Laboratory Studies.

State Agricultural College,

ZOLOGY.

AGRICULTURAL COLLEGE PRINTING OFFICE,
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1895.
President JOHN M. BLOSS, Dear Sir:—I take pleasure in submitting to you the following report of work done in the Zoological Department during the Fall and Winter Terms of 1894-5.

Physiology:—A very large class in this subject necessitated the formation of two divisions. Martin's "Human Body" was the text book used and laboratory work consisted in the following: study and drawing of the bones of the skeleton; the dissection of a mammal by each student, and the microscopical study, by all the members of the class, of leading tissues, bone, cartilage, voluntary and involuntary muscle, bloodvessels and blood, integument, liver and other glands, stomach, intestine, etc. Each student was obliged to make free hand drawings of sections studied. In addition, demonstrations were given illustrating coagulation of blood, mechanics of respiration, capillary circulation, reflex action in decapitated frog, physiology of pneumo-gastric nerve with reference to heart's beat, the presence of automatic nerve centres in the heart, the glycogen-secreting function of the liver and other facts of interest to students in physiology.

Ornithology.—A short course of lectures (optional) on the different orders of birds, characteristics of each order, food habits of birds etc. Laboratory work: dissection of type, practice in identification etc.

Zoology:—During the fall term a large class listened to lectures on the principles of classification, and these lectures were illustrated by museum specimens which the class handled, and in regard to which they were encouraged to make original observations. Salient points in Orton's "Comparative Zoölogy" were committed in order to make the lectures more easily understood. This work was preparatory to that of the winter term. This course in the winter term (optional) consisted in more advanced work, and was strictly a laboratory course. I was pleased to receive into this advanced class a considerable number whose high grades of the previous term and whose interest in the subject led them to continue the work beyond the elementary stages. The time at our disposal (three months) was short, but what has been done has been done, it is believed, thoroughly and
with profit to each student. A star fish, earthworm, cray fish, a bony fish (*D. argyrosomus*, see title page) and a bird were dissected. The last three weeks were spent in laboratory study of the development of the chick, as being fairly typical of vertebrate embryology. In connection with this course, a reading club met bi-weekly at home of instructor.

I have taken the liberty to present some of the more interesting drawings and descriptions made by members of the class under the head of "Studies from the Zoological Laboratory," fully aware that the work is such as has been done repeatedly by specialists and students for many years, yet in this case, as far as each student is concerned it represents *original investigation*, for it was done independently of book or co-laborer. The value of such work cannot be over-estimated. As the various essays indicate instruction was given in laboratory technique and each student hardened, stained, sectioned and mounted some tissue.

These studies are presented with the hope that they will lead the way to more complete work in future, embracing possibly all the laboratories connected with the institution. As they are, they represent faithful endeavor on the part of each and will serve to show to the friends of the students and to the patrons of the school the character of the work being done in the department of Animal Biology.

I wish to express my appreciation of the courtesy of Prof. Pernot of the Photographic department to whose efforts with those of Mr. Clark, the printer, the successful publication of the "Studies" is due. Last but not least I wish to thank you for the interest you have taken in forwarding this feature of college work.

Respectfully,

P. L. Washburn.
The above are representations of the lower pharyngeal teeth of two viviparous fish, Ditrema laterale and Damalichthys argyrosomus belonging to the family Embiotocidae. The former, a "blue perch" differs from the latter species in having a continuous blue streak along the edge of each row of scales; the head also has several series of blue spots and streaks. The number and arrangement of the spines and rays differ somewhat in the two genera.

One of the chief differences between the two fish above mentioned lies in the pharyngeal armature. The lower pavement teeth of argyrosomus, B, are very large; the anterior part forms a distinct angle with the posterior part, the individual teeth being ground off or truncated, and some are distinctly hexagonal in shape. The posterior teeth, B (2), are not used for crushing and are partly hidden under the tissues of the pharynx. They are reddish brown in color, have an exceedingly smooth surface and are slightly convex in outline. A number of the posterior teeth are soft, and filled with a red pulp, but as they ascend toward the grinding surface they become very hard and solid.

The lower pharyngeal teeth of Ditrema laterale A, are very small, do not cover nearly as large an area as the teeth of the former fish and are crowded together. All the teeth were originally conical, but the anterior teeth have become more or less worn. The teeth on the posterior part, (1) are still conical and are much larger than the others. There is no angle between the anterior and posterior parts as in the case of argyrosomus. C represents a median vertical section of B, showing the angle, (4), between anterior and posterior teeth.

Note.—The frontispiece represents D. argyrosomus and was drawn by Miss Nash.
The above drawing represents the eye of a four day chick, \( a \) representing the epiblast and \( b \) the mesoblast.

