

# Erysipelas Infections of Mammals and Birds

by D. F. Eveleth,<sup>1</sup> Alice I. Goldsby,<sup>2</sup> F. M. Bolin<sup>3</sup> and Glenn C. Holm<sup>1</sup>

*Erysipelothrix rhusiopathiae* is capable of invading the tissues and producing disease in mammals, birds, and fishes. Erysipelas has been known to exist in Europe for many years but it was not until 1892 that the disease as a mouse septicemia was described in North America. (1). Van Es and McGrath (2) have summarized the literature on the disease in domestic animals and Van Es (3) on "erysipeloid" of man.

It is now known that erysipelas infections are widespread and constitute economic hazards to livestock and poultry producers, and that infections are frequently transmitted from animals to man.

Swine erysipelas had become so widespread in North Dakota that in 1942 the State Livestock Sanitary Board authorized the use of the live culture and antiserum method of immunization for the protection of swine on those premises where the disease existed.

The disease has continued to spread among the swine droves of the state and has also been diagnosed in turkeys, cattle, sheep, and man.

## Erysipelas Infection in Swine

There has been considerably more research on swine erysipelas than there has on the disease in other species. However, the variability of the pathology, morbidity, and mortality is so great that frequently it is impossible for the veterinarian to make a diagnosis without laboratory assistance. For detailed descriptions of the various types of erysipelas infections in swine the reader is referred to the bulletin by Van Es and McGrath (2). It may, however, be of interest to point out some of the types of erysipelas infections in swine.

Swine erysipelas may be peracute, acute, or chronic.

**Peracute Form:** The subject is usually found dead with no previous history of illness. There are usually no specific diagnostic lesions. Lesions of a septicemia are usually present, but they are not advanced and may be overlooked in the post mortem examination.

**Acute Form:** This form may be found in swine of all ages. The animals quit eating and the temperature is high. Unlike swine with hog cholera, the animals do not huddle together and do not, as a rule, have the weaving gait associated with hog cholera infections.

<sup>1</sup>Veterinarian

<sup>2</sup>Assistant in Veterinary Science

<sup>3</sup>Associate Veterinarian

**Chronic Form:** Arthritis—The animals may be lame or merely show enlarged joints. There is usually stunting.

**Skin Lesions:** There may be scab-like areas on the skin that are easily confused with mange lesions. These skin lesions may also follow the recovery or apparent recovery of the acute form of swine erysipelas.

There may be small circumscribed areas of black skin often in the shape of a diamond. The ears and tail may drop off.

**Reproductive failures** The sow may abort with either acute or chronic erysipelas. The baby pigs may be born dead or very weak. The sow may fail to produce milk. The baby pigs may refuse to nurse. There may be difficulties in parturition. Sometimes there are mummified feti.

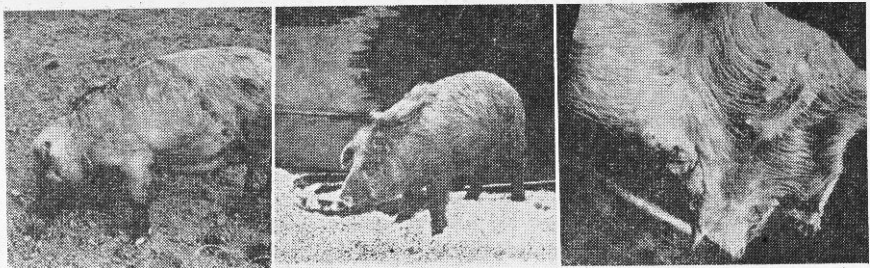
**Obscure Symptoms:**

Growth failure

Nervous symptoms

Cough

The erysipelas organism is known to be resistant to dessication. Reports of its living under unfavorable environmental conditions are quite numerous (Merchant 4.) This property of the organism probably accounts for the perpetuation of the disease on certain premises.



(a)

(b)

(c)

**Fig. 1. (a-b) Chronic erysipelas. Note breaks in skin. (c) Acute erysipelas. Note red discoloration of white skin.**

The dissemination of the disease in all probability follows the introduction of "carrier" swine into erysipelas-free droves. Numerous cases of erysipelas have been traced to the recent introduction of new swine onto farms which had previously been free from erysipelas. In some cases there was no history of either erysipelas outbreaks or of live culture vaccination of the introduced swine, but in many cases the introduced swine had been vaccinated with live culture vaccine and anti-swine erysipelas serum. It is believed, however, that in most instances the carrier is a naturally infected animal.

