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TICK PARALYSIS *

JOHN L. TODD

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Although for many years it has been well known by physicians practicing in southern British Columbia that paralysis may appear in children who have been bitten by ticks, it is only a few months since accounts of such an affection as "tick paralysis" appeared in scientific publications (Todd, 1912, 1912a; Temple, 1912). Medicine owes a debt to these practitioners, Corsan, Henderson, Hall, Kingston, Morris, Rose, Shewan and Temple. Their observations have supplied the first records of paralysis produced in children by the bites of ticks.

The first accounts of the disease were merely short descriptions of the symptoms which had been observed by half a score of physicians in a series of more than twenty-five cases. The patients had been seen during a number of years — Temple saw his first case in 1898 — in various places in southern British Columbia and in the neighboring portions of the United States. All of the patients were children; there were, however, somewhat obscure accounts of instances in which symptoms, resembling those observed in children, had been seen in men who had been bitten by ticks. The history and symptoms were much alike in all of the cases. The usual story was that an active and apparently healthy child suddenly developed a paresis or paralysis of the legs; neither abnormal temperature nor any other symptom but paralysis was constant. After the tick was discovered and removed the symptoms disappeared within a few hours, with the possible exception of a more or less local reaction, often probably due to a secondary bacterial infection, at the site of the tick's bite. In some of the cases reported the tick was not removed; in them the paralysis progressively involved the whole body until reflexes and control of the sphincters were lost, and death ensued.

The symptoms of these cases suggest infantile paralysis (acute poliomyelitis); but they are probably to be distinguished from cases

* I wish to express my indebtedness to all those who have supplied me with the information and material which has made this paper possible; the names of most of them are mentioned in it.

of that disease by the invariably transitory nature of their paralyses. In no instance has "tick paralysis" left permanent disability. It seems impossible to explain these many cases of "tick paralysis" as mere coincidences, in which tick infection has been fortuitously associated with sporadic attacks of a peculiarly mild form of acute poliomyelitis; none of the practitioners who saw these cases have recorded the contemporary existence of definite cases of acute poliomyelitis. Also, the symptoms of these cases of paralysis have little in common with the symptoms of the typhus-like "spotted fever," which is seen in persons bitten by ticks (*Dermacentor venustus*) in some parts of Montana. For these reasons it seems certain that a form of paralysis associated with the bites of ticks occurs in children in western North America and that the infection can be identified with no known disease. Similar cases from Wyoming and Montana have been reported (Bishopp and King, 1913). More recently very similar histories of instances in which paralysis has followed the bites of ticks (probably *Ixodes ricinus* or *I. holocyclus*) have been reported from Australia (Eaton, 1913).

Hadwen (1913) describes the occurrence of paralysis in sheep, which have been bitten by ticks, in British Columbia. He and Nuttall (1914) give references to publications which describe the existence of a paralysis caused by ticks (of a species, *I. pilosus,* other than that which exists in British Columbia) in South African sheep. Hadwen succeeded in producing paralysis in a lamb on which a tick (*D. venustus*) had, experimentally, been allowed to feed. He, with Nuttall (Hadwen and Nuttall, 1913), was successful in producing the same symptoms in a dog. A very complete bibliography of the effects of tick bite can be reached by a search through the papers referred to in this communication. Hadwen, especially, gives a good list of articles on the bites of ticks.

Since the observations contained in the publications mentioned above were published, the cases recorded below have been reported.

Dr. W. J. Knox, Kelowna, B. C., records two cases.

April 23, 1913, a boy of 4 years had pronounced flaccid paralysis from the hips down. He could not stand; his arms were weak; there was hyperesthesia; the pupils were normal; the temperature was 100 F.; the pulse was 112. The first symptom had been a little stiffness of the legs twenty-four hours previously; it progressed until in twelve hours walking was extremely difficult. A tick was found in the left axilla. It was removed by snipping it out with the tissue about its head; the wound was dressed antiseptically. A purgative was given to the child and, under slight stimulation, the pulse quickly became full and steady. In twenty-four hours the child could move his limbs fairly well, and in forty-eight hours he was apparently as well as ever.

