

The correlation described here between rate of growth and pigmentation (and feather length) is based strictly upon successive feathers from a single follicle. Feathers composing a given tract, as for example the main tail sequence, do not emerge simultaneously. The last feather of the first generation sequence to appear resembles the second generation feather from the follicle first in order of emergence. The second generation feather of any follicle must accordingly be compared with the first generation feather from that follicle alone. In the breast regions first generation feathers emerge relatively late. These feathers are accordingly much more similar to the adult type than are the first generation tail feathers which bear no resemblance whatever to the black adult feather. In terms of the view previously put forward, the specific pigmentation pattern found in a given feather appears to be a function of its rate of growth. The results described here are taken to support this earlier interpretation of the rôle of growth rates in the determination of pigmentation patterns.

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Paralysis in Old Age in Rats on a Diet Deficient in Vitamin E.*

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On January 3, 1935, a group of rats, just weaned, were put on a highly purified fat-free basal diet, 550-B.¹ Supplements consisted of British Drug House vitamin A, viosterol, and yeast from which practically all fat had been removed with alcohol and ether. This yeast proved to be slightly deficient in vitamin B₁ (antineuritic) and was supplemented with 10 gammas daily of crystalline B₁. Fat deficiency symptoms soon developed and were cured by the daily addition of 5 drops of linseed oil. The only factor which was known to be low or absent was vitamin E. The animals (all females) grew moderately well, and at the end of one year had an average weight of 172 gm. During the second year of life 3 of the 8 animals died from unknown causes. The survivors maintained their weight well in spite of the relatively high purity diet. In September, 1936, when

* The work was aided by grants from National Live Stock and Meat Board and from the Research Fund of the Graduate School of the University.

¹ Burr, G. O., and Burr, M. M., *J. Biol. Chem.*, 1929, **82**, 345.

approximately 22 months old, all 5 rats became paralyzed with loss of use of their hind limbs. The average weight for the group was 168 gm. Only one rat had lost weight; the rest were at the maximum for their entire life. The most striking fact was the incidence of paralysis at exactly the same age in all rats.

Efforts to effect a cure were made by increasing the yeast, the crystalline B₁, addition of Jensen's B₁ adsorbed on Fuller's earth, and addition of large doses of vitamin E. No method was successful, and in January, 1937, all rats had maintained their weights fairly well in spite of their difficulty in reaching food cups.

The one factor which is known to have been low or absent throughout the experiment was vitamin E. Vitamin E paralysis² is readily induced in suckling young and is known to be incurable (except for spontaneous cures). Rats may go through life paralyzed, grow to normal size and produce normal young. Further experimentation may demonstrate that this old age paralysis is also due to vitamin E deficiency. Hitherto it has been thought that a lack of this vitamin had no effect on the adult female rat except to produce sterility.†



FIG. 1.

Rat No. 34484 photographed at 2 years of age after being paralyzed for 2 months. Weight 176 gm. In fair condition except for paralysis of hind limbs.

² Evans, H. M., and Burr, G. O., *J. Biol. Chem.*, 1928, **76**, 273.

† A personal communication from Dr. H. M. Evans of California reveals that a similar paralysis has recently appeared in their colony. They attribute the effect to lack of vitamin E.

The nature of the paralysis is now under study by one of us (R.L.M.).

Gross findings are briefly: (1) In ordinary movements the hind limbs were not used, but were dragged along, in the flaccid condition. However, when the animal made vigorous attempts to move its body, the hind limbs were alternately flexed and extended, but were unable to support the hind part of the body, suggesting a weakness in the adductors of the thigh. (2) Faradic excitation of the skin of the intact animal showed that the sensibility to painful stimuli had not been affected. (3) Faradic excitation of the isolated muscles and larger nerve trunks of the leg and gluteal region gave normal responses. (4) Although normal movement of the hind limbs is affected, the paralysis is neither completely motor nor completely sensory. At autopsy the muscles of the leg and gluteal region were not noticeably atrophic. The sensory ganglia of the brain and spinal cord and the posterior funiculus of the spinal cord had a yellow color. From microscopic examination there are indications of pathological changes which are being studied in detail.

Pathology of the vitamin E paralysis appearing in suckling young has been studied by Lipshutz.³

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Relation between Thyroid and Growth of Testes and Penis When Stimulated by Electric Light.

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Immature male ducks, when fed with thyroid tissue^{1, 2} or injected with thyroxin² become sexually stimulated. Furthermore, thyroidectomy delays the normal testicular growth in chickens and ducks³ and reduces considerably the testicular growth in immature ducks exposed for 15 hours per day during 3 weeks, to the stimulating action of electric light.⁴

In new experiments, 10 Pekin ducks were thyroidectomized and

³ Lipshutz, M. D., *Revue Neurologique, T.*, 1936, **65**, 221.

¹ Jaap, R. G., *Poultry Science*, 1933, **12**, No. 5.

² Aron, M., and Benoit, J., *C. R. S. Biol.*, 1934, **116**, 218.

³ Benoit, J., and Aron, M., *ibid.*, p. 221.

⁴ Benoit, J., *ibid.*, 1936, **123**, 243.