The mode of infection appears to be variable. There appears to be little doubt that the ingestion and inhalation of dust contaminated with erysipelas organisms are common methods of transmitting the disease. It is not uncommon to isolate the erysipelas organism from the tonsils of apparently healthy swine (Udall 5).

Infection by way of the umbilical cord is discussed later for lambs; although this method of infection seems to apply to swine as well as sheep.

Infection by way of wounds is illustrated in the following case. The owner presented three dead gilts with the following history:

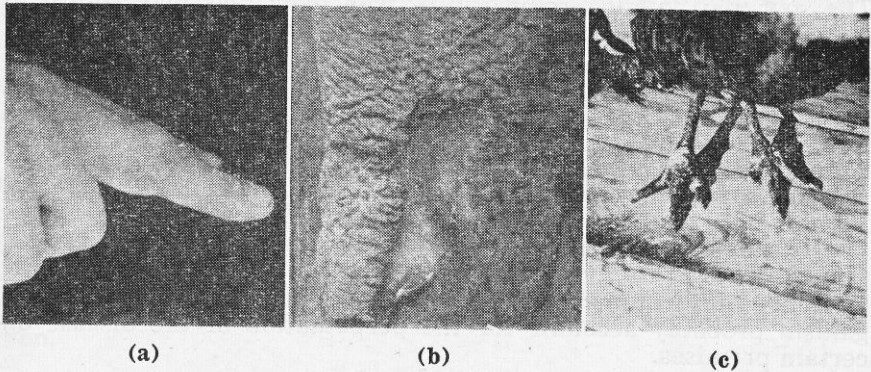


Fig. 2. (a) Erysipeloid infection of the human hand. (b) Acute erysipelas of the brisket of a ram. (c) Chronic erysipelas in the feet of a turkey.

The week previous he had selected the gilts he was going to keep for breeders. As each gilt was chosen a notch was cut from the ear. The pigs were all left together. Three days later he noticed that the ears of some of the gilts were swollen and they were not eating. *E. rhusiopathiae* was isolated from the three subjects presented. In no case was swelling observed in the ears that had not been notched and none of the other pigs showed signs of illness.

Acute swine erysipelas can be treated by use of either the antibiotics penicillin or streptomycin, or by use of anti-erysipelas serum. It has been found most effective, however, to use both streptomycin and penicillin in treating the septicemic form of the disease. With valuable animals the simultaneous use of the antibiotics and serum is justified, because the serum will give a certain amount of protection after the effects of the antibiotics have worn off.

Sulfonamides have not been effective against erysipelas infections. (Konst 6).

Necrosis of the skin has been effectively treated by spraying the pigs twice daily with streptomycin (one gram per gallon of water).

Acute arthritis responds to penicillin in oil injected directly into the involved joint capsule.

Chronic arthritis has been most effectively treated by producing an acute erysipelas. The animals are vaccinated with twice the recommended dose of culture and one-half the recommended dose of serum. If, after a week there is no improvement, the same dose of culture is again given without serum. If the animals show signs of septicemia, they should be treated as in acute erysipelas.

The usual practice of using the live culture and anti-serum method of vaccination has been quite effective, and has undoubtedly saved the swine industry millions of dollars. The method is not, however, without some undesirable features. The baby pigs are born without any great degree of immunity and must be vaccinated soon after birth. Swine sold from a vaccinated drove may be the means of introducing erysipelas infection onto other farms. However this has been considered rare when the usual 30 days quarantine is used.



Fig. 3. (a) Erysipelas arthritis in a small pig. (b) Enlarged and abscessed joint in a sow infected with erysipelas. (c) Swollen snood of a turkey tom.

