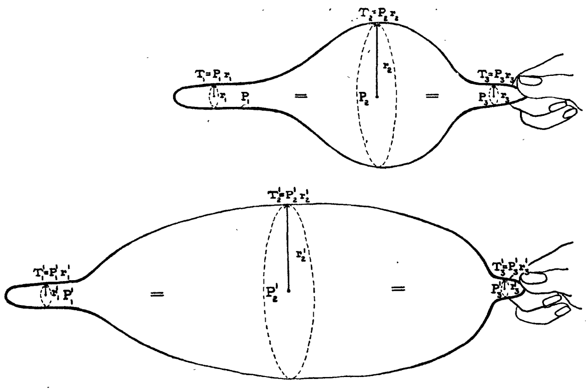

FIG. 1. Partially inflated rubber balloon may take these forms. The pressure P within the balloon is equally transmitted to all parts of the contained air (Pascal's law: $P_1 = P_2 = P_3$; $P_1' = P_2' = P_3'$), and the tension T in the wall of the balloon varies with the radius r in that portion.

that the pressure of the air within the balloon must everywhere be equal. The obvious tautness of the dilated portion (under greater stretch, with the rubber plainly thinner) contrasts sharply with the relative flaccidity of the undilated portion, making concrete the direct relation between the radius of curvature and the tension in the wall at a given internal pressure. It is demonstrated at once that this relation obtains even when there is no flow of fluid. One may note that this experiment is the converse of that performed in physics classes in which the air contained within each of two soap bubbles, blown on separate pipes, is put in communication. The surface tensions of the two soap films are essentially equal. Where one bubble has a smaller radius than the other, the internal pressure in that bubble is necessarily greater, and the small bubble discharges its air into the large.

Laplace's formula applies more exactly the smaller the wall thickness. In the case of a thin-walled cylinder (where the ratio of outside diameter to inside diameter is less than 1.20) one often considers only the "hoop stress" and assumes it to be uniformly distributed throughout the wall cross section. Hoop stress (e.g., in an iron pipe) drops off from a maximum value at the inner wall to a minimum value at the outer wall, the drop being greater the larger the ratio of diameters. Since, when a viscus is dilated, the cross-sectional thickness of the wall may markedly decrease, the tension of the wall per unit cross section is increased even more than indicated by Laplace's proportionality between radius and tension, applied to a relatively unstretchable wall.

Even without consideration of this aspect of the matter, the thinness of the walls of capillaries, for example, takes on added physiologic significance when considered in terms of wall tension rather than merely in terms of blood pressure. One becomes more sensible of how capillaries can sustain high blood pressures without rupturing (as where venous return is blocked), despite the delicacy of their structure. Burton *et al.* (*1–3*) have carefully studied the application of Laplace's equations in this field and reviewed much of the literature. Although these equations have long been known to physiology, few physiologists appear to use them in their everyday thinking and teaching. Classes will better understand such diverse physiologic topics as pressure-tension relations in the eyeball (*4*), the urinary bladder (*5*), the heart (*6*), and the gut (*7*) when proper attention is given to the formulas of Laplace. D'Arcy Thompson (*8*) treats of some of the more beautiful applications of these relations in biology.

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An Air-Cleaning Apparatus for the Flame Photometer

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We have found the flame photometer capable of measuring the sodium and potassium concentrations in biological materials with a precision comparable to that of the more laborious chemical methods. The simplicity and rapidity of the technique was, however, impaired by the extreme sensitivity of the instrument to room air contamination with dust and especially with tobacco smoke. In our instrument[1] the vaporized sample is led to the air inlet at the base of a Meker burner, where it is sucked with room air into the burner by the draft caused by the flame. An isolated or air-conditioned room was not available, and the photometer had to be used in a dusty room from which tobacco smoke could not always be excluded. Consequently the behavior of the instrument and the output were erratic, and much time was wasted in performing analyses under poor conditions because they had to be completed at once. To avoid the necessity of isolating the photometer or of air-conditioning the whole room, a closed air-cleaning system has been installed and has proved of value. The burner has been enclosed in an airtight chamber the inlet of which is through an air-cleaning apparatus and the outlet through a closed stack around the burner about 28 cm high.

In the Barclay instrument this was most easily

[1] A Barclay Flame Photometer, General Scientific Instrument Co., Hamden, Conn.