April 21, 1914, a girl of 3 years had slight paralysis of the right leg. The temperature was normal. Her condition was said to be better than it had been two hours previously; so rest and a purgative were prescribed. Twelve hours later the child was stuporous. Her legs and arms were entirely par-

alyzed; she could neither articulate nor swallow, and seemed to be sinking very rapidly. The pulse was 130, small and weak. The temperature was 102 F. No tick was found on the child's body, but the hair was clipped short and a small wood tick was found at the base of the skull. It was removed by snipping it out with the tissue surrounding its head. The wound was dressed antiseptically and purgatives and stimulants were given; in six hours the child's temperature was 99.4 F., her pulse 100 and regular and she was conscious and asking for water. In twelve hours she could move her limbs and in five days was running about as well as ever.

Dr. Knox also reports a case of quite another type in an adult.

April 27, 1914, a man of 28 years was seen. He gave a history of having pulled off the body of a tick, leaving the head behind, from the calf of his left leg. At the site of the bite was a large bluish-black area surrounded by much induration. The patient's body was covered with a spotted erythema. He felt very ill, and complained of vertigo and of pains in the back and in the legs. His pulse was 108, his temperature 102.5 F. Sensation was lost in the right leg from 6 inches below the hip-joint; the left leg was paralyzed. The head of the tick was excised and the wound dressed antiseptically. A purgative was given and in twelve hours the temperature had dropped to 99.6 F. and the pulse to 86. In thirty hours the temperature was normal, and the rash and pain were gone; in four days the patient, being well, was discharged.

Dr. Knox records an instance in which a very thin colt, so weak that it could not stand, was covered with ticks; the ticks were removed and within a few days the colt was able to walk and gradually regained its health. (It is possible that this was nothing more than a case of severe "tick worry.")

Dr. Elmer Fessler, St. Regis, Montana, records two cases.

On the morning of May 19, 1914, a 2-year-old girl was found to be unable to walk or stand, although she had slept well and had been quite well on the previous day. She tried to walk several times during the day but she was unable to do so. When the physician first saw her, on the morning of the twentieth, her temperature was 96.5 F., her pulse 120 and her respiration was normal. She could move her legs, but she could not stand, and the leg reflexes were gone. There was considerable loss of function of the arms. The mother said more than on the previous day. No urine had been passed for twenty-four hours. Although the child was somewhat peevish, she took her food as usual. Two ticks (*Dermacentor venustus*) were removed from the nape of the neck; one was a half-engorged female, the other a male. The child was given cathartics. In six hours her hands were moved less clumsily and a little later she tried, unsuccessfully, to stand. At 9 the next morning she could walk and by noon was running about as usual. She has been quite well ever since.

In 1905 a girl of 5 years was seen who was said to have been unable to walk for forty-eight hours. She could not move her legs which were without reflexes. She could move her arms clumsily, but could hold nothing in her hands. A large tick was removed from the base of the skull and on the following day she seemed to be quite well, save for a slight weakness that persisted for some days.

Dr. A. W. Kenning, who practiced in Rossland, southern British Columbia, for sixteen years, mentions two cases.

One, the only fatal case, which he saw, was in a girl of 8. She had general paralysis and when the tick was found on her arm, she was comatose with a rapid pulse and high temperature. The other case was a child of 6 who had general paralysis; the whole body was involved. On removing the tick from the child's head, she recovered as was usual in such cases.

Dr. G. S. Gordon, Vancouver, B. C., has records of one case.

In 1904 (?) a girl of 5 years was seen. The child came of neurotic stock; she seemed well in every particular save that, though she could move her arms and legs while sitting on the floor, she could not walk nor put one leg before the other when she was supported in the erect position. A second practitioner, whose opinion was asked, told the parents to look for "wood ticks." One was found and on its removal the symptoms disappeared.

Dr. R. W. Irving, Kamloops, B. C., records a case in a child.

May 1, 1912, a boy of 8 years was seen. He complained of numbness in his legs and was unable to stand. He seemed rather sleepy and dull; but otherwise was healthy, save that he could only move his legs in an ataxic manner while lying in bed and that at times his arms seemed to become weak. The special senses were not affected nor were the cranial nerves involved. The knee-jerks were not obtainable. There was no ankle clonus, nor Babinski's sign. The sphincters were under control and there were no areas of anesthesia or hyperesthesia. The pulse was normal and the temperature was 99.2 F. A tick was found at the base of the skull and it was removed. Under rest and catharsis the boy, in three or four days, became perfectly well.

Dr. Irving, with Dr. Murphy, saw a case in which definite nervous symptoms in an adult were associated with the presence of a tick.

