100 mg. of uric acid, while the normal daily output lies at 0.25 gm. or above. Urea, therefore, could not maintain this amount of the free acid in solution. 1500 cc. of 3% urea could dissolve 2.1 gm. of sodium urate, an amount well above the daily output of a normal individual. Ammonium urate has about one-half the solubility of sodium urate, and therefore on a concentrated urine with high uric acid content the limit of saturation would be surpassed. Uric acid is present wholly in the form of the free acid only at a pH of 5 or less and is present wholly as the urate only at a pH of about 8. Hence in most normal urines mixtures of free acid and salt occur.

Conclusions. The peptizing action of urea may be an important factor in increasing the solubility of these sparingly soluble compounds which are normally present in urine at about their saturation limit.

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A Natural Infection of the Sharp-tailed Grouse and the Ruffed Grouse by Pasteurella tularensis.

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The widespread destruction of rabbits and grouse in Minnesota during 1925 and 1926 led to a consideration of tularemia in epizootic proportions as a cause of the periodic decimation of wild rabbits and possibly of grouse. Green and Wade[1] reported that ruffed grouse were susceptible to experimental infection with *Pasteurella tularensis.* Parker and Spencer[2] had previously considered tularemia as a possible disease of grouse and had produced a fatal infection in a blue grouse. Tularemia as a natural disease of birds was definitely established by Green and Wade,[3] when they isolated *Pasteurella tularensis* from a quail dying in the wild. Parker,

[1] Green, R. G., and Wade, E. M., PROC. SOC. EXP. BIOL. AND MED., 1928, **15**, 515.

[2] Parker, R. R., and Spencer, R. R., *Sixth Biennial Report of the Montana State Board of Entomology*, 1925-1926, 30.

[3] Green, R. G., and Wade, E. M., PROC. SOC. EXP. BIOL. AND MED., 1929, **26**, 626.

Philip, and Davis[4] recovered *Pasteurella tularensis* from sage hens, found dead or killed, on an area in which these birds were known to be dying.

In the present paper is reported the isolation of *Pasteurella tularensis* from a sharp-tailed grouse and from a ruffed grouse in Minnesota. In the course of the wild-life disease investigation, routine examinations and study were carried out on game birds collected in various areas of Minnesota during the fall of 1932. Most of the specimens were collected by game wardens, through the cooperation of the State Department of Conservation.

Tularemia in the Sharp-tailed Grouse *(Pedioecetes phasianellus)*. A sharp-tailed grouse, No. B-10419, collected by shooting on September 27, 1932, in Pine County, apparently well when killed, was received at the laboratory on September 28, and 46 ticks of the genus *Hemophysalis* were collected, principally from the bag in which the carcass was shipped. Necropsy of the grouse revealed no abnormal pathology.

First transmission generation. A guinea pig injected with the 46 ground ticks remained well. A guinea pig injected with a suspension of the liver died on the 12th day. This pig showed infiltration and adenopathy in the right inguinal region at the point of inoculation. There were several large abscesses on the liver. The spleen was enlarged but bore no visible lesions. Cultures from the liver and spleen inoculated on glucose-cystine blood agar yielded no growth.

Second transmission generation. Two guinea pigs were inoculated with ground liver and spleen from the preceding guinea pig. One of these was found dead on the 8th day, with local adenopathy and infiltration, and with the necrotic areas typical of tularemia on the liver and spleen. The spleen was used for further transmission. The second guinea pig, which died on the 13th day, showed the usual lesions of tularemia, except for the absence of necrotic areas on the spleen. Cultures on glucose-cystine blood agar remained sterile.

Third transmission generation. Two guinea pigs inoculated by skin scarification died on the 5th and 6th days, respectively, with lesions typical of tularemia. *Pasteurella tularensis* was isolated in pure culture from both the liver and the spleen of the guinea pig dying on the 5th day.

Fourth transmission generation. The infection was transferred

[4] Parker, R. R., Philip, Cornelius B., and Davis, Gordon E., *Public Health Reports*, 1932, **47**, 479.

by scarification with spleen into 2 guinea pigs, which died on the 5th and 7th days, respectively. *Pasteurella tularensis* was isolated from the liver and spleen of both animals. This strain of *Pasteurella tularensis* has been preserved as Minnesota No. 30.

