cause the student can grind sections for himself quickly and inexpensively. Thin sections of about 1 mm in thickness are sawed with a hack saw and given to the students who grind them on glass plates (discarded lantern slides make suitable plates) with aloxite powder and water. The quantity of water used is just enough to maintain the powder in a pasty consistency during the grinding. Ordinary corks are used to hold the sections during the process. The grinding should be conducted by frequently alternating the surfaces, thus insuring more uniform thinness and better finish. When the sections become transparent or of tissue-paper thinness, they are polished by dipping in water, blotting dry and rubbing carefully with finger on a carborundum or greenstone hone. This last step is necessary so as to fill the lacunae and canaliculi with débris. The sections are mounted, as usual, in gelatin.

Comparative trials show that aloxite used as described cuts twice as fast as the fastest of the other above-mentioned abrasives. No more than ten minutes should be required to completely grind and mount a section.

EDMOND J. FARRIS
DEPARTMENT OF ANATOMY
MEDICAL COLLEGE OF THE STATE
OF SOUTH CAROLINA

SPECIAL ARTICLES

THE CENTRIOLE OF THE AMPHIBIAN LEUCOCYTE

IN 1926 Belar published his observations on the centrioles of the perihepatic leucopoietic tissue of Salamandra. These studies were made by the Flemming-hematoxylin method and demonstrated the fact that a cell in the interphase contains two centrioles which have been derived directly from telophasic division of a single centriole at the pole of the mitotic spindle and that during a subsequent prophase these two centers of the non-dividing cell separate and become located at the poles of the spindle. Belar's series of figures illustrating this genetic continuity of the centriole is so completely demonstrative that it is difficult to understand why these very significant results have not received more attention in recent discussions of the central body problem.

I have repeated Belar's observations on Salamandra and have extended the study to other Urodeles, namely: Amphiuma, two species of Amblystoma, Triturus and Siren. Material was fixed in the fluids of Champy, Flemming, Benda, Helly, Bouin, and a saturated solution of corrosive sublimate in normal saline. Staining was by means of iron hematoxylin, Kull's acid fuchsin-thionin-aurantia and Benda's alizarin-crystal violet. The facts are demonstrated by any of these combinations, but the Benda method is most useful, since it stains the centrioles a distinctive color, unlike that of any other structures in the cell.

This extensive reexamination completely confirms Belar's results and in my opinion incontestably establishes the fact that the centrioles maintain direct visible genetic continuity through all the numerous cell generations in the differentiation of the mature leucocytes. This general conclusion holds for the six types examined, but in minor details there are differences among the genera. The following brief description refers, in all its details, only to Amphiuma.

The myelocyte in the interphase contains a single large aster. The Golgi apparatus is closely applied to this structure, and chondrioconts in its vicinity are oriented so that their axes are radial to its center. At the focal point of the astral rays is a spherical zone that stains considerably more heavily than the general cytoplasm, and which I shall more or less arbitrarily call the centrosome. Outside this zone and considerably excentric with reference to the focal point of the astral radiations are two granules which stain very intensely and which I consider are most accurately termed the centrioles. These have so great an affinity for hematoxylin, acid fuchsin or crystal violet that slides can be extracted until the centrioles are the only stained objects outside the nucleus. Both centrosome and centrioles are well preserved and may be stained after such fixatives as Champy's fluid, which preserves not the least trace of an aster. In early prophase the centrioles seem to enlarge slightly and then they move apart. A spindle forms between them, and upon breakdown of the nuclear membrane the chromosomes become arranged in the metaphase plate. The centriole at this stage is exactly at the focal point of the spindle fibers, but I wish to forestall any possibility of a suggestion that it is their coagulated focal point by stating that in Benda preparations the spindle fibers are light orange, while the centriole is a brilliant purple. The centriole in this material is far more clear-cut and definite than any I have ever seen. Its size and spherical shape are constant. In the early telophase, after disappearance of the polar part of the spindle, the centrosome and astral zones are reformed around the centriole, and in middle telophase it can first be clearly seen that the centriole has divided. At first these division products are very small and close together, but in late telophase they move apart somewhat and enlarge to the size which they maintain throughout the interphase.