It is rare that vaccination breaks occur. However, they may. Predisposing factors may prevent the pigs from developing proper immunity. The following case illustrates such a failure. A group of seven 40 to 50 pound pigs were brought to the laboratory for use in an experiment not related to swine erysipelas. They were given the standard serum and culture vaccination. At that time we had on hand a large quantity of frozen deer liver. The swine were allowed to eat this as a supplement to grain. Two days after the feeding of the liver, which was two weeks after vaccination, three of the pigs showed high temperatures and quit eating. One died of acute swine erysipelas. The other two recovered following treatment.

At the present time experiments are being conducted on the use of a bacterin for the control of erysipelas in swine. Preliminary experiments indicate that the use of the killed organism may confer sufficient immunity for swine to withstand field exposure.



## Erysipelas Infection Of Sheep

Hutyra, Marek and Manninger (7) describe a septicemic disease of sheep caused by *E. rhusiopathiae*, the same organism that causes erysipelas in swine. Howarth (8), Ray (9), and Marsh (10), have described a polyarthritis of sheep caused by the same organism. Growth of the erysipelas organism in sheep dipping vats and the infection of the skin and the joints of sheep that were dipped 24 hours or more after the infected sheep were dipped has been reported from New Zealand (11).

The data available on erysipelas infection of sheep point to septicemic, arthritic and cutaneous forms of the disease.

A few case reports as well as some laboratory investigations will be used to illustrate the pathology, clinical manifestations, epidemiology and possible therapeutic and prophylactic methods of control.

**Case I**—A small flock of ewes was stabled in a building previously occupied by swine. Soon after lambing started several lambs developed lameness and death losses were "heavy". The veterinarian treated all cases with anti-swine erysipelas serum and reported satisfactory results. Nearly a year later he reported that he was still being called to treat cases of arthritis in this flock.

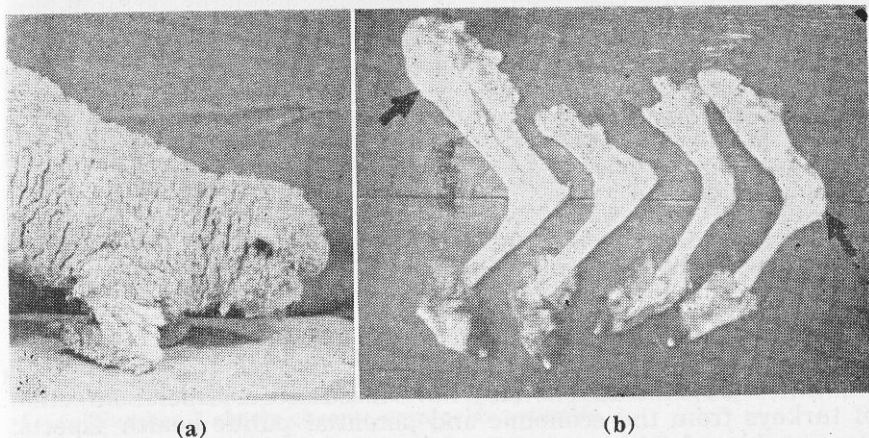
**Case II**—Lambs and swine were both housed in a single building for experimental work. Some of the lambs were transferred to the regular sheep barn and later slaughtered. Some time after the lambs were sold, the pen they had previously occupied was used to hold some rams. One of the rams developed a necrosis of the skin on the brisket. *E. rhusiopathiae* was isolated from the necrotic tissue. The involved area was treated with sulfanilamide-urea powder and the ram given anti-erysipelas serum. He appeared to make an uneventful recovery, but suddenly developed a high temperature and died two days later. On post mortem examination the visceral organs presented typical lesions of a septicemia, *E. rhusiopathiae* was isolated from the spleen.

**Case III**—A flock of approximately 1,000 ewes was maintained under semi-range conditions during the summer and early winter. As lambing time approached they were stabled in a large shed and ewes taken out of the flock as they showed signs of approaching parturition. During the 1947 lambing season the death losses were low, but many lambs showed signs of lameness. Two of the lambs were brought to the laboratory and the erysipelas organism recovered from arthritic joints.

The same plan as outlined above was followed in 1948; however there were heavy death losses of lambs of only two to three days old. Symptoms were indefinite, the herdsman reported that lambs would be observed to nurse and that they would be dead in an hour. Three lamb carcasses presented evidence of infection by way of the umbilical cord. *E. rhusiopathiae* was isolated from the blood of these lambs.

