during the period of fasting serum phosphatase decreased from 200 to 139 units; the changes of icteric index and of bilirubin were not parallel during the same period or subsequently.

The maximum phosphatase content was approximately 80 times the initial value. This is the highest value that we have obtained in any condition in any animal. It may well be near the possible maximum in the dog. The high value of serum phosphatase was all the more significant in view of the marked malnutrition toward the end of the experiment, associated with gastro-intestinal disturbances and hemorrhages (necropsy showed gastric and intestinal ulcers).

It would have been desirable to amplify this study with data of tissue phosphatase changes. Studies in this direction are in progress.

7493 P

Pattern Analysis in Plumage.* I. Curve of Barb Growth.

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Lillie and Juhn[1] reached the conclusion that "general physiological conditions produce morphological diversity in genetically identical feather germs, and . . . . the main cause of the diversity of action is definitely oriented, accurately regulated differences of growth rate within the germ." (p.177.) It was further pointed out that, since pattern is primarily differentiation in respect of barb level, the curve of barb growth rate becomes highly important in the interpretation of pattern. A curve given in the earlier study was believed to describe the growth of a barb from its origin at the ventral collar limit to its emergence on the rhachis. From this curve of barb growth it was concluded that the rate of barb growth decreased continuously from a maximum value at the point of origin to a minimum value at the dorsal limit of the collar. Differentials in growth rate are greatest through the ventral-most region of the collar and decrease progressively to the dorsal limit of the collar. Growth rate through the ventral-most quarter of the collar is, in terms of the curve of barb growth given, several times the rate of growth through the 2 dorsal fourths of the collar.

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[1] Lillie, Frank R., and Juhn, Mary, *Physiol. Zool.*, 1932, **5**, 124.

Further study of the subject has confirmed the idea of a growth gradient in the barbs, but at the same time has led to the conclusion that the gradient was originally represented as too steep from ventral to dorsal regions. Several lines of evidence bearing on this conclusion are as follows:

1. Completely limited pattern reactions. Lillie and Juhn have shown that it is possible to induce the female pattern completely across one vane-half of wing covert feathers without visible reaction in the opposite vane-half. This complete asymmetry is interpreted in terms of differential growth rate levels of barbs on the 2 sides of the germ. It follows that there can have been no regions of equal growth rates in the 2 collar halves during the period of pattern determination. The maximum rate of barb growth in the vane-half reacting to female hormone must accordingly have been less than the minimum growth rate of the vane-half in which the reaction does not appear.

The limiting necessary difference of growth rates in the 2 collar halves is given approximately by the differences in growth rate at dorsal and ventral limits of the generalized curve of barb growth. Assuming moderate values for the ventral-dorsal ratio of barb growth rates, the difference in rates of growth of barbs in the 2 collar halves would be of the order of several hundred percent. Known relations of collar length, barb length and asymmetry of growth observed in germ preparations combine to eliminate the possibility that growth rate differences of any such order exist in fact in the wing covert feather.

2. Making use of the methods described in the following note, we have attempted to transpose pattern relations in the definitive feather to events in the collar which must have corresponded to the origin of these patterns.

The regions of reaction observed immediately adjacent to the collar correspond with the observed pattern in the definitive feather. If, however, we attempt to follow the course of a pattern above the zone of differentiation, and from these relations attempt a transposition to the definitive feather or vice versa, discrepancies are apparent. The transposition of the definitive feather pattern indicates that the differences in growth rates in the germ in respect of barb level are relatively small. A quantitative formulation of barb development from the time of origin of the barb to its final position in the feather should make possible a direct transposition of pattern relations from the definitive pattern to the germ and equally, the converse operation. We are at present engaged in such an analysis.

3. Fault bars. The ideal line of pattern contour would of course be given if an instantaneous reaction might be induced at the same collar level with respect to the barbs. An examination of fault bars suggests that they may approach this limiting condition rather more closely than do experimentally induced reactions. We have attempted to transpose the definitive fault bar line to the collar in order to derive the antecedent barb relations. The *apparent* differences in barb growth rates thus arrived at are smaller than are the differences called for by the original curve of barb growth. At this time we record these observations without considering the value of fault bars in plumage analysis to have been demonstrated beyond question.

7494 P

Pattern Analysis in Plumage. II. Methods of Definitive Feather Analysis.

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The correspondence of events in the germ and definitive feather pattern characteristics is implicit in the relations which Lillie and Juhn have shown to exist in the collar during the reaction of barbs at all levels to high concentrations of thyroxin and female hormone. From this point of view measurable elements of pattern are of direct developmental and physiological significance. Definitive pattern relations are also of direct importance in other respects, as in the quantitative formulation of symmetry relations. We report here methods which have been developed to give the desired data.

The characteristics of the definitive feather which can be measured are distances between barbs on rhachis, lengths of barbs, and lengths of pattern elements within the limits of definition as barb or rhachis segment. Barbule lengths and distances between barbules may also be measured in certain instances.

(a) Mounting the feather. In order to obtain the desired measurements on barb length and barb frequency with precision and reasonable rapidity it is necessary that the feather be permanently mounted with reference to simplest possible axes, *i. e.*, with barbs at right angles to rhachis.

The rhachis of the feather is first set in paraffine, applied hot, on the glazed surface of heavy bristol board. The barbs are then