The work very properly begins with an annotated translation of the Monaco and Geneva Agreements for the Unification of Anthropometric Measurements. There follows a concise treatment of the preliminaries of the subject, such as preparation, instruments, landmarks, recording grouping of subjects, estimation of age, admixture of blood, pathological conditions, etc. The various topics are handled with clarity and include much original data in regard to general methods. There is a sane appraisal of the various anthropometric instruments and accessories employed in investigations.

The section on the anthropometry of the living deals with a selected list of the most important measurements and observations as determined by the experience of the author. The directions given are very clear and include many practical suggestions tending to promote facility of observation and accuracy of result.

The anthropometry of the skeleton is satisfactorily treated and includes a description of the invaluable system of visual observations elaborated by the author. In the opinion of the reviewer this standardization of morphological observations constitutes a contribution to anthropometric method of first importance, and the section dealing with it might advantageously be expanded. It is to be hoped that Dr. Hrdlička may find time to publish elsewhere a series of articles illustrating the normal or medium development of the various morphological characters and the extremes of their variations. Such illustrations, together with a discussion of the extent and significance of variations, would provide a standard basis for judging the degree of development of immensurable characters. At the present time the value of such observations is dependent upon the accuracy and experience of the individual investigator. It is becoming apparent to physical anthropologists that morphological differences of detail that do not lend themselves to measurement are of primary importance in distinguishing races. Many important functional adaptations belong also to this category of features which must be described rather than measured.

Perhaps it may be said that the greatest value of this work on anthropometry lies in the fact that it represents the perfected methods of one of the most skilled and best qualified practitioners of the science. Experts may differ as to the value of this or that measurement, or may prefer their own technique in individual cases, but this book is in general reliable and conclusive. A careful follower of its methods can not fail to secure completely adequate physical data in any general anthropometric investigation.

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SPECIAL ARTICLES

SUBEPITHELIAL GLYCOGEN CELLS IN EMBRYO AND RECENTLY HATCHED FISH

In April, 1912, while studying the development of the yellow perch (*Perca flavescens*) I discovered numerous cells filled with glycogen located just below the flat epithelium covering the surface of the embryo. The embryos in which I demonstrated these cells had been developing in the laboratory for twelve days. Upon the addition of a few drops of tincture of iodine to the water in the saucer in which the embryos were contained it was noticed, upon microscopical examination, that there were many round or oval cells, stained a reddish brown, scattered over the surface of the embryo, and especially marked in the fins. I have repeatedly studied these cells in the yellow perch and some other species of fish since I first observed them, and I have found them so interesting that I wish to make a record of some of my findings.

The embryos of the yellow perch are especially well adapted for microscopic examination, as they are exceedingly transparent, and retain their transparency to an advanced stage of development. The development of the eggs takes place rapidly at the ordinary temperature of the laboratory. At the end of the fourth or the beginning of the fifth day after the first division of the egg the embryo begins to make spontaneous movements of its body,

and the rudimentary heart commences to beat. No glycogen cells can be detected at this time, but about the beginning of the sixth day they appear as minute dark brown spots after the application of the dilute iodine solution. The glycogen cells increase in size and become more granular during the further development of the fish. At the time of the appearance of the cells the embryos are covered with a single layer of very thin flat epithelium. The intercellular substance of the epithelial cells can be easily and strikingly stained, after the application of a weak iodine solution and washing in water, by immersing the animal in a dilute aqueous solution of methylene blue for a short time. The blue staining fluid forms a dark precipitate with the iodine in the cement substance, and forms zigzag lines which delimit the cells in the clearest manner. The dark lines may be seen to cross the glycogen cells in many places, indicating that these cells are beneath the epithelial covering.

The glycogen cells are usually more or less elliptical and their dimensions vary with their stage of development. When they first appear their diameters may vary within the limits of 3μ and 10μ. At this time the protoplasm of the cells forms a ring surrounding a large central vacuole containing the glycogen granules. One part of the ring is usually thickened, and contains an elongated elliptical or crescentic nucleus. As the cells enlarge with the advanced development of the fish their vacuoles encroach on the protoplasm until the cells are converted into microscopic sacs of glycogen, in the walls of which a long elliptical or reniform nucleus can usually be found. At this stage the diameters of the cells may be 15μ to 25μ, and the granules, stained a mahogany color with iodine, are chiefly found just below the cell membrane. A number of these granules may coalesce and form a rod-shaped body in the interior of the cell. Sometimes three of the rods unite in the shape of a Y. The stained granules of glycogen dissolve with considerable rapidity in the water containing the preparation, and many of them disappear after a few minutes, leaving the thin cell membrane containing the nucleus. A very weak solution of iodine formed by adding a drop or two of the tincture to 5 c.c. of water gives the cells their characteristic color in a few seconds if the animal has been removed from the egg envelopes. If the embryos retain their gelatinous envelope they are stained in a few minutes, and it is easy to follow the gradual staining of the cells before the animals are killed by the iodine.

