NEW BOYLE'S LAW APPARATUS.

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Boyle's Law like Ohm's Law is one of the experiments in physics that is never "overlooked" in laboratory work for students taking secondary physics or general college physics. Both laws are easy to prove provided the apparatus is in good condition and works all right but—the writers' experience has been that Boyle's Law apparatus more often gives trouble than it gives "P. V. equals a constant." We believe that more mercury is lost or damaged by this experiment than by any other three experiments in general laboratory work. This makes the experiment a costly one. The writer has used every kind of Boyle's Law apparatus that he has heard about and he has tried many that he wishes he had never heard about, seen described or much less purchased.

Several times the writer has worked out different ideas for apparatus for this experiment but they always had some bad effect like those already on the market. However, at last a simple form took shape and has proved more than satisfactory. Like most discoveries it is simplicity itself, yet it is this very simplicity that makes it so valuable for this experiment. We have been using it now for two years with our freshmen students and in all this time we have not lost five grams of mercury and a leak is impossible. We have had about one hundred fifty students a year who handle this apparatus and when we are through with the experiment the apparatus is just as good as when we started. Then while we can get a pressure from less than a quarter of an atmosphere to over two atmospheres very little mercury is used and no rubber tubing. This means an apparatus at very low cost and with no repair from one year to the next. Our tubes now are in as good working condition as they were at first with the exception of a slight oxidation of the mercury.

The drawings show how the apparatus works. A number of trials with tubes of different diameters proved that tubes with an internal diameter of about two millimeters were most satisfactory. The greatest trouble was to find tubes with anything like uniform bores. Twenty-four tubes were tested before three satisfactory ones were found. When these three were carefully calibrated they showed changes in the bores great enough to account for the errors in the P, V. product. Tubes which

appeared uniform when tested would vary over ten per cent in the diameters of the two ends. In most cases the tubes would swell or contract slowly from one end to the other, depending upon the end first tested while in other cases marked changes would appear along the tube. In the first tube used no calibration was performed and results for P. V. always increased as the volume of the gas was increased. Later the bore of this tube was tested and it was found that the diameter gradually became less from the closed end. This of course made the volume or rather length which was used for volume increase too rapidly. The tubes now in use are not free from variations in internal diameter but in most cases the error is small. Anyone desiring to try out the apparatus should calibrate their tubes before filling with mercury and sealing the one end.

The apparatus is mounted as shown in drawings a and b so that it may be rotated about the pivot p, which is placed near the center of mass of the system. If mounted upon an axis normal to the wall of the laboratory and about five inches from the wall where it is, not in the way it will be found very convenient. A wing nut will hold it in position at any desired place. A horizontal shelf just low enough for it to clear makes measurements of H_c and H_o very easy.

The inside of the square made from two meter sticks was grooved for holding the glass tube. The stick used on the open end of the apparatus, however, does not need to be graduated. The tubes used varied from one hundred sixty centimeters to one hundred eighty centimeters long. The right angle bend was made slightly nearer the end left open so as to give more pressure.

We are using the apparatus on a laboratory table supported by a laboratory stand and clamped so that it may be rotated and also moved up and down.

Our students enjoy the experiment very much and it gives very good results, the value of P. V. for pressures from about 20 centimeters of mercury to over 150 centimeters running about as follows:

P. V.	2753.75	2763.01	2760.43	2757.83
	2759.08	2763.56	2757.63	Mean P. V 2759.44

ARTICLES IN CURRENT PERIODICALS.

American Forestry, for February, Washington. \$4.00 per year, 40 cents a copy. "The Vanishing Trail," Arthur N. Paek, six illustrations; "Sherlock Holmes of the Forests," ten illustrations; "Trees in Winter," Henry T. Stephenson, nineteen illustrations; "The Royal Palm," Hollister Sage, five illustrations; "Forest Recreation Department—A Federation of Outdoor Clubs," Arthur A. Carhart, seven illustrations; "Broad-Leaved Evergreen Shrubs for the South," F. L. Mulford, nine illustrations; "Badgers and Wolverenes," R. W. Shufeldt, eight illustrations.

American Journal of Botany, for January, Brooklyn Botanic Garden. \$6.00 per year, 75 cents a copy. "Ecological Relations of Plants in South-eastern Missouri," J. C. Th. Uphof; "Methods of Healing in Some Algal Cells," Susan P. Nichols; "The Present Status of Scopelendrium in New York State," Mabel R. Hunter; "Biophysics as a Point of View in Plant Physiology," Howard E. Pulling.

Popular Astronomy, for February, Northfield, Minn., \$4.00 per year. "Drake University Municipal Observatory," with Plates II and III, D. W. Morehouse; "Larger Worlds," F. R. Moulton; "The New Electric Driving Clock of the Photographic Telescope of the U. S. Naval Observatory," with Plates IV to VII, George H. Peters; "How to Look at the Moon," Julian L. Coolidge; "A Few Facts for the Meteor Observer," Rufus O. Suter, Jr.; "A Memorial to Elias Colbert," with Plate VIII, Charles H. Taylor; "Silvering Mirrors," with Plate IX, Edward S. King; "The Thirty-Eight Stars Having Largest Known Parallaxes," Carl L. Stearns; "The American Section of the International Astronomical Union," Joel Stebbins.

School Review, for February, University of Chicago Press. \$2.50 per year, 30 cents a copy. "The Selective Principle in American Secondary Education. II," George S. Counts; "Current Practice in the Organization and Administration of Junior High Schools," J. A. Clement; "Oppor-