All lambs were given five ml. anti-erysipelas serum and the flock moved to new quarters. The death losses ceased abruptly.

**Case IV**—This case concerns a small flock of lambs on pasture. The veterinarian was called because the lambs were showing symptoms of lameness. The lame lambs were treated with anti-erysipelas serum which was followed by a satisfactory response. Later he presented the carcass of one of the untreated lambs from this flock. This lamb had not been observed to be sick. *E. rhusiopathiae* was obtained from a culture of the blood. The lesions were those of a septicemia.



**Fig. 4.** (a) Lamb showing symptoms of pain due to erysipelas arthritis. (b) Arrows point to enlarged joints of lambs infected with erysipelas.

The cases reported here show that in general the same disease pictures may be obtained in sheep and swine infected with the erysipelas organism.

A preliminary trial with the serum and culture vaccination was tried. A sheep was vaccinated with one ml. of culture and 20 ml. of serum. Six weeks later this sheep and another non-vaccinated one were challenged by the intravenous injection of one ml. of a 24 hour broth culture of *E. rhusiopathiae*. The vaccinated sheep showed no temperature rise or symptoms. The non-vaccinated sheep showed a temperature rise to over 108°F and died two days after challenge.

In another trial 12 lambs which had been raised on a farm where erysipelas was present were used. Six were vaccinated by the injection of one ml. of vaccine and 10 ml. of antiserum.

Thirty days after vaccination they were all challenged with a 24 hour broth culture of *E. rhusiopathiae*. Some of the sheep showed mild temperature reactions, but there were no deaths. These tests indicate that vaccination or exposure causes the sheep to develop immunity to subsequent exposure.

It is doubtful if it would be desirable to use live culture vaccine on sheep except for feeders or sheep to be maintained on the infected farm. It is quite conceivable that vaccinated sheep could be moved into a highly susceptible flock with a subsequent heavy loss through arthritis or deaths due to the septicemic form of erysipelas.

### Erysipelas Infection In Cattle

Erysipelas infection in cattle appears to be rare. It has been discussed by Hutyra, Marek, and Manninger (7), but according to Udall (12) it has not been reported in the United States.

The following case is cited as an example of the possible epidemiological factors involved:

A calf carcass was submitted to the laboratory by the owner and his veterinarian. The veterinarian reported that just before the calf died its temperature was 110°F. This was the third calf to die from a herd of 70. The calves were stabled in a shed previously used by swine. *E. rhusiopathiae* was isolated from the tissues through pigeon inoculation.

These findings would indicate that calves can at times become infected with the erysipelas organism from contaminated surroundings.

### Erysipelas Infection Of Turkeys

Stiles (13) and Bivens (14) have discussed erysipelas infection of turkeys from the economic and potential public health aspects; Rosenwald and Dickinson (15), Beaudette and Hudson (16), Madison (17), Van Roekel, Bullis and Clark (18), Hoffman and Hinchshaw (19), Jungherr and Gifford (20) and others have described the disease in turkeys.

In turkeys it is usually an acute septicemia with high mortality of the infected birds. This disease is frequently confused with fowl cholera, botulism or Newcastle disease. To make an accurate diagnosis, laboratory facilities are necessary. We have encountered some cases of chronic erysipelas usually characterized by a mottled coloring of the non-feathered areas of the head, necrosis of the snood, and in one case necrosis of the feet. In the case of infection of the feet, the turkeys had been pastured on land used several years before for swine. This flock suffered no losses until the fall rains started. The damage to the skin of the feet caused by the wet soil apparently offered a portal of entry for the erysipelas organisms.

As a general rule, in mixed flocks the majority of cases of erysipelas are toms. This seems to be the result of fighting. The healthy birds pick the sick ones and contaminate their beaks, then in the subsequent fighting among themselves they break the skin on the head and snood, and infection of new individuals becomes established. In breeding flocks, where the majority of the birds are females, there are more females infected. This appears to result from injuries acquired during mating.

A few cases of erysipelas in young poults have been observed. Nothing has been learned regarding the primary source of infection, but the disease seems to be spread from bird to bird by their picking each other.

