vascular membrane (*pseudo-chorion*) and an inner non-vascular layer (*pseudo-amnion*) which is adherent to the embryo. The vascular membrane with its blood vessels derived from the old vitelline circulation is used as an organ for respiration and nutrition throughout gestation. The surrounding follicle becomes highly vascular and develops a layer of high, irregular columnar cells. (2) In Aulophallus and some species of Poeciliopsis which have small yolk sacs the lateral portions of the pericardial somatopleure are poorly developed, but the ventral portion becomes enlarged into an extensive vascular belly sac. The surrounding follicle develops on the internal surface an extensive system of anastomosing villi which are vascular and are covered with a secretory epithelium. The wall of the belly sac, together with the wall of the follicle with its villi, form a *follicular pseudo-placenta.*

Anablepidae. A more complicated and apparently more effective *follicular pseudo-placenta* has been developed in at least two of the three existing species of Anableps. The belly sac becomes very large and at an early stage takes over and expands the vitelline circulation. The blood vessels of the sac become expanded into rows of connected and projecting vascular bulbs. The surrounding follicle is covered on its inner surface with a mat of long vascular villi which are covered with a low epithelium.

The looped small intestine is everted into the cavity of the belly sac in *Anableps anableps.* In *A. dowei* the large intestine becomes a balloon-like sac which nearly fills the cavity of the sac. In both species there is a metamorphosis of the gut at birth involving shortening and reorganization. Follicular fluid is imbibed by the embryo and absorption takes place by means of specialized villi of the gut. The concentrated unabsorbed material is retained in the gut.

Goodeidae. In this family and in the Jenynsiidae the embryos are evacuated from the ovarian follicles into the ovarian cavity at early stages and develop in the ovarian cavity.

Goodeid species have various degrees of specialization in foetal structures. (1) In the primitive Ataeniobius the yolk sac is fairly large, and there is no expansion of the pericardial membrane. In late gestation the embryos imbibe ovarian fluid through an enlarged opercular opening and the mouth. (2) *Goodea luitpoldii* has a smaller yolk sac. The extra-embryonic pericardial sac is somewhat enlarged and vascular in early stages but recedes with the development of the trophotaeniae, ribbon-shaped outgrowths from the rectal lip which increase the absorbing surface. (3) Lermichthys, Neotoca and others have very small yolk sacs. Extensions of the pericardial somatopleure arise early but begin to recede at the thirty-five somite stage. A very extensive system of vascular trophotaeniae begins to develop at the twenty somite stage and with the recession of the extra-embryonic pericardial membrane takes over the functions of respiration and nutrition.

Jenynsiidae. In *Jenynsia* (*Fitzroya*) *lineata* the embryo augments the respiratory surface by expanding the vascular pericardial sac. The sac reaches the maximal size at the 6 mm stage at the point at which the yolk becomes exhausted. The pericardial sac begins to recede at this point, but in the meantime club-shaped vascular flaps grow out from the ovarian wall and extend into the branchial and mouth cavities through an enlarged opercular opening. Respiratory exchanges are accomplished by this device during the remainder of the gestational period, but nutritional materials are obtained by absorption from ovarian fluid imbibed through the mouth or opercular openings.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A THORACIC WINDOW FOR OBSERVATION OF THE LUNG IN A LIVING ANIMAL

DURING my investigation of the presence of fluid in the pulmonary air sacs a number of techniques have been tried to make these chambers accessible for observation in the living animal. Whereas this is a simple matter in the case of amphibians, it is not so in dealing with mammals, as every investigator who has approached the provinces of structure or physiology of the terminal spaces of the lung has realized. In attempts to overcome the difficulty of maintaining the lung under natural physiological conditions and at the same time having it available for observation and experiment, an instrument has been devised which is simple in construction, easy to adjust and which has proved successful for observations of the superficial air sacs and alveoli in the cat's lung. The principle of the method seems to be sound and practicable; some changes in the construction of accessory parts and in the means of illumination may be found desirable.

