course, have no bearing on the question as to how the virus is disseminated in the body under natural conditions of invasion from the periphery, before it has come in direct contact with the central nervous system.

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Feathers as Indicators of Concentration of Female Hormone in the Blood.*

MARY JUHN, G. H. FAULKNER AND R. G. GUSTAVSON.
(Introduced by F. R. Lillie.)

From the Whitman Laboratory of Experimental Zoology and the Department of Physiological Chemistry, University of Chicago.

In the first observations made in this laboratory on the induction of ♀ feathering in capons and cocks subsequent to injections of chemically prepared ♀ hormone during the period of feather regeneration, regional variations in the degree of plumage responses became evident. It was noted that feathers having a more rapid growth rate required definitely higher concentrations of hormone for the female reaction than feathers having a slower growth rate.[1] The growth rates of feathers in various parts of the body have now been accurately measured, and constant regional differences have been established. The birds used for these experiments were brown leghorn fowls, and in this breed the capon is similar in plumage to the cock. In both cock and capon, the growth rate of the feathers is greater in the breast than in the saddle or back, and even greater in the posterior than in the anterior region of the breast. The ratio between the most rapidly and the most slowly growing feathers when measured in growth in length per day is approximately 2:1. In the hen differences in growth rate in various parts of the body are slight, and the general rate for all is intermediate between the maximum and minimum rates of the cock. The threshold concentrations of hormone required for the ♀ reaction are closely correlated with this observed difference in growth rate.

Feathers formed on a capon receiving regular effective daily injections of female hormone are completely female in character; if, however, the injections are restricted to short periods of time, then

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[1] Juhn and Gustavson, *J. Exp. Zool.*, 1930, lvi, 31.

bars or patches of female color are laid down on an otherwise male type of feather. One single injection will, if sufficiently large to produce the threshold concentration, be recorded by the feather. If injections are given intermittently, then feathers with alternate bars of female and of male type are formed, the width of the bars varying with the size, and the number, of the injections. On the long saddle feathers it is possible to produce 5 such bars, by a treatment consisting of a sequence of 3 daily injections, then an interval of 3 days with no injections, and a repetition of this cycle 4 times.

In any one bird the induced ♀ bars are broader in the saddle than in the breast feathers, and since the rate of growth *of the female bar* is approximately the same in both, this indicates that the concentration of hormone in the blood was above the saddle threshold for a longer time than it was above the breast threshold: *i. e.,* the more slowly growing saddle feathers have a lower threshold, as indicated above. By measuring the width of the ♀ bars induced in the various types of feather on any one bird in hours of growth, a record is obtained of the relative times at which the concentration of hormone in the blood passed their respective thresholds in its rise and fall.

As the concentration of hormone following injection rises and falls, it passes the thresholds for the various types of feathers in sequence. If one now plots a curve of the cubes of linear growth rates of feathers in the various regions of the body against time it is found that the various thresholds appear on this curve in their natural order and proportions. Such a curve, therefore, expresses the concentration of hormone in the blood, or the affected feather germs, as it rises and falls after injection and cessation of injection, measured in threshold values.

The following additional data for the construction of this curve have been determined by subsidiary experiments. Female pigment is laid down in the feathers growing on the breast 48 hours after injection of an effective dose of the hormone given in olive oil. If the injection is not repeated, the hormone is gradually excreted after this time, but other feathers show that some probably persists in the blood for 72 hours. From this it follows that if daily injections are given, the concentration induced by the first 2 or 3 is a summation, and the maximum attainable by the dosage being used is not reached for about 3 days. If daily injections are omitted on one occasion, the breast feathers with high growth rate and threshold revert during this time to the male type, though the saddle feathers with a lower growth rate and threshold do not. However, if the injections are omitted on 2 consecutive days, the posterior saddle

feathers (growing slightly faster than the anterior saddle) also revert to the male type, and after a 3-day omission the most slowly growing anterior saddle feathers also revert. These observations give an indication of the rate of excretion of the hormone after cessation of injection. They demonstrate that, with the particular preparations and dosages used, the hormone is not entirely excreted in 3 days.