the claims of the weather service both to the Government and to the public. Immediate questions which should engage the attention of this advisory committee would be: (1) The proper location and distribution of aerological stations; (2) the training of personnel; (3) the testing, selection and development of the most suitable aerological instruments; (4) research projects, particularly those looking toward the development of long-range forecasting methods.

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# SCIENTIFIC APPARATUS AND LABORATORY METHODS

## A SIMPLE PNEUMATIC PULSATOR

THE apparatus here described can be used with any type of laboratory apparatus in which it is desired to (1) move a fluid into and out of a vessel, or (2) to intermittently move a liquid in a given direction. Both types of fluid movement are used in the gas analysis apparatus at Davis[1] (the pneumatic pulsator has replaced the water-wheel pulsator formerly used).

Essentially, the pulsator has but one moving part. This is the valve mechanism, which is, in effect, two three-way stop-cocks so arranged as to operate simultaneously. This part of the apparatus is made of a steel-jacketed bronze bushing and snugly fitting shaft. The bushing is drilled with six holes, four of which are tapped and fitted with metal tubes. The shaft is drilled to correspond with the bushing, the holes having the same relative positions as those of the plugs of three-way stop-cocks. The bushing is stationary, while the shaft is movable, like the plug of a stop-cock. The construction of the valve mechanism is shown in the sketch.

To a metal arm fastened to the shaft are suspended two leveling bulbs, connected together by rubber tubing and partly filled with mercury. The arm A is prevented from rotating too far in either direction by rubber-cushioned metal bumpers (not shown in sketch), which are located just above the ends of the arm.

A metal weight is mounted at center of arm so that it shifts the center of gravity with each partial revolution of the arm, thus assisting in bringing the valve into correct position at the end of each partial revolution.

Suction is furnished by an ordinary filter pump attached to a water faucet. Both the pulsator and the filter pump are connected to a five-gallon bottle which is in turn connected by glass tubing to a second bottle twelve feet below, in such a way that an excess of suction pulls water up into the first bottle, whereas insufficient suction is compensated for by the pull of the water column which tends to run down into the lower bottle. The battery of bottles compensates for continuous small variations which occur in water pressure, and at the same time makes possible a smaller stream of water through the suction pump than would otherwise be required.

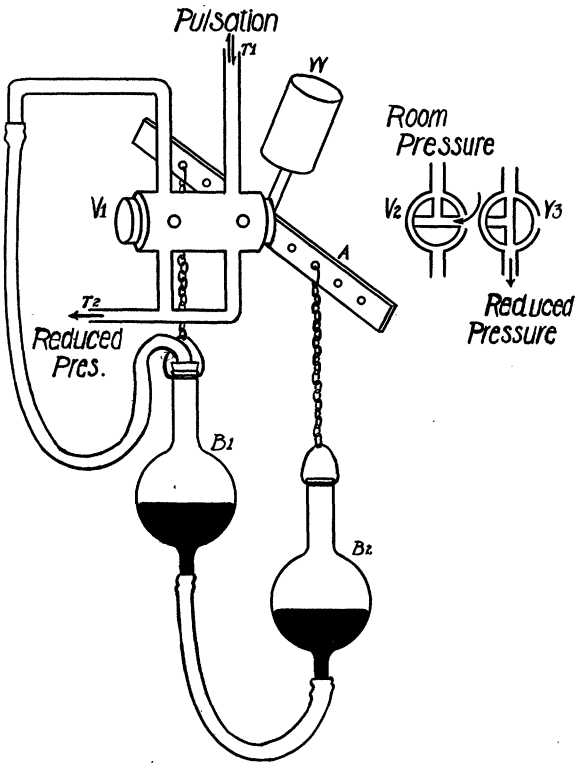


FIG. 1

EXPLANATION OF SKETCH

$V_1$ Projection of valve. Reduced pressure is drawing mercury into $B_1$ as shown in section of valve $V_3$

$V_2$ Cross-section of valve. $B_2$ is in its upper position. $B_1$ is open to room air and mercury is allowed to flow back into $B_2$

$V_3$ Cross-section of valve. $B_2$ is in its lower position and $B_1$ subjected to reduced pressure drawing mercury up into $B_1$

$T_1$ Tube carrying pulsations. Connection to be made here to tube leading to apparatus.

$T_2$ Reduced pressure connection.