The following field case illustrates the value of anti-erysipelas serum in the treatment of turkeys. On June 13, 1947, two poults were submitted to the laboratory for diagnosis. One presented typical lesions of histomoniasis while the other showed only the

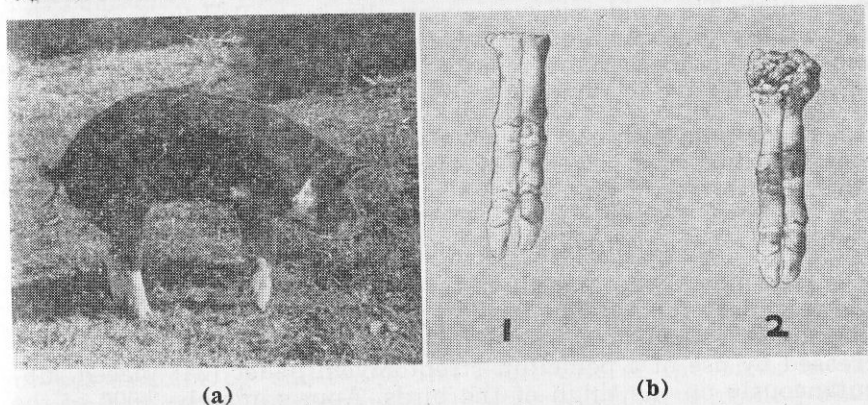


Fig. 5. (a) Chronic erysipelas. Note arched back and position of right front foot. (b) Bones of the feet of a pig. Number 1 is normal, while Number 2 shows chronic erysipelas arthritis.

lesions of enteritis. Cultures obtained from the blood of the second poult were composed of small gram positive bacilli which were identified as *E. rhusiopathiae*. The owner was advised to use a quaternary ammonium compound in the drinking water and to use anti-erysipelas serum on the birds showing evidence of the disease. He injected five ml. of serum into all sick birds and separated them from the flock. All new cases were treated in a like manner. The case is summarized below.

Twelve hundred three week old turkeys had been maintained in one brooder house. At the time of treatment there were 400 visibly sick poults and there had been 150 deaths. There were 35 deaths in the two weeks following treatment.

These findings are not in agreement with those reported by Rosenwald and Dickinson (15) but are in agreement with the findings of Van Roekel, Bullis and Clarke (18), and Lindemeyer and Hamilton (21).

During 1948 and 1949 a more detailed study of prophylactic and therapeutic measures directed at stopping losses of turkeys due to erysipelas was initiated.

On one farm erysipelas was diagnosed simultaneously in swine and turkeys. There was only a woven wire fence between the tur-



keys and the swine. The swine were given the simultaneous serum and culture treatment and losses stopped. The turkey flock, numbering about one thousand, was moved to a nearby field and the sick birds removed as they were observed. This part of the control was not effectively carried out. The sick birds were put in an isolation pen and given 10,000 to 25,000 units of penicillin (20) (22) daily by inserting a portion or whole "bovine teat bougie" directly into the crop. In nearly all cases there was an immediate response on the part of the turkeys, but relapses were frequent and death losses were high. The epidemic was eventually controlled by moving the flock daily and moving the stragglers to the isolation pen where most of them died. Many reports indicate, however, that penicillin in oil is effective in stopping losses due to erysipelas.

In another outbreak a flock of 3,000 turkeys was involved. This was a portion of a larger flock totaling nearly 20,000. There was a severe outbreak of sinusitis which was the disease for which aid was asked of this laboratory. Cultures from some of the turkeys yielded *E. rhusiopathiae* and *Pseudomonas* organisms.

Treatments were instituted for both the control of sinusitis and the secondary factors. The treatment for sinusitis has been reported in another article (23). The daily death losses were markedly decreased by use of a penicillin-streptomycin pellet (24) placed subcutaneously on the thigh of the birds. Approximately 2,000 of the 3,000 birds were treated. They were not identified but it is safe to conclude that most of the sick birds were treated because they were more easily caught. The pellets contained 10,000 units of procaine penicillin G and 17 mg. dihydrostreptomycin (equal to 12.5 mg. streptomycin base). The pellets were inserted with a Kearns injector.