The instrument, made of bronze, consists of a short hollow cylinder, at one end of which is mounted a small cover glass window and at its opposite or internal end is formed a quadrilateral plate or flange. When adjusted in the thoracic wall, the cylinder projects through an opening made in an intercostal space, the plate fitting against the internal surface of the wall and the instrument fixed in place by means presently to be explained. When the air has been drawn out of the pleural cavity by an exhaust tube, the surface of the lung comes in contact with the window and remains there in view during respiration. Details of

the form and the dimensions of the principal parts of the instrument are shown in the accompanying figures.

The preferred points of opening the chest in an adult cat have been either the right second intercostal space or the right fifth intercostal space; the former because the movement there of the cephalic lobe is slight; the latter, chosen for manipulation of the ventral thin edge of the lung. In either case the pectoral muscles were divided and retracted (cat anesthetized with urethane), exposing intercostal muscles and the ribs. An opening barely large enough to admit the plate is made through the parietal pleura and the instrument, controlled by the handle, is introduced into the pleural cavity, then adjusted so that the cylinder stands between the two adjacent ribs. A piece of dental rubber dam somewhat larger than the plate and having a hole cut in the center to fit when stretched over the cylinder, is applied to the external face of the plate before the instrument is introduced into the chest. Fixation of the window in the thoracic wall is accomplished by screwing a flange upon the threaded cylinder down to the level of the ribs, thereby drawing the plate with its rubber mantle snugly against the internal surface of the thoracic wall. Two small lugs on the edges of the plate impinge upon the margins of the ribs, so that any tendency toward twisting of the window is prevented. By these means the window is incorporated in the chest wall, joints are sealed, and it moves with the movements of the wall in respiration, unless fixed, as it can be, by clamping the handle to the animal carrier.

Air that entered the pleural cavity when the window was inserted is removed by suction through an exhaust tube, whose bore opens internally immediately beneath the cover glass. When the last air is drawn out the surface of the lung strikes the glass with a noticeable clink. Clamping the suction tube maintains the vacuum. The cover glass, set in Canada balsam on a shoulder of the cylinder, is placed eccentrically in order to give room in the cylinder for the handle, the exhaust tube and a tunnel (Fig. 1, a). The latter goes very

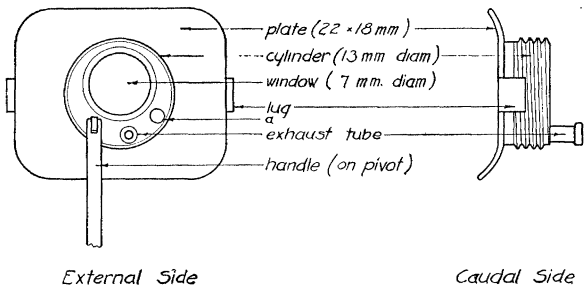

FIG. 1. Thoracic window.

obliquely to open beneath the cover glass and provides a way for experimental procedures, quartz rod lighting, etc.

Observations have been made with the binocular microscope and with a skin microscope; illumination for the former being an arc lamp, for the latter a 6-volt bulb. From both these sources of direct light the glare has been a disadvantage, controlled somewhat by the use of polaroid film. Experiments with quartz rod transmitted lighting are in progress. Good views of the superficial air sacs and alveoli have been obtained and a motion picture has recently been made recording such phenomena as could be brought forth with low power magnification and arc lamp illumination. With higher power lenses the capillary nets could be observed. Studies by means of the thoracic window are in progress and will be communicated in later publication.

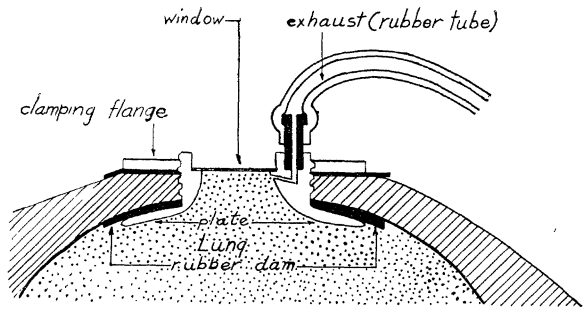

FIG. 2. Schematic transverse section of thoracic wall with thoracic window adjusted.

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