The eye is formed by a pushing out of the epiblast from the first cerebral vesicle, \( 1 \), thus forming a bud connected by a hollow stalk, composed of epiblast, \( 2 \), to the cerebral vesicle. The cavity formed is called the primary optic vesicle.

The optic nerve is formed by the solidifying of the stalk. Then there is an invagination of the epiblast of this vesicle forming a double walled cup, thus making the secondary optic vesicle \( 4 \).

The lens, \( 5 \), is formed at this stage by a thickening of the outer layer of epiblast, and a constricting off of the same, leaving it in the opening of the secondary optic vesicle.

The first layer of this double walled cup forms the pigments of the choroid; the inner or anterior layer thickens and forms the retina. The mesoblast pushes by the lens into the secondary optic vesicle and thus forms the vitreous humor; some passes in front of the lens thereby making the aqueous humor.

The choroid, the vehicle of the dark pigments just formed, is of mesoblast also, as is the sclerotic and cornea, excepting the epithelium of the cornea which is of the superficial epiblast. The eye does not form at right angles to brain, the position being obliquely downwards and backwards.

The drawing was made with a 1 inch objective and Bausch & Lomb camera lucida. It is enlarged 33 diameters.
The above section was made from a piece of stomach, treated with chromic acid and alcohol; stained with Haematoxylin and sectioned on Bausch & Lomb microtome. Section 25 micromillimeters thick.

a. Represents serous epithelium.
b. Muscular coat, (longitudinal.)
c. Muscular coat, (circular.) Oblique muscles wanting.
d. Submucous coat containing blood vessels and lymphatics.
e. Mucous membrane containing gastric glands lined with secreting cells.
f. Is placed between the openings of two glands.
SPINAL CORD OF FISH.
(Enlarged 36 diameters.)

LULU C. THORNTON.

The spinal cord is composed of grey and white matter, the grey on the inside and the white on the outside. The arrangement of the grey matter in the fish is greatly different from that in the human spinal cord, being very irregular and not taking the form of an H at all. The cord is enclosed in a membrane, the pia mater.

The section from which the above free hand drawing was made, was cut from material, hardened with alcohol and stained with haematoxylin. The sections were cut on a Bausch & Lomb microtome and each is 25 micromillimeters in thickness.

The cord is almost divided into two halves by an anterior fissure \((a\ g)\) and a posterior fissure \((g\ b)\); \(g\) is the central canal which extends through the centre of the cord.

The grey matter \(D\ c\) extends about half way across on both sides of the cord, from there the right portion, \(c\), sends off strips of matter, one to the exterior at \(b\), and two the mass of grey matter in front of it. The left portion, \(D\), sends off a strip of grey matter, \(m\), to the exterior, and four strips to the mass in front of it. The two large masses of grey matter \(E\ E\) meet at opposite points on the anterior fissure, and have many projections of grey matter, called root bundles, extending to the periphery. The white matter is composed of medullated nerve fibers, loosely bound together. The grey matter is made up of non-medullated fibers and nerve cells, closely bound together.
NOTES ON THE VENOUS SYSTEM OF A PERCH. *(D. argyrosomus.)*

KATE B. MCCUNE.

The above diagram represents a partial dissection of the venous system. All venous blood is ultimately collected in the *sinus venosus* (2), which in turn opens into the auricle (1). The *hepatic vein* (6) collects the blood from the liver. The right and left *cardinal vein* (7) run through the substance of each kidney. The veins coming from the body wall are numerous and very small at first, but later unite to form a large vein (5) which empties into the cardinal veins on either side. One of the branches forming 5 may come from the muscles of the pectoral fin. This was not proved.

There are two *jugular veins* (4) bringing blood from the head. Veins (4 and 7) unite on either side to form the *praevascular vein* (3) of that side.

EAR OF PERCH. *(Damhlichthys argyrosomus.)*

A. D. MORRISON.

The labyrinth of this species of perch lies close under the roof of the skull, back of and above the eye, and is surrounded by soft lymph-like fluid; Three semi-circular canals are present and lie in planes at right angles to each other. Anterior vertical, posterior vertical, and horizontal
canals, (see a, b, and c. in figure) each has a vesicle-like swelling or am-
pulla (d e. and f.) The utriculus, (g.) contains a liquid in which occurs a
calcareous body, otolith, (f,) in some there are more than one,

Branches of the auditory nerve, (i i) are connected with the ampullae at
(d) and (e.) These branches pass over a small bone (j) which lies in the brain
cavity. The above drawing represents the left labyrinth, the nerves, and
the peculiar irregular shaped bone in a grove of which the nerves run. The
nerves and bone are drawn somewhat out of their place that they may be
more easily seen. In reality these nerve branches run inward and back-
ward. The small bone referred to lies below the brain separated from it
by membrane.