A normal, well-nourished male of 40 years complained that four days previously he found it difficult to speak and that he was awkward in his movements. He had been perfectly well and said that he had felt as though he were "partially drunk." A day later he fell on attempting to arise in the morning and was unable to balance himself in any way. When the patient was seen there were few constitutional symptoms and his only other complaint was that he felt "a bit seedy." On examination his hands and arms were found to be weak and incoordination was definitely present. The knee-jerks were absent; there was no ankle clonus, Babinski's sign, area of anesthesia or hyperesthesia, and no involvement of cranial nerves nor loss of sphincter control. A tick was found on the upper part of the back and removed. The symptoms commenced to disappear within twenty hours. In three days the man was as well as ever, and in three days more he was married.

These and other cases add a little to the first descriptions of the affection; they show that an elevated temperature, a rapid pulse and respiration and other constitutional conditions may frequently be symptoms. It also seems probable that nervous symptoms may supervene in adults who have been bitten by ticks. Convulsions, sudden stupidity and clumsiness are mentioned as symptoms that may follow tick bite. One physician asserts that in southern British Columbia practitioners, who have been in the country for long, always look for ticks on a child who has a convulsion. One or two physicians mention cases which suggest that spotted fever may not be entirely confined to Montana. There are many records of ulcers and other inflammatory lesions at the site of ticks' bites. Sometimes these lesions are said to be suggestively obstinate to ordinary treatment.

The experiments recorded below were made in the hope of producing, under experimental conditions, paralysis in laboratory animals, by the bites of ticks.

The way in which the experiments were done was practically identical in each instance. The animals, together with control animals, were well cared for. The lambs, when the experiments commenced, were from 4 to 6 weeks old; they were kept in pens with their mothers. The puppies were about the same age; they were kept in individual cages and fed on milk. The ticks were attached either to the nape of the neck or to the loins as is stated. The hair was removed either by slipping and shaving or by epilating powder. The ticks were then placed on the skin beneath a finely perforated porcelain filter cone, which measured about 1 inch in diameter at the base and 1 inch in height. The cone was fastened to the animal by an ample bandage of adhesive plaster, firmly stitched in position. As a rule, this method of attaching the ticks was satisfactory. In only one or two instances did the ticks find their way beneath the edge of the cone and become lost or fixed to the plaster. Paralysis was produced in no experiment.

Monkey 1.—Aug. 16, 1912. Two ticks (*D. venustus* or *D. andersoni*), sent by Dr. J. B. McClintic, Victor, Mont., were placed on the nape of the neck of a large rhesus monkey; August 21, both ticks, each half engorged and firmly attached, were removed. August 24, three ticks, from the same source, were placed on the nape of the neck; August 31, two engorged ticks were removed; one tick had disappeared. November 18, four ticks, obtained by Dr. Lee Ganson of Odessa, Wash., from "jack rabbits," were placed on the nape of the neck of this monkey; November 30, during the night the monkey pulled off the bandage and destroyed the ticks.

Monkey 2.—Aug. 16, 1912, three ticks (*D. venustus* or *D. andersoni*), sent by Dr. J. B. McClintic, Victor, Mont., were placed on the nape of the neck of a small rhesus monkey; August 20, the half-engorged ticks were removed. August 24, two ticks, from the same source, were placed on the neck; August 30, one engorged tick was removed; the second was dead.

Monkey 3.—May 2, 1913, three ticks (not identified) were placed on the nape of the neck of a large rhesus monkey. One of these ticks was that which was removed from the little boy whose case is recorded above by Dr. Knox at Kelowna, B. C. The other two were sent by Dr. Boyce, from a horse, from the same place. May 26, the engorged ticks were removed.

Ten ticks, all of them very probably *D. venustus,* fed on one or the other of these three monkeys. Paralysis appeared in none of the three, although the child from which one of the ticks had been taken was paralyzed.

Lamb 1.—April 20, 1914, two ticks (*D. venustus*) from H. P. Wood, Esq., Florence, Mont., were placed on the neck of a lamb about 3 weeks old. The ticks were collected from cattle in a district where "spotted fever" exists. April 21, the lamb was obviously disinclined to move. April 22, the lamb died. A naked-eye examination at the autopsy revealed nothing beyond four or five superficial, almost petechial, pneumonic areas on the lungs. One of these was sectioned and the lung was found to be congested and collapsed, rather than pneumonic. The stomach and intestines were filled with normally digested food.