In this particular case the double treatment with penicillin and streptomycin acted as a therapeutic measure which kept the birds alive so that they could respond to the treatments directed against the sinusitis.

A third flock of 5,000 marketable turkeys was investigated. This owner was losing 20 to 30 birds per day with what appeared to be purely an erysipelas infection. He selected 150 visibly sick birds and implanted two pellets subcutaneously into each. During the next 48 hours he lost four. He marketed his flock as rapidly as possible so no final comparison of losses of treated and non-treated birds could be made.

The pellets were tried on pigeons and found to protect them against lethal doses of erysipelas cultures so a controlled field trial was carried out through the cooperation of the owner.

On November 25, 1949, a turkey grower sought aid from this department. He had a flock of approximately 3,200 birds. His losses were about eight per day, but had been going on for over a month.

A diagnosis of erysipelas was made by identification of microorganisms isolated from specimens submitted.

The owner agreed to bring all visibly sick turkeys to the laboratory where they could be treated or left as controls and careful records kept. Each turkey was banded for identification when taken from the truck. All birds were in burlap bags and the non-treated controls were selected by chance.

The treatment consisted of implanting a streptomycin-penicillin pellet subcutaneously either under the skin of the leg or at the back of the neck. The same amount of penicillin and streptomycin was contained in these pellets as those described above.

**Table 1.** TREATMENT OF FIELD CASES OF ERYSIPELAS INFECTION IN TURKEYS

Date	No. Treated	No. Died	Percent Mortality	No. Non-Treated	No. Died	Percent Mortality
11/26.....	9	4	44	1	1	100
11/27.....	8	2	25	1	1	100
11/28.....	11	5	45	3	2	66
11/29.....	8	2	25	4	4	100
	36	13	38	9	8	89

The death losses were 38 per cent in the treated and 89 per cent in the non-treated. In nearly all cases the erysipelas organism was isolated from these birds either antemortem by culture of the blood or postmortem by culture of the liver. One of the birds in the nontreated group had chronic skin lesions which were healing when it was removed from the flock.

Another interesting point was a lowered incidence of clinical cases experienced by the entire flock following the daily removal of visibly sick birds.

Further investigations on the value of the streptomycin-penicillin pellets seemed indicated. Twelve pigeons were inoculated with a culture of *E. rhusiopathiae* from amniotic allantoic fluid of chick embryos. Six of these birds were treated by implanting the streptomycin-penicillin pellets subcutaneously. During the ensuing 96 hours five of the six nontreated birds died and no symptoms of disease were observed in the treated birds.

In another trial 15 six-week old poults were challenged with an erysipelas culture. Eight of these were injected with a streptomycin-penicillin pellet each. During the following 96 hours six of the non-treated birds died and the other showed definite symptoms but recovered. None of the treated poults showed symptoms of disease.

The desirability of a bacterin to be used concurrently with antibiotics during an outbreak is of course evident. A suspension of killed *E. rhusiopathiae* organisms in a medium containing alumina gel was prepared. Adult turkeys were injected intramuscularly with five ml. of the bacterin and challenged by an intramuscular injection of 1.0 ml. broth culture of *E. rhusiopathiae* 23 days later. During the next seven days one of six vaccinated birds died giving a mortality of 16 per cent while three of five non-vaccinated birds died, the mortality in this case being 60 per cent.

The results of these field trials and laboratory experiments show that by a proper sanitation program, death losses can be kept low. In the event of an outbreak, anti-erysipelas serum or the antibiotics penicillin and streptomycin are useful as therapeutic agents.

The use of a bacterin in combination with the antibiotics is suggested as a means of controlling an outbreak of erysipelas.

The danger of this disease as a public health problem is more likely from infected turkeys than from any other species. Most turkeys are not killed under standardized meat inspection. An infected bird going onto the market could act as a source of infection to anyone handling the bird before it is cooked. There would, of course, be a potential public health danger if the serum and culture method of immunization were followed.

## DISCUSSION

Swine erysipelas was first found in the United States in 1892 by Moore (1). In the following 58 years it has been recognized in all swine growing areas and many of the turkey producing areas. Reports of erysipelas infection in chickens, geese, ducks, mudhens, pigeons, parrots, quail, and other species of birds are available. In this laboratory erysipelas has been found in swine, sheep, turkeys, cattle, and man.