![Intestine of Fish](camera lucida drawing. Enlarged to diameters.)

LESTER M. LELAND.

The accompanying figure represents a longitudinal section of the intes-
tine of a fish, hardened in alcohol, stained in haematoxylin and sectioned
with a Bausch & Lomb microtome. Sections 1-1000 of an inch in thickness.
It is composed of four coats; the serous, muscular, areolar or sub-
mucous, and the true mucous membrane. The serous is thin and is on the
outside. Aside from the muscular coat it is more dense than the other
coats. The muscular coat is composed of two layers, of nearly even thick-
ness; the outer longitudinal layer and the inner circular layer. Next to
the muscular coat is the sub-mucous coat, less dense than the previous one,
and containing blood vessels. This coat gradually blends into the true mu-
cous membrane, the gradation being such that it is difficult to see where one
ends and the other begins. The surface of absorption and the delayed
passage of food is greatly increased by projections of the mucous membrane.

- **a a a** Serous coat.
- **b b b** Muscular (longitudinal.)
- **c c c** Muscular (circular.)
- **d d** Sub-mucous coat.
- **e e e** Mucous membrane with projections.
- **g g g** Blood vessels in sub-mucous coat.
OVARY OF CAT.

W. F. HOLMAN.

The material from which the above section was made, was prepared in the usual way, being hardened in alcohol and stained with borax carmine. A slide of seventy-three serial sections was then made, each section being twenty-five millimetres in thickness. The above drawing was made with a Bausch & Lomb camera lucida and represents a section enlarged 29 diameters

2. Graafian follicles in early stage of development.
3. " " " later stages.
4. Outer tunic of follicles.
5. Membrana granulosa.
6. Vitellus. 6 and 7 with enveloping vitelline membrane constitute the ovum proper.
7. Germinal vesicle and germinal dot.
8. Nest of epithelium cells to form follicle.
9. Stroma.

A THIRTY HOUR CHICK.

LENA WILLIS.

The embryo was subjected to treatment in picric acid for several hours and then washed in different grades of alcohol. The following conditions are noted at this period.

Medullary folds a a are formed by the growing up of the mesoblast
(The Embryo, seen from above, camera lucida drawing.)
carrying with it epiblast and forming two parallel ridges which extend
nearly the full length of the embryo. Between these folds is the medullary
groove, b. From c to d the medullary folds have united forming the neu-
ral canal. Back of c the medullary canal is still open. The notochord i is
seen through the floor of this canal. The splanchnopleuse folds have
reached the position j. The beginning of the amnion is shown at g g.
Six pairs of the mesoblastic somites h h, have formed. The anterior
two-thirds only (enlarged 15 diameters) is shown.

NOTES ON A FOUR DAY CHICK.
(Made opaque with picric acid and alcohol, and drawn with a camera lucida.
Enlarged 8 diameters.)

LOUISE LEUENBERGER.

The cerebral hemispheres, c. h., have been formed by an outgrowth of
the first cerebral vesicle, the original vesicle giving rise to the fore brain
and the second and third cerebral vesicles forming the mid brain M. B.,
cerebellum, c. b. and medulla oblongata. The eye, 2, is well formed,
seen lying on c., but in reality an outgrowth of the fore brain or first cerebral vesicle. The number 1 is on the lense of the eye. The otocyst, 3, or primitive ear is noted, formed by a pushing in of the epiblast in the neighborhood of hind brain, making a closed sac. The position of heart is denoted by the number 11. It sends branches through the visceral arches, 4, 5, 6, 7, to form the dorsal aorta. Along the body of the embryo appears a low ridge of somatopleure, running backward from the neck nearly or quite to the tail. Upon this ridge limbs first appear, being buds from the mesoblast covered with epiblast; shown at 8 and 9. About this time the allantois, 10, pushes farther out from the hind gut growing up between the true and false amnion. It is furnished with numerous blood vessels, and helps to perform the office of lungs until the chick gets access to the air. A visceral or gill cleft occurs between every two of the visceral folds, 4, 5, 6, 7, and there is also one in front of the first, 7, and behind the last, 4.

Number 12 is placed at the end of the notochord as this structure was seen through the tissue lying above it. Dorsal to the notochord a number of mesoblastic somites were seen and are represented.

The section represented above was prepared from material treated in the same way as the spinal cord of fish described on page 7 and sections are of same thickness.

SPINAL CORD OF RAT. Enlarged 29 diameters.

AMELIA J. MCCUNE.

a Grey matter.
b White matter.
c Ventral fissure.
d Dorsal fissure.
e Central canal.
f Pia mater.