Lamb 2.—On April 20, 1914, three female ticks, two *D. venustus* and one *D albipictus,* collected by Seymour Hawden, D.V.Sci., from horses at Keremeos,

B. C., were placed on the neck of a lamb about 4 weeks old. April 30, the three ticks, none of them engorged, were removed. Four ticks, three male and one female *D. venustus*, sent by H. P. Wood, Esq. (see Lamb 1), were placed on the neck; May 9, the engorged female and three unfed male ticks were removed. May 28, an engorged female *D. venustus*, taken by Dr. Arthur from the skin of a bear, at Nelson, B. C., was placed on the neck; June 5, the tick was removed unfed. June 19 two ticks, *D. venustus*, sent by R. A. Cooley, Esq., Bozeman, Mont., were placed on the neck; June 24, both ticks were removed, unfed.

LAMB 3.—April 24, 1914, four ticks, from H. P. Wood, Esq., Florence, Mont., were placed on the neck; April 30, two of the ticks were lost and one dead, the remaining living tick was not engorged. Four other ticks, two male and two female *D. venustus*, from the same source, were placed on the lamb; May 9, one of the ticks was dead, the three living ones were removed, none were engorged. May 28, one female, *D. venustus*, partially engorged, from Dr. Arthur (see above) was placed on the neck; June 5, the tick was dead; and probably was never attached. June 19, two *D. venustus*, from Bozeman, Mont., were placed on the neck; June 24, one unfed tick was removed, one was missing. June 25, three *D. venustus*, two females and one male, from Bozeman, Mont., were placed on the neck; July 2, one engorged female and one attached male tick was removed.

LAMB 4.—April 24, 1914, one male and one female *D. venustus*, from Florence, Mont., were placed on the neck; April 30, ticks removed; both had attached; one was fully engorged. Four other ticks, one male and three females, from the above source, were placed on the loins; May 9, ticks removed; all had attached; three were engorged. May 28, three partially fed ticks, one male and two female *D. venustus*, from Dr. Arthur (see above) were placed on the neck; June 5, ticks removed; the two female ticks were engorged; the male was not. June 6, a half-engorged female *D. venustus* was placed on the neck. This tick was one of those removed from the case recorded above by Dr. Fessler. June 12, tick removed; probably had not attached. June 19, a male *D. venustus*, also from Dr. Fessler's case, previously fed on Puppy 1, was placed on the neck; June 24, tick dead. June 25, a male and a female *D. venustus* from Bozeman, Mont., were placed on neck; July 2, the engorged female and unfed male ticks were removed.

LAMB 5.—April 30, 1914, a tick (unidentified) from the case described above by Dr. Irving, was placed on the neck; May 9, tick dead; apparently had not attached. May 28, one male and two female *D. venustus* from Dr. Arthur (see above) were placed on the neck; June 5, ticks removed; two were engorged; one not. June 19, two ticks, *D. venustus*, from Bozeman, Mont., were placed on the neck; June 24, ticks removed, only one was half engorged. June 25, four ticks, two male and two female *D. venustus*, from Bozeman, Mont., were placed on the neck; July 2, one female was dead, the remainder being attached, were left in position; July 7, an engorged female and one dead and one still attached male were removed.

LAMB 6.—May 5, 1914, two female *D. venustus*, from Dr. Hawden (see above), were placed on the neck of this lamb; May 16, both ticks, attached but not engorged, were dead. May 28, one partially engorged female *D. venustus* from Dr. Arthur (see above), was placed on the neck; June 5, tick dead, probably had not attached. June 19, one male and one female *D. venustus*, from Bozeman, Mont., were placed on the neck; June 24, both ticks dead; one attached; neither engorged. June 25, one female and one male *D. venustus*, from Bozeman, Mont., were placed on the neck; July 2, male dead, female engorged.

LAMB 7.—May 9, 1914, a female *D. venustus*, obtained from surveyors by Dr. Arthur of Nelson, B. C., was placed on the neck of this lamb. May 16, tick removed, three-fourths engorged. May 28, two partially engorged female *D. venustus*, obtained from Dr. Arthur, at Nelson, B. C., from a bear skin, were

placed on the neck; June 5, both ticks dead, probably never attached. June 19, two ticks, *D. venustus*, from Bozeman, Mont., placed on the neck; June 24, ticks removed, both attached, one half engorged. June 25, two ticks, *D. venustus*, from Bozeman, Mont., were placed on the neck; July 2, one male tick and one attached female removed, both were unfed.