W Weight mounted on moving arm to assist in bringing holes in shaft opposite holes in bearing.

A Arm fastened to shaft-supports leveling bulbs.

$B_1$ and $B_2$ Leveling bulbs.

[1] M. Kleiber, "Contribution to the Method of Gas Analysis for Respiration Trials," *Jour. Biol. Chem.*, 101: 3, p. 583, August, 1933.

The principle of operation is very simple. When at rest the unstoppered leveling bulb $B_2$ is in the lower position. When suction is turned on, mercury is pulled up into the stoppered bulb $B_1$ until the weight of this bulb becomes greater than that of the lower bulb. The upper bulb then descends, but does not reach a position as low as the highest position of the lower bulb. The partial rotation of the arm caused by the change in weights brings the valve to such a position that room air is free to flow into the stoppered bulb, and as a result of the increased pressure, mercury flows downward into the lower bulb. The shift in weight now pulls the lower bulb to its bottom position and changes the relative positions of the valve openings so that they are again in the same position in which they were at the beginning of the cycle. One set of valve openings actuates the pulsator itself, while the other produces changes in pressure in the tubing connected with whatever apparatus the pulsator is being used to run.

The pulsator can be easily and cheaply constructed, and most of the materials used are available in any laboratory. It is clean, quiet in operation, and can be placed anywhere out of the way. During the past few months the one now in use has been in operation almost daily and has required almost no care aside from weekly lubrications with vaseline.

The pulsator is adjustable through a wide range of speeds, ranging from very rapid to very slow pulsations. For use with the gas analysis apparatus the optimum speed has been found to be about four pulsations per minute.

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# SPECIAL ARTICLES

## EXPERIMENTAL TRICHINOSIS IN CHICKS

WHILE it is generally known that *Trichinella spiralis* will develop to the adult stage in the intestine of birds, the development of muscle larvae from oral infection, so far as we are aware, has never been observed.

In the present study mature Trichinella larvae have been demonstrated consistently in the musculature of chicks fed infective material. It is believed that failure heretofore to demonstrate this stage of the parasite in this host is due to the method of search employed (that of direct microscopic examination).

In the first of the present experiments, eight two-day-old chicks were fed thousands of isolated infective Trichinella larvae. On the first day after infection, one of the chicks was killed and a thorough search of the intestine was made for the parasite. A few young adults were found in the lower portion of the small intestine. Forty-five days after the infective feeding, two of the chicks died of a coccidial infection (diagnosed *Eimeria tenella* by Dr. E. Elizabeth Jones). A careful microscopic search of muscles failed to reveal any evidence of trichinosis. The white and dark meat were removed separately, then ground and treated by artificial peptic digestion. In the concentrated sediment from each, about two hundred fully developed Trichinella larvae were found, many of which were inactive and appeared lifeless. The remaining five chicks were killed a few days later. None showed infection by direct microscopic examination, but a few dead larvae were obtained from each chick by the digestion method.

It was thought that the lightness of the infections might be due to a mechanical destruction of a large number of larvae during their passage through the gizzard. To determine whether ingested larvae may thus be destroyed, a ten-week-old chick was fed thousands of isolated Trichinella larvae, and its droppings during the following three hours were collected for examination. In the intestinal discharges, numerous broken and mangled larvae were found, as well as many coiled larvae, which responded sluggishly to warmth. The chick was then killed and the entire intestinal tract examined. Active, uninjured larvae were found in the crop and proventriculus. In the gizzard and throughout the small and large intestine, however, many crushed forms and pieces of larvae were found along with others which were apparently unharmed. It is evident from these results that a large number of Trichinella larvae are destroyed in the gizzard of birds.

In the following experiments, it was hoped to establish a sufficiently heavy muscle infection whereby its nature could be studied. Four eleven-day-old chicks were etherized, and well over a thousand Trichinella larvae liberated from their cysts by the ingestion method were injected directly into the lumen of the jejunum of each. Three days later one of the chicks was killed. Numerous adult males and females with eggs in the uterus were found in the middle portion of the small intestine. The three remaining chicks were killed and examined fifty-four days after injection of larvae. Direct microscopic examinations of the muscles were negative. A few brownish dead larvae were obtained from each by the digestion method. From these results it is evident that the protective mechanism of chickens against trichinosis is not centered solely in the gizzard. According to