a program which will insure biology for every boy and girl.

Just as biology has in most schools, replaced botany and zoology as individual subjects, so also have the methods of teaching biology changed. Some schools list general biology in their curriculum, but on examination of the course of study there is revealed the fact that a number of weeks are devoted to the separate study of plant life, animal life, and human physiology. In schools where this is the case the only modern thing is the title of the course. In the great majority of high schools the study of biology is what the name implies, a study of living things. The subject matter is grouped around topics or problems such as: Health and Disease; Adaptations to Environment; Growth and Reproduction; Food Relationships; Improvement of Life; etc.; the aims being to instruct the boy and girl in the fundamental principles governing living things.

Plants and animals are associated together, for the most part, in nature, and it is quite logical that the boys and girls will observe this relationship. Why not teach them about living things from the point of view of this natural relationship and interdependence, rather than having them spend a number of weeks studying plant life; then having them "exposed" to a number of weeks of animal study; and finally finishing the course studying about man—especially physiological processes? Many conscientious teachers still follow the so-called, "biological trinity" course, but I am wondering if the boys and girls really enjoy their introduction to the science of life. The so-called "blended or correlated" course is favored by most teachers. It requires more adequate teacher training and also more work on the part of the teacher, but our boys and girls really enjoy their exploration of the living world—which more than compensates for the extra effort on the part of the teacher.

Biology should be, and in an increasing number of schools is, the most popular subject in the high school. It offers a pleasing and varied appeal to the average students' interest. It should not be called the course or subject where you have to cut up animals, hold snakes, etc. Where this is the case, the dissection has not functioned as intended. One often hears from students on visits to schools that all they do is observe "smelly" specimens, at least those that have been preserved in formaldehyde. Why not have living animals to replace the preserved ones for observation, at least the more common specimens studied? These criticisms are fair, but are they the cause of the biology course being unpopular? I believe that our trouble lies in the fact that the courses in the biological field are not within the range, interest, and ability of the boys and girls who either elect or are required to take the course.

To help solve this problem we can offer courses in biology adapted to the ability of the students who take them. In other words, we must, first of all, adjust the subject matter to meet the ability of the boys and girls rather than use "accepted" standards of attainment, or college entrance requirements.

Our high school enrollment figures have increased rapidly the past ten years and more boys and girls are taking or are required to take biology. The teacher in a school where biology is required has a real challenge. We have the students, and it is up to us to do something for these boys and girls. The progressive teacher knows that he cannot give the same work to the entire group and expect identical results. Biology teachers must meet this challenge, face the facts, and above all MUST adjust their teaching to meet the varied needs of the boys and girls who joined the "party" for a "tour of the living world."

For the past nine years, in cooperation with the administration of our high school, we have been experimenting—I might say, pioneering—and have achieved results in a community where science, heretofore, has never been able to fulfill its true mission. Biology is a required subject, and no one can get a diploma unless he or she has passed a year's work in biology. We therefore get all the students in our school, good, fair, and poor. The I.Q.'s one year ranged from 63 to 132. Even though one does not have much faith in I.Q.'s it would not take a progressive teacher long to discover that there was a great variation in the abilities of this group of students. Naturally, those in the lower level cannot keep up with those of average or "superior" ability, and in far too many cases fail. Experience has borne out the fact that students dislike failure, and consequently we have a number who dislike biology, become discouraged, and often change their attitude toward school and life. Aside from the development of this undesirable attitude and the creation of problems of discipline, the most important aspect of the matter is that the boys and girls have not been given a fair chance to learn something of the science of living things. A modern biology program has, to a great extent, helped to solve this important problem.

Our students are divided into groups of more or less equal ability. The groups are selected on the basis of a weighted classification score, which takes into consideration, intelligence, school marks, teacher recommendations, social adjustment, and whatever else seems desirable.

In our school, this classification begins in the seventh grade, so that by the time the student reaches the sophomore year we can place him in a section with other students of somewhat similar abilities. We offer biology courses to fit the needs and abilities of the various groups of students. We do not tell the students which section they are in, but the nature, quality, and quantity of work depends on their classification. Each course is divided into minimum, median, and maximum assignments. At present we have a course for the "superior" or X group; another for the average or Y groups; and still another for the lower level or Z group. The latter we call Modified Biology.

The "Modified Class" presents a problem which is not easily solved. This being a new venture in the teaching of biology, there is little material available, and the teacher must supply the necessary tools. It was necessary to write a text, and to work out a plan of teaching which would help these students learn something of the science of life. Our present text was revised in 1935; it is in mimeograph form, bound, and consists of 168 pages. It is now being revised, with special attention being paid to the vocabulary which can be comprehended by the lower level students. The presentation of subject matter is more simple, the subject matter is couched in familiar terms, the illustrations are from life, and life and health are stressed. Methods of teaching too have been revised. Some of the handwork methods of bygone high school days are again being used; but nevertheless the students are finding biology interesting, and are learning something about the science of life which would probably have been denied them, without a modern biology program emphasizing the boy and the girl rather than the subject matter.

We are now offering courses in General Biology adapted for X and Y groups, Modified Biology for the Z group, and Advanced Biology as an elective for juniors or seniors. This gives us a balanced program for the natural sciences—one which has commanded the respect of the students who were required or elected to take them. Advanced Biology was the result of a request on the part of the students for more advanced work in the natural sciences, and we feel that now biology is really achieving its true mission in this community.

A Teaching Aid for the Demonstration of Yeast Fermentation

HAROLD M. KAPLAN
Middlesex University, Waltham, Massachusetts

I

There are several experimental methods available for the study of fermentation processes. Some of these are very complex, being useful particularly in physiological or industrial research. Others are neither sufficiently illustrative nor striking for demonstrating fermentation to a class of pupils or for motivating them to further their studies in this aspect of biology.

In the present paper, a simple apparatus is described which should be of value for demonstrating clearly to a group of biology pupils (1) the nature of the fermentation process, (2) a method to measure and compare fermentation rates, and (3) modifications of the time course of fermentation when a given chemical substance is added to the fermenting medium.

II

A section of the apparatus is illustrated in the accompanying figure.

It was originally devised by the author in connection with certain research carried out at Harvard University a few years ago.[1]

[1] Unpublished data.

It consists of a series of fermentation vials, each capable of holding 8 c.c. of fluid (fermenting yeast cells suspended in aqueous solution). Each vial is closed with a tight fitting one-hole rubber stopper. A glass tube leads out, and by rubber pressure tubing connects each vial with a horizontal calibrated glass tube, 60 inches in length.

In the original apparatus, the writer has used twenty of these tubes, mounted parallel to each other on a board having the dimensions $62'' \times 24'' \times 2''$. The vials are held in a rack which is 24 inches long, $2\frac{3}{4}$ inches wide, and whose side walls are 1 inch in height. In the accompanying figure, less than one half of the total width of the apparatus has been drawn.

Before running any test, a large index drop of water is pipetted into each calibrated tube. The initial position of the index drop in each system is recorded after all connections have been made tight. The drops are then seen to be moved along with slow non-uniform velocity, due to the pressure of the CO_2 gas produced in the vials. Their positions (menisci) are recorded at successive equal intervals ($\frac{1}{2}$ to 1 hour) until the