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## ROCKY MOUNTAIN SPOTTED FEVER

### A Preliminary Report on the Weil-Felix Reaction

By A. L. KERLEE,<sup>1</sup> *Bacteriologist, United States Public Health Service*, and R. R. SPENCER, *Surgeon, United States Public Health Service*

Kelly<sup>2</sup> tested the sera from nine cases of Rocky Mountain spotted fever occurring in California, using as antigens a fresh agar culture and a formalized suspension of a strain of *B. proteus* X<sub>19</sub> obtained from the Hygienic Laboratory at Washington. Eight of these sera did not agglutinate the organism. The serum of one patient, however, taken during the third or fourth week of the disease gave a positive agglutination in a dilution of 1:400 when "the first 24-hour transplant from a stock culture" was employed as antigen. The same specimen of serum gave negative results two days later against "a 24-hour agar culture, a 24-hour glucose agar culture, and a formalized antigen."

So far as we are aware Kelly was the first to perform the Weil-Felix reaction with Rocky Mountain spotted fever sera; and while he recognized his series of tests were not large, he felt that his results suggested "that the Weil-Felix reaction is negative in Rocky Mountain spotted fever and may be of value in differentiating between this disease and typhus fever."

Kelly's observations seemed to support the view held by many regarding the agglutination of *B. proteus* X<sub>19</sub> in typhus sera, namely, that the reaction was a specific one for typhus fever.

The tests recorded herewith show that strains of *B. proteus* X<sub>19</sub> are agglutinated by the sera of experimental animals and patients suffering from Rocky Mountain spotted fever.

Altogether three strains of *B. proteus* X<sub>19</sub> were used. The Hygienic Laboratory strain No. 271 has been fully tested for sensitivity against the endemic typhus occurring in the southern United States by Maxcy and has been used extensively for diagnostic purposes. The other two strains used were the Kingsbury strain and the Warsaw strain both obtained from Fletcher<sup>3</sup> of Kuala Lumpur, Federated Malay States. Strain No. 271 and the Warsaw strain are indologenic, while the Kingsbury strain does not produce indol.

Concentrated antigens were prepared with 0.1 per cent formalin, so that when diluted for use to a turbidity comparable to 500 parts per million of a silica standard the concentration of formalin would be negligible and interference with the reaction reduced to a minimum.

<sup>1</sup> A. Leroy Kerlee died February 14, 1928, from Rocky Mountain spotted fever contracted in line of duty at the field laboratory of the U. S. Public Health Service located at Hamilton, Mont.

<sup>2</sup> Kelly, F. L.: Weil-Felix Reaction in Rocky Mountain Spotted Fever. *Jour. Inf. Dis.*, vol. 32, No. 3, March, 1923, pp. 223-225.

<sup>3</sup> Fletcher, W., and Lesslar, J. E.: Tropical Typhus in the Federated Malay States. *Bull. No. 2 of 1925*, Institute for Medical Research, Kuala Lumpur, Federated Malay States.

TEST I (GUINEA PIGS)

A series of 12 guinea pigs were inoculated intraperitoneally with Rocky Mountain spotted fever blood virus on September 15, 1927. Beginning on the first day on which any of the animals showed an elevation of temperature (September 19), and each day thereafter until the fourteenth day after inoculation, about 1 cubic centimeter of blood was drawn from all surviving guinea pigs by heart puncture with a very small needle. Blood was also taken on the nineteenth, the twenty-fourth, and the twenty-ninth days after inoculation. Only four animals lived through the entire course. At no time was a positive test recorded for any of these animals, although all of them developed typical lesions of Rocky Mountain spotted fever. All sera were tested against the Hygienic Laboratory strain No. 271 (the same as that used by Kelly) and the Kingsbury strain of *B. proteus* X<sub>19</sub>.

TEST II (RABBITS)

A series of seven rabbits were inoculated intraperitoneally with 1 cubic centimeter of blood virus. Four days later blood was drawn from the ear vein of each, as well as on each succeeding day until the ninth, at which time the temperature of all rabbits had again become normal. Blood was also taken on the fourteenth, nineteenth, and twenty-fourth days after onset.

These sera were tested against two antigens; namely, one prepared from the Kingsbury strain and one from the Warsaw strain. For this reason the rabbit and the guinea pig tests are not entirely comparable.

TABLE 1.—Results of tests on three rabbits

Day after onset of disease	Antigen	Rabbit No. 3033 (dilution)						Rabbit No. 3034 (dilution)						Rabbit No. 3035 (dilution)											
		20	40	80	160	320	640	1, 280	2, 560	20	40	80	160	320	640	1, 280	2, 560	20	40	80	160	320	640	1, 280	2, 560
1	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	K	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	K	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	W	-	-	-	-	-	-	tr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	K	+	+	+	-	-	-	tr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	K	+	+	+	-	-	-	+	+	+	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-
7	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	K	+	+	+	tr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	K	+	+	+	+	-	-	+	+	-	-	-	-	-	-	#	+	+	-	-	-	-	-	-	-
9	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	K	+	+	#	+	+	-	+	+	+	-	-	-	-	-	+	+	+	+	-	-	-	-	-	-
14	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	K	+	+	+	+	-	-	+	+	-	-	-	-	-	-	+	+	+	+	-	-	-	-	-	-
19	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	K	+	+	+	+	-	-	+	+	-	-	-	-	-	-	+	+	+	+	-	-	-	-	-	-
24	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	K	+	+	+	+	-	-	+	+	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-

Symbols: K = Kingsbury antigen; W = Warsaw antigen; # = Complete agglutination; + = Partial agglutination; tr = Trace.

