

bolic rate during the fever, on myxedema cases before and after treatment, on patients whose basal metabolic rate had been changed by reduction in diet, and on cases in which basal metabolic rate had been increased following adrenalin injections, etc. (Table I.) We excluded all cases of valvular heart disease, of heart failure from any cause, and cases showing anemia. The basal metabolic rates in the cases which could not be called normal varied between -42% and $+29\%$. In our series, the standard deviation was 0.17 and the coefficient of variation was 8%. In other words, the variability has been reduced by one-half from Grollman's¹ findings with his cardiac index. We believe that our formula expresses a law of physiology which has no greater variations than other laws of biology; namely that transportation of oxygen is keyed to oxygen consumption.

8441 P

Transmission of Rabbit Papillomatosis by the Rabbit Tick,
Haemaphysalis leporis palustris.

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Rabbit horns occurring on cottontails and on jack rabbits were described by Seton.¹ He reported specimens collected in Oklahoma, Nebraska, and Colorado. Transmission of these tumors was accomplished by Shope, who described them as infectious papilloma. Shope further showed that the causative agent is to be classed as a filtrable virus,² and succeeded in transmitting tumors to domestic rabbits.³

Our first attempts to transmit the infection to domestic rabbits were unsuccessful and we were unable to demonstrate any intracellular structures which might be termed inclusion bodies. Subsequently we succeeded in transmitting the tumors to cottontail rabbits,⁴ domestic rabbits,⁵ and to snowshoe hares.⁶ More recently Beard and

¹ Seton, E. T., *Life Histories of Northern Animals*, Vol. I. Charles Scribner's Sons, New York, 1909, p. 672.

² Shope, R. E., *J. Exp. Med.*, 1933, **58**, 607.

³ Shope, R. E., *Proc. Soc. Exp. Biol. and Med.*, 1935, **32**, 830.

⁴ Green, R. G., and Shillinger, J. E., *Reports Minnesota Wildlife Disease Investigation*, February, 1934, **1**, 13, 14. Mimeographed U. S. Dept. Agriculture.

⁵ *Ibid.*, July, 1934, **60**, 61.

Rous have established the experimental infection in snowshoe hares and in jack rabbits.⁷

We have observed many cases of the natural infection, and in Minnesota have found the condition to occur in more or less endemic areas. The occurrence of the tumors more conspicuously on the head and neck, and their discrete distribution on almost any part of the body, indicate insect or arthropod transmission.

We have thus far investigated experimental transmission by fleas, wood ticks and rabbit ticks. Six attempts to transmit the tumor by the feeding of fleas have given negative results, as have six trials by the feeding of wood ticks in the nymphal and adult stages. The larval stage of the rabbit tick failed to transmit the infection in one attempt made. A single experiment with the nymphal stage of the rabbit tick gave a positive result.

In this successful experiment 200 flat nymphs were fed in a muslin bag over the ear of a cottontail rabbit carrying an experimental papilloma at the base of the ear. After 24 hours' feeding, 50 ticks attached near the base of the experimental papilloma were removed. The remaining 150 ticks feeding on the ear apart from the horn were allowed to feed for 5 days, and no new horns developed subsequently at the site of feeding. Fifty ticks removed from attachment near the base of the horn were placed in a muslin bag upon one ear of another cottontail rabbit and were allowed to feed for 5 days. Twenty-one days after placement, 2 small horns were observed at the site of tick infestation, and 3 days later 5 additional small tumors were noted in the same locality. Growth continued and they developed a typical infection of rabbit papillomatosis as it occurs in wild rabbits. In conjunction with this experiment, fecal material taken from the infective ticks was scarified into the skin of another cottontail rabbit without causing the production of papillomas.

The rabbit ticks used in this experiment were collected in the Lake Alexander Area, Morrison County, Minnesota. This source practically precludes any possibility of the ticks being naturally infected with the virus of rabbit papillomatosis. Intensive study of this 4,000 acre area over a period of 10 years has failed to reveal any evidence of the virus of papillomatosis. Over 4,000 rabbits have been banded on the area. Recaptures and examinations of wild specimens have been at least 3 times that number. More than

⁶ *Ibid.*, Vol. II, January, 1935, 5, 6.

⁷ Beard, J. W., and Rous, Peyton, *PROC. SOC. EXP. BIOL. AND MED.*, 1935, **33**, 191.

4,000 rabbits have been collected from the area and have been given minute examination. As the rabbits during the summer time have averaged over 2,000 ticks, there has been ample opportunity to observe the spread of this virus if it were present in the ticks. Many experiments involving the feeding of ticks upon rabbits have been carried out with the collections from the Lake Alexander Area without production of rabbit horns. The possibility of a spontaneous development of the tumors described above would therefore appear to be excluded by the origin of both the experimental animals and the ticks from the Lake Alexander Area.

The development of the experimental horns only on the one ear infested with ticks and the appearance of numerous foci of development within a two-day period and at a time corresponding to the incubation period of the infection, point directly to the tick bites as the source of infection.

Our successful transmission of rabbit horns by the feeding of ticks shows only a mechanical transfer, but demonstrates that sufficient virus may be carried by an insect bite to produce successful inoculation. It appears probable that this infection may be likewise transferred by mosquitoes and biting flies.

8442 C

The Vitamin-B and -G Content of Commercial Beer.

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Since beer is being advertised by several commercial companies as a source of vitamins, it is desirable to have quantitative information on its vitamin content. The only published studies on this question were made on European beers more than 8 years ago. Scheunert and Schieblich¹ and also Southgate² demonstrated vitamins of the B complex in beer and reported further that A and C are very low or absent. On the other hand, Harden and Zilva,³ while agreeing on the absence of C, were unable to find B in the beer which they examined.

¹ Scheunert, A., and Schieblich, M., *Chemie der Zelle und Gewebe*, 1924, **12**, 45; *Biochem. Z.*, 1927, **186**, 229.

² Southgate, H. W., *Biochem. J.*, 1924, **18**, 769.

³ Harden, A., and Zilva, S., *Biochem. J.*, 1924, **18**, 1129.