At the time of the first appearance of the glycogen cells there are no blood globules in circulation, but these are first seen a day or two later. At a little later period the liver is formed, and may be stained a brick red by the iodine solution. The liver cells do not contain glycogen granules but are diffusely stained a lighter and more reddish color than the subepithelial glycogen cells.

After a certain degree of development of the fish the number of the glycogen cells becomes gradually lessened by absorption. As I have had the perch under observation for only a limited time after hatching I have never witnessed the complete disappearance of the cells. In and after the third week of development their number becomes much smaller. At that time the glycogen cells of the tail may be crowded into its edge, and those of the pectoral fins arranged in columns radiating in the direction of the striation. This change in position is probably due to the growth of other tissue elements which displace the glycogen cells. In advanced development I have noticed in the tail fin many smaller mesoblastic cells which are not stained with iodine.

I have found many glycogen cells, very similar to those of the yellow perch, in recently hatched pike-perch or wall-eyed pike, and in the small-mouthed black bass, but some differences in the appearance of the cells in the different species, and in the solubility of their glycogen granules were noted. The glycogen cells of the pike-perch are coarsely granular, and their glycogen dissolves very rapidly in the dilute iodine solution. The nuclei of the cells are not so apparent as those of the yellow perch. The glycogen cells of the pike-perch may be seen under the

microscope as light spots without the iodine treatment, and an enormous number of the cells are scattered over the yolk sac. The cells of the small-mouthed black bass are large and contain much glycogen which dissolves very readily in water after iodine staining. I have noted in pike-perch which have been kept under observation for a considerable time that their glycogen cells become greatly diminished in number. I have not been successful in finding the glycogen cells in all species of fish. I have never been able to discover them in *Fundulus*, and have sought for them in vain in recently hatched smelt. They evidently act as temporary reservoirs of glycogen, but why they are present in some species of recently hatched fish, and not in others, is not apparent.

If it should be discovered that these peculiar cells can be isolated and satisfactorily cultivated in artificial media, they will offer most promising material for studying experimentally the formation of glycogen.

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Monson, Mass.,
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THE OVARIAN CYCLE OF SWINE

Most of our information regarding the changes in the mammalian ovary during the various events of the reproductive cycle has been gained from study of the laboratory rodents and small carnivores. The domestic ungulates, on account of their large size and commercial value, have been neglected in this respect, although they promise certain advantages because of the simplicity of their ovarian structure and the regular, outspoken appearance of œstrus.

The only attempt to follow the history of the ripening follicles and the corpora lutea of an ungulate, with material of known history, is that recently published by Max Küpfer of Zurich,[1] who made use of the municipal abattoir of that city to procure a large series of ovaries of the cow. He was able to obtain records of the last appearance of œstrus in a certain number of animals (apparently 33) and has given a set of handsome plates illustrating the rise and retrogression of the corpus luteum. From the gross appearances and from measurements (no microscopic studies were made) Küpfer states that the interœstral period of 21 days may be divided into two parts. During the first 10–11 days after ovulation the corpus luteum is slowly reaching its full size, and thereafter it is in a state of retrogression which continues throughout the next interval, until by the time of the second following ovulation (42 days) the corpus luteum is macroscopically insignificant. The ovaries of animals undergoing uninterrupted œstrus cycles will therefore contain the follicles and corpora lutea of two or three periods, at successive stages of growth and retrogression.

The present writer has been endeavoring to piece out a similar account of the pig, in order to provide an anatomical basis for the physiological relations of ovary, ovum, and uterus in this species, and has published[2] a description of the mature follicles and developing corpora lutea up to the tenth or eleventh day, but has been unable, until the present, on account of conditions of the meat-packing trade, to follow the animals longer than this time. The lacking material has now been supplied, through the cooperation of Mr. W. N. Cooper, manager of the American Feeding Company of Baltimore, at whose large piggery farm a series of 22 sows has been obtained covering practically every day of the 21-day cycle.

The story as read from these specimens is a simple one, as will be seen from the accompanying diagram. It appears that mature ovaries of non-pregnant animals contain a reserve stock of follicles of 5 mm. diameter or

[1] Küpfer, Max, "Beiträge zur Morphologie der weiblichen Geschlechtsorgane bei den Säugetieren," *Denksschr. d. Schweiz. Naturf. Gesellsch.*, 1920, Bd. LVI.

[2] Corner, G. W., "On the origin of the corpus luteum of the sow from both granulosa and theca interna," *Amer. Jour. Anat.*, 1920, Vol. 26, pp. 117–183.