The above description is based upon examination of certainly hundreds of thousands of leucocytes of Amphiuma. The results may seem more convincing to some cytologists when I state that I have found not one cell inconsistent with this outline of the history of the centrioles. The only cells in which these facts are not easily observable are those where the staining is either so heavy as to obscure all details or so light that there is no differentiation of structures in the cytoplasm. I have slides, prepared by the Benda method, in which the stain has been extracted to such a degree that the centrioles are a faint blue and even then it is always possible in every cell to make out these "ghosts of centrioles" exactly where one would expect to find them. On any properly stained slide every cell demonstrates the centriole situation to be as I have described above.

It is perhaps also worth mentioning that I have observed many mitotic figures in the hepatic glandular cells on the same slides with the leucopoietic tissue. The centrioles, always present at the poles of these spindles, are identical in size and staining characteristics with those of the leucocytes.

In conclusion let me emphasize the aspects of this case of the leucocyte that make me consider it highly significant for the whole centriole problem in its present state. First, it demonstrates the individuality and genetic continuity of the centriole in somatic tissue of adult animals by the use of a wide variety of technical methods. The more general significance of this is that the centrioles are the only part of the mitotic apparatus that persists from one cell generation to the next. Second, the centrioles are not the coagulated focal point of the spindle fibers, because the histories of these two structures are very different and because there are marked differences in staining reaction. Third, the centrioles are not the coagulated focal point of the astral rays, since there are differences in fixing and staining reactions and especially because the interphase centrioles are *double* and placed *excentrically* inside a *single* aster.

ARTHUR W. POLLISTER

DEPARTMENT OF ZOOLOGY,
COLUMBIA UNIVERSITY

LEAF TEMPERATURES OF COTTON PLANTS WITH PHYMATOTRICHUM ROOT ROT[1]

THE leaves of cotton plants that have wilted from *Phymatotrichum omnivorum* root rot are so regularly and so definitely warmer than those of normal plants that the writers have been able to utilize this difference in leaf temperatures in diagnosing cotton plants about to succumb to the effects of the disease.[2] It has therefore been of interest to find the actual differences in temperature between leaves of cotton plants with root rot and those of normal plants. The observations recorded below have been made on plants of Startex cotton (Texas Station No. 7000) growing in experimental plats at College Station, Texas.

MEASUREMENTS WITH MERCURY THERMOMETERS

Two ordinary chemical thermometers, previously tested and found to register the same temperatures and to respond at the same rate to changes within the range used, were mounted inside an insulated cardboard box, free of the sides, and used for simultaneous readings on leaves from root-rot and from normal plants. This box was carried around the field to the plants, care being taken to have the open side of the box away from the sun and the thermometers thus always shaded. The leaves were selected from adjacent plants, similar in size and other characteristics except that one had wilted from root rot while the other was apparently normal; and each of the pair of leaves to be compared was selected of the same size, height on the plants and exposure to the sun. Each leaf was cut off the plant with small scissors, grasped with forceps, doubled together rapidly, and the doubled leaf then folded around the bulb of the corresponding thermometer. An insulating cardboard cover was immediately slipped around the bulb and leaf, and clamped loosely in place. The entire operation took ten seconds or less, and the leaf was touched only with the implements which were all kept in a shaded compartment of the thermometer box when not in use. Immediately before putting the leaves on the thermometers, the air temperature was read and recorded for each thermometer; after clamping the leaves in place, readings were taken at intervals of 1 minute for 3 or 4 minutes. The thermometers usually showed a rapid change during the first 30 seconds, but after 1 minute the equilibria reached usually remained unchanged for 5 to 10 minutes or until the thermometer bulbs were again exposed to the air. The thermometers were alternated, each being used first for the leaf from a normal plant and then for the leaf from a root-rot plant. On account of this alternation, any unobserved lag in reaching equilibrium with air temperature would have tended to decrease rather than to accentuate the differences found between the leaves from the normal plants and those from the wilted plants.

Measurements with mercury thermometers were made on July 15, on a bright, sunny afternoon, and again on July 21, 1930, early on a partly cloudy

[1] Published with the approval of the director of the Texas Agricultural Experiment Station as Contribution No. 177, Technical Series, of the station.

[2] J. J. Taubenhaus and Walter N. Ezekiel, "Cotton Root-rot and Its Control," Texas Agr. Exp. Sta. Bul. 423, 1931.