Tularemia in the Ruffed Grouse *(Bonasa umbellus togata).* A ruffed grouse, No. B-10477, was collected, by shooting, in St. Louis County, on October 2. It was reported that six rabbits were seen but that there were few grouse in the vicinity. The carcass was received at the laboratory on October 4. Twelve ticks were obtained from this grouse after arrival at the laboratory.

First transmission generation. A guinea pig injected with 12 ticks, emulsified in saline, remained well. Muscle tissue only[5] was injected from this grouse, as the carcass was somewhat decomposed. The guinea pig injected with the muscle tissue died on the 23rd day, with slight adenopathy and infiltration in the right inguinal region at the point of injection. The spleen was greatly enlarged, and both the liver and the spleen were studded with small necrotic areas.

Second transmission generation. A guinea pig injected subcutaneously with a suspension of liver and spleen died on the 3rd day. Cultures from the liver and spleen yielded *Escherichia coli.*

Third transmission generation. Two guinea pigs and one rabbit were scarified with a suspension of liver and spleen. One guinea pig died on the 5th day, with lesions typical of tularemia. Cultures, however, yielded staphylococcus. The second guinea pig and the rabbit died on the 6th day, both with lesions typical of tularemia. Cultures from the liver and spleen of these animals yielded *Pasteur-*

TABLE I.
Agglutination Tests.

Serum (R.G.G.) preserved in 50% glycerol	10	20	40	80	160	320	640	1280	2560	5120
Minn. No. 30 (Origin, sharp-tailed grouse)										
4 hr. incubation	neg.	neg.	neg.	neg.	2+	3+	4+	4+	4+	4+
12 hr. refrigeration	"	"	"	1+	3+	4+	4+	4+	4+	4+
Minn. No. 32 (Origin, ruffed grouse)										
4 hr. incubation	neg.	neg.	1+	3+	4+	4+	4+	4+	4+	4+
12 hr. refrigeration	"	"	3+	4+	4+	4+	4+	4+	4+	4+
U.S.P.H. No. 38										
4 hr. incubation	4+	4+	4+	4+	4+	4+	4+	4+	4+	3+
12 hr. refrigeration	4+	4+	4+	4+	4+	4+	4+	4+	4+	3+

[5] Green, R. G., and Wade, E. M., PROC. SOC. EXP. BIOL. AND MED., 1929, **17**, 214.

ella tularensis. This strain of *Pasteurella tularensis* has been preserved as Minnesota No. 31.

Identification of the organism was established by the typical lesions of the disease produced by its growth only on a medium containing cystine, by morphological characters, and by the following agglutination tests, which showed a prozone for the organisms isolated from both birds.

The recognition of natural infections of tularemia in quail, sage hens, sharp-tailed grouse, and ruffed grouse, indicates that this disease is widely distributed among species of game bird.

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Absorption of Strychnine Sulphate from Strangulated Segments of Bowel.*

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Death, following strangulation of the intestine in man and the experimental animal, is usually attributed to a resulting toxemia. There has been considerable controversy as to the nature of the toxic material, and its route of absorption. To throw light on possible avenues of absorption, a product of known toxicity was introduced into the lumen of strangulated segments of dogs' intestines. Strychnine sulphate was chosen for the toxic substance, as it produced unmistakable clinical symptoms when present in relatively minute doses.

Controls. 50 mg. doses of strychnine sulphate were introduced into the lumen of the normal small intestine of 3 dogs. Similar doses were placed free in the peritoneal cavities of 2 other dogs. All 5 developed definite signs of irritability, followed by convulsions in from 3 to 8 minutes, and subsequent death.

Experiments. 50 to 150 mg. doses of strychnine sulphate were then introduced into the lumen of strangulated segments of bowel. Four types of strangulation were employed. In each type the lumen of the normal bowel, proximal and distal to the strangulated segment, was occluded by tying binding tape firmly about the bowel wall. A small window was first made in the mesentery between the

* This work was supported in part by Grant 224 allowed by the Committee on Scientific Research of the American Medical Association.