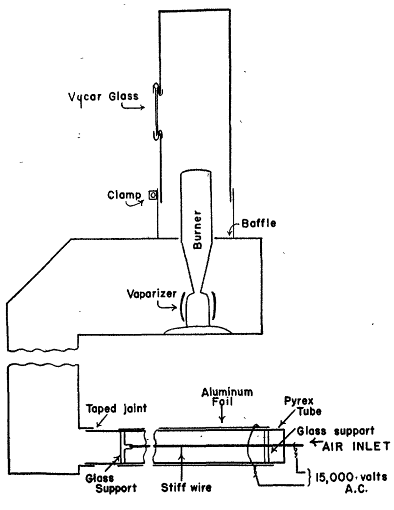

FIG. 1. Air cleaner attached to the inner, airtight chamber of the flame photometer.

achieved by constructing an inner chamber of sheet metal connected to a wide tube leading forward and downward just behind the control panel to the air-cleaning mechanism, the top of which was connected to the metal chimney provided in the machine. The windows in the chimney were closed with "Vycor" glass mounted in metal brackets.

The requisites for an air-cleaner with high efficiency and minimal obstruction to air flow, to eliminate the necessity of a forced air supply, are adequately met by a simple apparatus first suggested by Drinker (*1*). Such a precipitator, based on the principle of ionizing and precipitating foreign bodies in a strong electric field, has an air-cleaning efficiency of better than 98%. As used, it consists of two Pyrex tubes of 34 mm ID and 45 cm long, wrapped with aluminum foil and lacquered, with a stiff hay-binding wire mounted in the axis of each. A 15,000-v a-c source[2] is connected between the wire and the foil. Care must be used to provide protective shielding and insulation for the high-voltage circuit. This can be done most conveniently by placing the transformer near the tubes, thus shortening the high-voltage leads and enclosing the entire assembly in a wooden cage under the work-desk. In addition, the distance between the foil or center wire and the metal conduit must be at least 3 cm, to prevent sparking to the machine. Even with this distance the Pyrex tube and the glass wire support must be perfectly dry. The efficiency of the air-cleaning system can be judged from the absence of yellow flashes from the flame and from the appearance of the tubes after the apparatus has been working for some weeks: the distal 2″–3″ of the tube is coated with grime, the remainder perfectly clean.

The air chamber and precipitation tube interfere markedly with the free supply of air to the burner, even to the point where there is incomplete combustion of the propane, with the consequent appearance of zones of incandescence in the flame. This difficulty was overcome by building into the chimney a baffle plate (Fig. 1) which occludes the gap between the burner and the chimney, above the air holes in the former, deflecting through the burner air that would otherwise flow around it.

We have also found it necessary to decrease the width and height of the windows in the chimney through which light reaches the photocells; possibly because of a decrease in the width of the flame caused by the structural alterations we have made, the edge of the flame sometimes presented at one or another of the windows, leading to irregularities in the amount of light reaching the cells.

With these modifications, we have an instrument whose reliability and convenience are equal to those of the unmodified machine but which can be used without interruption, even in the presence of ordinary room air contaminants. The standard readings are reproducible for several hours, and the galvanometer is free of distracting fluctuation.

[2] A commercial neon light transformer of 15,000-v, 30-ma output is adequate for at least 3 such tubes connected in parallel.

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A New Reaction and Color Test for Allethrin and Pyrethrins

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We wish to give a preliminary account of a new reaction and color test for allethrin and pyrethrins. Allethrin (*1*) is a synthetic insecticide of a structure similar to that of the pyrethrins and is used in insecticide sprays and aerosol bombs to replace the natural pyrethrins. Either pyrethrins or allethrin, but not pure allethrolone or chrysanthemum monocarboxylic acid, gives the reaction.

We have found that a solution of 2-(2-aminoethylamino) ethanol (Eastman's organic chemical, No. 4774, hydroxyethyl-ethylenediamine) in ethanol and alcoholic potassium hydroxide will give a red or violet color with pyrethrins or allethrin if sulfur is added. Without the addition of sulfur, allethrin does not give this color and pyrethrins appear to give only an orange color. The addition of sulfur to the pyrethrin orange reaction mixture causes a red or violet-brown color to form. Pure pyrethrins themselves may not react unless sulfur is present, but every supply available at present has reacted to give the orange color before the addition of sulfur.

The mechanism of the reaction is not known. It appears, however, that certain conditions must be met to cause the color reaction. Morpholine and other amines can take the place of 2-(2-aminoethylamino) ethanol and other alkalies can substitute for potassium