About twenty ticks, almost all of them adult male or female *D. venustus*, fed on one or the other of seven lambs. Six of the lambs remained in perfect health. One of them (Lamb 1) died on the second day after two ticks were placed on it; it is not probable that the ticks were the cause of death, since other ticks from the same source were harmless to similar animals.

GUINEA-PIG 1.—May 6, 1914, a male and a female *D. venustus* sent by H. P. Wood, Esq., Florence, Mont., were placed on the loins; May 16, ticks removed, the female was partially engorged. June 3, dead; the guinea-pig had seemed to be quite well, and temperature was not abnormal until May 16, when daily observations were discontinued. At autopsy, there were no signs of irritation about tick bites; the cause of death was bronchopneumonia.

No sign of paralysis followed the feeding of a single tick on a guinea-pig.

PUPPY 1.—June 6, 1914, a male *D. venustus*, sent by R. A. Cooley, Esq., Bozeman, Mont., was placed on the back of a puppy, about 6 weeks old. This tick was one of those taken by Dr. Fessler from the case recorded above by him; June 12, tick removed, unattached and unfed. June 19, two male *D. venustus*, from Bozeman, Mont., were placed on the back; June 24, two ticks removed, both unfed and dead. June 25, one male and one female *D. venustus*, from Bozeman, Mont., were placed on the loins; July 2, both ticks dead, neither fed.

PUPPY 2.—June 19, 1914, two male *D. venustus*, from Bozeman, Mont., were placed on the loins of a puppy about 8 weeks old; June 24, both ticks removed, unfed and dead.

PUPPY 3.—June 19, 1914, two female *D. venustus*, from Bozeman, Mont., were placed on the loins of a puppy about 8 weeks old; June 24, ticks removed, both engorged.

Paralysis did not appear in a puppy on which two ticks fed.

The ticks used in all of these experiments were identified with the assistance of the key published by Banks (1908). *Dermacentor venustus* and *D. albipictus* were the only ticks received from southern British Columbia, and of these the former was much the more common. In a personal letter, Hadwen wrote that it is difficult to get *D. venustus* to feed under laboratory conditions unless it has been recently collected; the diaries of the above experiments ratify his statement. The ticks used in these experiments were confined in Ehrlenmeyer flasks plugged with cotton wool, and were kept in a humid atmosphere at 25 C. Care was taken to give every tick every chance for feeding; several of the ticks used in these experiments had opportunities for feeding on two or more animals. These conditions seemed to agree with some females which laid many fertile eggs; but about half of the females laid only a few eggs and these infertile ones.

In the records of the tick-feeding experiments only those ticks which were definitely engorged are counted as having fed. It is unfortunate that their number is not larger and, especially, that the ticks which had been removed from paralyzed children would not all feed well on the experimental animals. Enough fed, however, to justify the statement that, under the conditions of these experiments, not every bite of a tick (*D. venustus* and *D. albipictus*) is able to cause paralysis in the laboratory animals employed.

It was thought that the paralysis produced by the bites of ticks in children might be caused by some toxin secreted by the ticks. Experiments were therefore designed to ascertain whether an extract capable of producing paralysis in laboratory animals could be obtained from the bodies of ticks.

EXPERIMENT 380.—About 4 c.cm. of larvae of "Texas fever ticks," (*Margaropus* sp.?), obtained from Washington, D. C., through the courtesy of the Bureau of Animal Industry, were dried for six weeks, and were then ground up in 50 c.cm. of a 4 per cent. solution of glycerin in distilled water. The resulting mixture was shaken for one and a half hours and then passed through a Buchner and a Berkefeld filter. The fluid so obtained was inoculated beneath the skin of the rump of two rats and two mice; one rat and one mouse received 2 c.cm., the other rat and mouse 1 c.cm. The two mice died within twenty-four hours; no cause of death was evident. The rat which received 1 c.cm. died ninety-six hours after inoculation; the cause of death was not evident. The second rat died two weeks after inoculation, from bronchopneumonia; neither it nor any of the animals had ever shown any sign of paralysis, or of suppuration at the site of inoculation.

EXPERIMENT 400.—Ten adult *Margaropus annulatus* and about 700 larvae, also obtained from Washington, D. C., were dried, ground up in glycerin and water, shaken and filtered in the same way as was done in Experiment 380. Four c.cm. of the filtrate was inoculated beneath the skin at the back of the neck, of two rats; one received 2 c.cm., the other 4 c.cm. Neither rat developed any sign of paralysis nor was there suppuration at the site of inoculation in either.