Table 1 records the tests carried out on three of the seven rabbits selected at random and shows a definite increase in agglutinins in these rabbits, reaching a maximum on the ninth day. The other rabbits, which are not recorded, also showed an increase in titer of their sera in about the same degree. The period of incubation of the disease in rabbits was about four to five days, so that the maximum titers actually occurred about two weeks after inoculation, which is about the same as observed in typhus fever. Sera from control rabbits never gave a positive test at any time.

## TEST III (HUMAN)

As human controls, the sera from 43 university students who had never had spotted fever or typhus fever were tested for agglutination titer against the Kingsbury and the Hygienic Laboratory strains of *B. proteus* X<sub>19</sub>. None of these sera gave a positive result. This test was made before we obtained the Warsaw strain.

Table 2 gives the results of tests on eight sera from spotted-fever patients against the Hygienic Laboratory strain of *B. proteus* X<sub>19</sub>. Four were also tested against the Kingsbury antigen.

TABLE 2.—Results of tests on eight sera from spotted-fever patients

No.	Patient data	Anti- gen	Dilution							
			20	40	80	160	320	640	1,280	2,560
1	J. P.: First week of convalescence	H. L.	#	#	#	#	#	—	—	—
2	E. T. S.: Eighteenth day after onset—early convalescence	H. L.	#	#	#	#	#	#	#	#
3	D. H.: Eleventh day of illness	H. L.	#	#	#	#	#	#	+	—
4	J. W.: Fifteenth day of illness	H. L.	#	#	#	#	#	#	+	—
5	A. M. C.: Spotted fever in August, 1926. Blood taken Sept. 20, 1927.	{ H. L. K	—	+	+	+	—	—	—	—
6	M. I. N.: Spotted fever in August, 1926. Blood taken Sept. 20, 1927.	{ H. L. K	—	+	+	+	—	—	+	—
7	L. McN.: Spotted fever in April, 1927. Blood taken Sept. 20, 1927.	{ H. L. K	—	+	+	+	+	+	+	—
8	J. T. B.: Blood taken seventh day of illness	{ H. L. K	+	+	+	+	+	+	—	—
	Blood taken fourteenth day of illness during early convalescence	{ H. L. K	—	+	+	+	—	—	+	—
	Blood taken 2 months and 7 days after onset	{ H. L. K	—	+	+	+	—	—	—	—
		{ H. L. K	—	—	—	—	—	—	—	—

Symbols: H. L. = Hygienic Laboratory antigen; K = Kingsbury antigen; # = Complete agglutination; + = Partial agglutination.

## DISCUSSION

It will be noted that the serum from patient No. 8 (Table 2) was tested on the seventh and fourteenth days after onset and again after complete recovery. This serum showed an increase in titer from the seventh to the fourteenth day. Sera Nos. 5 and 6 showed the presence of agglutinins more than a year after onset of illness, which suggests that agglutinins persist longer in the sera of spotted-fever patients than has been commonly observed in typhus fever.

Our results with the sera of Rocky Mountain spotted fever infected animals coincide with those obtained by others in the study of experimental typhus in that rabbits produce agglutinins for *B. proteus* X<sub>19</sub> and guinea pigs do not.

In view of the clinical similarity of typhus fever and Rocky Mountain spotted fever, and the high titers obtained in our tests, we believe the finding of a positive agglutination in Rocky Mountain spotted fever is not accidental. While Kelly obtained a single positive test which could not be repeated, our tables show that the agglutinin content of the sera of both rabbits and man increases as the disease progresses and then decreases during convalescence. Such a result is strong additional evidence of relationship between the disease process and the agglutinin reaction.

#### SUMMARY

1. The sera from guinea pigs inoculated with Rocky Mountain spotted fever virus did not agglutinate two strains of *B. proteus* X<sub>19</sub>.
2. Sera from rabbits similarly inoculated with spotted fever virus showed a definite increase in agglutinin content reaching a maximum titer on the ninth day after onset of symptoms, or the fourteenth day after inoculation.
3. The sera of human patients taken during the course of the disease and during convalescence showed the presence of agglutinins for two strains of *B. proteus* X<sub>19</sub>.

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### THE NOTIFIABLE DISEASES IN STATES DURING 1927

#### Summary

The summary, published herewith, of the reported prevalence of communicable diseases in States during 1927 is taken from Supplement No. 73, which will soon be issued by the Public Health Service. The rates have been compiled from data furnished by the health officers of the several States, the District of Columbia, and the insular possessions. The following list of diseases is included in the supplement:

Anthrax in man.	Meningococcus meningitis.
Chicken pox.	Mumps.
Cholera.	Pellagra.
Dengue.	Plague (human.)
Diphtheria.	Pneumonia (all forms).
Gonorrhea.	Poliomyelitis.
Influenza.	Rabies in animals.
Lethargic encephalitis.	Rabies in man.
Malaria.	Rocky Mountain spotted fever.
Measles.	Scarlet fever.