The problem confronting the veterinary profession is to develop a control plan which is economically possible and at the same time compatible with the protection of human health.

It would appear from the information available at this time that the use of vaccine may be necessary for the economical production of swine. It does not, however, appear to be advisable to attempt to use live vaccine prophylaxis in other species.

A live culture vaccination program alone is not likely to succeed in controlling this disease and certainly will not eradicate it. Van Es, Olney and Blore (25) (26) have pointed out a long list of factors to be considered in determining the effectiveness of a vaccination program. Holm, Griffith, and Beeson (27) found that they could effectively control swine erysipelas by a strict system of sanitation, the test and slaughter of reacting animals, good farrowing barn hygiene and closed herd management.

The saprophytic nature of the organism makes its elimination from an area extremely difficult. *E. rhusiopathiae* grows in a slightly alkaline medium. Acidity tends to destroy the organism. Some preliminary studies have indicated that decreasing the pH of the soil of swine lots has a tendency to decrease the incidence of the disease. The practical application of this means of control must be further studied. In a few cases the spraying of farrowing houses with an acid spray has apparently decreased the incidence of ery-

sipelas. In other cases the use of sulfur in the swine lots has been of some value. These findings are in agreement with the laboratory observation that the erysipelas organism lives and reproduces best in an alkaline medium.

### SUMMARY

1. Erysipelas infections in swine, sheep, calves and turkeys have been described.
2. Methods of prophylaxis and therapeutics have been discussed.
3. The antibiotics streptomycin and penicillin in combination were found highly effective in treating field and experimentally produced cases of erysipelas in turkeys.
4. The public health aspects of erysipelas infections have been discussed.

### BIBLIOGRAPHY

- (1) Moore, V. A. 1892—*Jour. Comp. Med. and Vet. Archives*, Vol. 13, p. 333 (cited by Van Es and McGrath (2))
- (2) Van Es, L. and McGrath, C. B. 1942—*Swine Erysipelas*, Research Bulletin 128, College of Agriculture, Univ. of Nebraska Agricultural Experiment Station
- (3) Van Es, L. 1942—*Swine Erysipelas Infection in Man*, Research Bulletin 130, College of Agriculture, Univ. of Nebraska Agricultural Experiment Station
- (4) Merchant, I. A. 1946—*Veterinary Bacteriology*, Third Edition, Published by Iowa State College Press, Ames, Iowa
- (5) Udall, D. H. 1947—*The Practice of Veterinary Medicine*, Fifth Revised Edition, Published by Author, Ithaca, New York
- (6) Konst, H. 1945—*Chemotherapy of Swine Erysipelas*, Trials using Sulfanilamide, Sulfapyridine and Sulfathiazole in Experimental Infection of Mice, *Canadian Jour. Comp. Med.*, Vol. 9, No. 5, pp. 135-139
- (7) Hutyra, F., Marek, J. and Manninger, R. 1938—*Special Pathology and Therapeutics of the Diseases of Domestic Animals*, Vol. 1, Published by Alexander Eger, Chicago, Illinois
- (8) Howarth, J. A. 1933—*Polyarthritis of Sheep*, *North Amer. Vet.*, Vol. 14, pp. 26-39
- (9) Ray, D. J. 1930—*Arthritis in Lambs and Erysipelothrix rhusiopathiae*, *Jour. Amer. Vet. Med. Assoc.*, Vol. 77, N. S. Vol. 30, pp. 107-108
- (10) Marsh, Hadleigh 1931—*The Bacillus of Swine Erysipelas Associated with Arthritis in Lambs*, *Jour. Amer. Vet. Med. Assoc.*, N. S. Vol. 31, pp. 57-63
- (11) Whitten, L. K. 1948—*Cutaneous Erysipelothrix Infection in Sheep*, *Australian Vet. Jour.*, Vol. 24, pp. 157-163
- (12) Udall, D. H. 1950—*Questions and Replies, Erysipelas (?) in Cattle*, *North Amer. Vet.*, Vol. 31, No. 3, p. 75
- (13) Stiles, G. W. 1946—*Observations of Swine Erysipelas in Turkeys (Including the Public Health Aspect and Possible Human Cases)*, *Jour. Amer. Vet. Med. Assoc.*, Vol. 109, pp. 65-69
- (14) Bivens, J. A. 1949—*Erysipelas in Turkeys—A Case Report*, *Jour. Amer. Vet. Med. Assoc.*, Vol. 114, pp. 226-227
- (15) Rosenwald, A. S. and Dickinson, E. M. 1941—*Swine Erysipelas in Turkeys*, *Amer Jour. Vet. Res.*, Vol. 2, No. 3, pp. 202-213