EXPERIMENT 531.—About 3.5 c.cm. of dried ticks of all ages and of both sexes were employed. Most of them were adults. With the exception of one or two *D. albipictus*, all were *D. venustus*. These ticks were those, or their progeny, which had been used in the feeding experiments described above. All were ground up in 50 c.cm. of a 4 per cent. solution of glycerin in distilled water, shaken for two and a half hours and then filtered through a Buchner and a Berkefeld filter. Respectively, 2 c.cm., 4 c.cm. and 5 c.cm. of the clear filtrate was inoculated under the skin of the rumps of three young white rats, weighing about 30 gm. each. Paralysis appeared in none of them, although as in the previous experiments, all showed some disinclination to move; probably because of the soreness at the site of inoculation. One rat died four days after the inoculation. There was no sign of suppuration at the wound, and the cause of death was not evident to naked-eye examination, at the autopsy.

EXPERIMENT 532.—Five male, eight female and about 1,500 larval ticks, all living *D. venustus*, which had been used, or were the progeny of those used, in the above feeding experiments, were ground up, shaken and filtered in the same way as in Experiment 531. Respectively, 2 c.cm., 4.5 c.cm. and 6 c.cm. of the clear filtrate obtained was inoculated beneath the skin over the rump

of three young rats, each weighing about 30 gm. All of the rats survived; in none did paralysis appear.

EXPERIMENTS 550-551.—Three boxes, each containing a female *D. venustus*, and young seed ticks from her, were obtained from the Bitter Root Valley through the courtesy of R. A. Cooley, Esq. In two of the boxes the females and many hundreds of seed ticks were dead; in the third box the female and seed ticks were living. All were ground up together in 50 c.cm. of normal saline solution, shaken for two hours and then passed through Buchner and Berkefeld filters. About two-thirds of the whole filtrate obtained was inoculated subcutaneously over the withers of a 4½-months old lamb; 3.5 c.cm. of the filtrate was inoculated subcutaneously over the rump of a young white rat. Paralysis was never observed in either of these animals.

It has been proved (Nuttall and Strickland, 1908) that ticks secrete an anticoagulin which prevents blood from clotting. Observations were, therefore, made to ascertain whether an anticoagulin existed in the filtrate of extracted ticks, which was inoculated into the animals used in Experiments 380, 400, 531 and 532. Blood from a healthy man was drawn up into capillary tubes, of about 1 mm. internal diameter, with one-third, occasionally one-fourth, of its volume of the filtrate to be tested. A control tube was made in every instance, in which a 4 per cent. solution of glycerin was substituted for the filtrate. The tubes were then kept at room temperature, and the time in which the blood of each coagulated was observed. The tick extract used in Experiments 380 and 400 seemed to have no definite power of preventing coagulation, since coagulation usually occurred in both tubes in the same length of time. The tick extracts used in Experiments 532 and 531 had a definite, though slight, power of preventing coagulation. That used in Experiment 532 was definitely more powerful than that used in Experiment 531; with it, coagulation had usually only commenced at the end of three minutes, while it was complete at the end of that time in the control tubes. It is possible that the lack of symptoms obtained by the inoculation of the filtrates, as well as the lack of coagulating power of the filtrates used in Experiments 380, 400 and 531, may be explained in part by the comparatively large quantity of diluent in which the ticks were extracted. It must also be remembered that only in Experiment 532 was the extract made from living ticks.

It can be concluded that an extract of ticks, prepared in the manner described, will not cause paralysis in rats even when it possesses slight power to prevent the coagulation of human blood.

SUMMARY

1. Previous publications have proved:

(*a*) That a paralysis in children may be associated with the bites of ticks in western North America and in Australia.

(*b*) That a paralysis of sheep has been associated with the bites of ticks in British Columbia and in South Africa.

(*c*) That the ticks associated with these affections are of more than one sort.

(*d*) That *Dermacentor venustus* has produced paralysis in lambs and in a puppy in experiments made under laboratory conditions.

(*e*) That the paralysis following tick-bite is probably an individual and novel condition.

2. The paralysis of children is not infrequently accompanied by elevation of temperature and by other constitutional symptoms; it is possible that symptoms resembling those observed in children sometimes may appear in adults who have been bitten by ticks.

3. Under experimental conditions by no means every tick bite produces paralysis in laboratory animals.

4. A weak extract of ticks will not cause paralysis when injected into white rats, even though it possesses definite power to prevent the coagulation of blood.

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