

TABLE IV
EMBRYO PASSAGE OF MOUSE TISSUE

<i>Egg Passage</i>	<i>Crop #4*</i>	<i>Crop #30*</i>	<i>Brain #14*</i>	<i>Brain #18*</i>
First	7/9†	7/9	7/10	2/10
Second	0/10	0/10	3/9	0/10
Third	0/10	0/10	0/10	0/10

* Number refers to original autopsy number given to specimen.

† Ten embryos were inoculated per tissue.

The specifically active tissues from mice were traced back to duck origin and a striking similarity was found for each tissue. On initial duck autopsy, specimens numbered 4 and 14, arbitrarily, showed engorged and necrotic crops, brain inflammation and no lead in the gizzard. Specimens numbered 18 and 30 showed all but necrosis of the crop. All were impacted. Tissue extracts from these specimens produced gas distention of the intestine and brain inflammation on mouse passage.

DISCUSSION

The laboratory findings indicate that the Mallard "die-off" in Arkansas was due primarily to three causes: namely, lead poisoning, crop engorgement suggesting "impaction," and a micro-biological agent of low virulence to chicken embryos and white mice. It is postulated by the investigators that this low-virulent agent could be the biological factor responsible for a condition conducive to "crop impaction" since it is the opinion of these investigators that "impaction" would not occur or cause death unless there was present some other disturbing factor.

REFERENCES

1. Durant, A. J. Impaction and pressure necrosis in Canada Geese due to eating dry hulled soybeans. *Journal of Wildlife Management*, XX, 1956: 399-404.
2. Hanson, Harold C. and Robert H. Smith. Canada Geese of the Mississippi flyway. *Illinois Natural History Survey Bulletin*, XXV, 1950: 159-161.
3. Perkins, J. W. U. S. Fish and Wildlife Field Communication, 1956.

THE OCCURRENCE OF TUMORS IN WILD ANIMALS

By LAWRENCE KILHAM

Hunters have noticed "warts" or "horns" on cottontail rabbits for many years and have usually thrown such animals away as unfit to bring home. In 1931, however, one hunter, who happened to be a member of the Rockefeller Institute for Medical Research, brought his cottontail, warts and all, back to the laboratory. This episode was the start of a chain reaction of investigations on virus tumors. The particular cottontail shot near Princeton, New Jersey, had fleshy growths on its skin known as fibromas and in efforts to transmit the virus which causes them, Dr. Richard E. Shope obtained shipments of live cottontails from Kansas. Chance favors in the prepared mind in science. These western cottontails had a second type of tumor,—hard and shaped like a horn—of a type known as a papilloma. A proportion of rabbits afflicted with papillomas eventually die of cancer. While the present report considers tumors as infectious diseases of wildlife, the principle investigations regarding them have been motivated by an interest in medical research.

The two tumors of cottontails, fibromas and papillomas, are distinct in their geographical distributions. The papillomas, or "horns," occur in states such as Minnesota, Iowa and Kansas west of the Mississippi and are found mostly on the heads and necks of afflicted animals. Fibromas or "warts," however, are limited to eastern cottontails. They have been encountered from Michigan to New York and Maryland and are located mostly on the feet and lower legs. A surprising thing is that thousands of western cottontails have been liberated

in eastern states, but none of them have been known to develop papillomas in their new environment.

Hunters may notice that the tumors of either type, east or west, are fairly numerous in certain years and are not encountered at all in other years. They occur in outbreaks like many other kinds of infectious diseases. A few years ago Carlton M. Herman, Oscar Warbach, and I studied one such outbreak, of fibromas, among cottontails of the Patuxent Research Refuge. The rabbits were live-trapped over a 6-year period, from 1947 to 1953. Fibromas were encountered in only 12 months of this time, from December 1950 to December 1951. Using specific blood tests, as well as direct observation, we found that 30 percent of the 86 cottontails captured had or had had fibromas during the outbreak. Animals retrapped or maintained in captivity were observed to lose their tumors over several months to a year. Their general health was not affected.

I became interested in the problem of how the fibroma disease might be transmitted. It was obvious from initial laboratory experiments that fibroma could be passed from one cottontail to another by fleas or even by pin pricks. Neither of these methods produced good tumors. I then tried mosquitoes with the aid of Dr. Paul A. Woke and found that the insects were remarkably efficient vectors for the fibroma virus, transmitting the agent immediately after feeding on a tumor or for as long as five weeks afterward. Four different species of mosquitoes native to the eastern United States were used with equal success. They appeared to feed on tumor in preference to other parts of the body. Probable reasons for this preference, were that the fibromas represented raised landing areas, the bare surfaces of which had a rich supply of blood vessels for the mosquito to probe. A mosquito might pick up 10,000 infectious doses of fibroma virus, along with the blood, after feeding; and Dr. Herbert Dalmat and I discovered that the virus remained in the head parts of the insect. The virus does not multiply in the mosquitoes. It appears probable that cottontails bearing tumors are the natural reservoirs of infection during winter months. Dr. Dalmat has recently shown that papillomas, the "horns" of western cottontails, can be transmitted by mosquitoes as well as by assassin bugs, giving a second example of insect transmission of a virus tumor.

Thanks to Dr. Herman, I was able to obtain a series of grey squirrels caught or shot in the vicinity of Washington, D. C. These animals had many small tumors. Investigations showed that the virus involved was similar to that of the Shope cottontail fibroma and could be transmitted from one young squirrel to another by means of mosquitoes.

Dr. Richard E. Shope has continued his interest in tumors of wildlife over many years. He has been working recently on tumors of wild deer. The occurrence of these fibromas, which usually cluster on the heads and necks of the animals and may impede vision, has been observed from California to New Jersey. Dr. Carlton M. Herman has given one of the earliest descriptions. Deer do not make very easy subjects for laboratory research. Dr. Shope, however, was able to obtain orphaned fawns, raised on bottles, and to demonstrate that deer tumors are due to a virus which is apparently different from that causing similar skin tumors in cattle. Hunters should not fear that they will get any of the above tumors from handling wild game. All of these growths, whether fibromas or papillomas, are only skin deep; they are removed with the hide and they are not contagious for man.