## BIBLIOGRAPHY (Cont.)

- (16) Beaudette, F. R. and Hudson, C. B. 1936—An Outbreak of Acute Swine Erysipelas Infection in Turkeys, Jour. Amer. Vet. Med. Assoc., Vol. 88, N. S. Vol. 41, No. 4, pp 475-487
- (17) Madsen, D. E. 1937—An Erysipelas Outbreak in Turkeys, Jour. Amer. Vet. Med. Assoc., Vol. 91, N. S. 44, pp. 206-208
- (18) Van Roekel, H., Bullis, K. L. and Clarke, M. K. 1938—Erysipelas Outbreaks in Turkey Flocks, Jour. Amer. Vet. Med. Assoc., Vol. 92, pp. 403-418
- (19) Hoffman, H. A. and Hinshaw, W. R. 1938—Erysipelas of Turkeys, Poultry Science, Vol. 17, pp. 443
- (20) Jungherr, E. and Gifford, Rebecca 1944—Three Hitherto Unreported Turkey Diseases in Connecticut—Erysipelas—Hexamitiasis—Mycotic Encephalitis, Cornell Vet., Vol. 34, No. 3, pp. 214-226
- (21) Lindemeyer, J. E. and Hamilton, C. M. 1942—Treatment of Swine Erysipelas in Turkeys with Serum from a Turkey Infected with *Erysipelothrix rhusiopathiae*, Jour. Amer. Vet. Med. Assoc., Vol. 100, pp. 212
- (22) Grey, C. G. 1947—Penicillin in the Treatment of *Erysipelothrix rhusiopathiae* Infected Turkeys, Vet. Med., Vol. 42, pp. 177-178
- (23) Eveleth, D. F. 1950—Sinusitis of Turkeys, in press Proc. N. Dak. Academy of Science
- (24) Grey, C. G. 1947—Streptomycin in the Treatment of *Erysipelothrix rhusiopathiae* Infected Turkeys, Vet. Med., Vol. 42, p. 216
- (25) Van Es, L., Olney, J. F. and Blore, I. C. 1946—Studies on the Validity of Swine Erysipelas Culture-Vaccines, Research Bulletin 145, Univ. of Nebraska, College of Agriculture Experiment Station
- (26) Van Es, L., Olney, J. F. and Blore, I. C. 1940—Some Factors Influencing Swine Erysipelas Prophylaxis; Proc. of 44th U. S. Livestock Sanitary Association
- (27) Holm, G. C., Griffith, R. L., Jr. and Beeson, W. M. 1942—Chronic Swine Erysipelas, Vet. Med., Vol. 37, No. 3, pp. 123-127

## ACKNOWLEDGMENT

The authors wish to express their appreciation to Fort Dodge Laboratories, Inc., Fort Dodge, Iowa; Wyeth, Inc., Philadelphia; and Merck and Co., Rahway, New Jersey, for their assistance in conducting this investigation.

## LATEST ON CROSSBRED DAIRY COWS

Many agricultural workers have seen the herd of crossbred dairy cows at Beltsville. Latest reports from the herd show continued improvement. Average production for 54 two-breed cows at slightly over two years of age was 13,006 pounds of milk and 585 pounds of butterfat. They beat their straight-bred dams by 2,868 pounds of milk and 143 pounds of butterfat. Forty-five of the 54 topped their mothers on milk and 51 on fat. Average for 41 three-breed cows was 13,465 pounds of milk and 606 pounds of fat. This was an increase over their two-breed dams of 367 pounds of milk per cow and a decrease of one pound of fat. These results show that a high level of production may be reached in a comparatively short time and maintained by following a cross-breeding program in which proved sires are used—USDA.