

LESSONS FROM HISTORY

THE SO-CALLED “SPOTTED FEVER” OF THE ROCKY MOUNTAINS

PRELIMINARY REPORT TO THE MONTANA STATE BOARD OF HEALTH¹

LOUIS B. WILSON, M.D.

MINNEAPOLIS.

First Assistant Bacteriologist, Minnesota State Board of Health; Senior Demonstrator in Pathology, Minnesota State University.

AND

WM. M. CHOWNING, M.D.

MINNEAPOLIS.

Junior Demonstrator in Pathology, Minnesota State University.

INTRODUCTORY.

The persistence over a limited portion of Montana of a disease locally known as “spotted fever” led the Montana State Board of Health to undertake a special investigation as to its etiology and pathology. In May, 1902, Dr. A. F. Longeway, secretary of the Montana State Board of Health, consulted the secretary of the Minnesota State Board of Health relative to said investigation. The latter expressed a willingness to aid the Montana authorities in every way possible.

Arrangements were made for Dr. Wilson to go at once to Montana and begin observations for the Montana State Board of Health. At the same time it was planned that Dr. Chowning should follow Dr. Wilson at the earliest possible date.

The disease had been recognized as a distinct clinical entity by local physicians for fifteen or twenty years, but the only article in a medical journal hitherto published concerning it is that by Dr. E. E. Maxey, in the *Portland Medical Sentinel*, for October, 1899. Two other papers, by Drs. R. Gwinn and G. T. McCullough, were read at the May, 1902, meeting of the Montana State Medical Association, and will be published shortly. These three deal very clearly with the history and clinical symptoms, but the pathology and etiology, we believe, have not hitherto been reported on.

LOCATION.

Dr. Maxey's paper describes cases in Idaho, mostly along the southern foothills of the Boise mountains. The cases in Montana are confined to the eastern foothills of the Bitter Root mountains (a range along the top of

which runs the Montana-Idaho state line), namely on the western side of the Bitter Root valley in an area from four to ten miles wide and ninety miles long. No case has ever been known to originate in Montana outside of this territory except seven cases in an area about a half mile wide and two miles long in the narrow canon of Rock, creek about 20 miles east of the Bitter Root valley.

The Bitter Root range of mountains is very rugged, the top being covered with snow until about July 1, and some peaks capped throughout the year. The range on the east side of the valley is less rugged, though the snow remains almost as long in spring as on the west side. On the foothills the snow melts from sunny exposures as early as February, the bulk of it disappearing in April and May. The climate of the valley is very mild, as is evidenced by the many orchards of apple, pear, cherry and plum trees. The altitude of the valley is about 3,500 feet above sea level.

The population of the valley is made up largely of fairly well-to-do ranchers, the majority of whom have come from Missouri, Georgia and the Carolinas. They are, as a rule, cleanly and healthy.

HISTORY.

In Idaho spotted fever has been known for about thirty years. So far as can be determined, the first case of “spotted fever,” “black fever” or “blue disease” in the Bitter Root valley in Montana occurred in 1873. At this time there were but few white men in the valley. No authentic information of its occurrence among the Indians—who until 1890 inhabited the valley—has been obtained.

Since its first appearance probably 200 cases of the severe type have occurred, 70 to 80 per cent, of which have been fatal. During the spring of 1902 10 such cases

1. Reprinted from *JAMA*, July 19, 1902, pp 131–136. Reprinted with permission from the American Medical Association. Original style, spelling, and punctuation have been retained.

observed in children and women, a few days before death.

Nervous System—Aside from the headache at the beginning, many patients show no nervous symptoms until just prior to death. A low muttering delirium as in typhoid fever is present in severe cases, the patient being but partly rational. In the severe stages, picking at mouth, ears, bedclothing, etc., is present. Except at the outset, the disease is remarkable for its freedom from pain. The pupils react normally to light and accommodation. There is no opisthotonos. Kernig's sign is absent.

Circulatory System—The pulse at the onset is usually full and strong, but gradually becomes more and more rapid, while it loses in volume and strength, very much as in diphtheria. In fatal cases in adults it may reach 150 per minute some days before death. The rapidity of the pulse is sometimes out of all proportion to the temperature, as may be also the respiration. The red blood count in five cases examined was 4,100,000, 4,200,000, 4,300,000, 4,500,000 and 4,600,000 respectively.³ There was a slight increase of leucocytes—from 12,000 to 13,000—in the four cases examined.

Blood, when removed for examination, appears to be somewhat darker than normal, as well as somewhat less fluid. On exposure to the air the color brightens perceptibly. In five cases examined during various stages of the disease the hemoglobin was 50 to 60 per cent. One child of 12 years, examined two months after convalescence, showed Hb. 80 per cent. Freshly drawn blood when examined with the 1-12 oil immersion objective shows parasites sparingly in the red blood cells. The Widal reaction with *B. typhosus* is not present. The spleen is uniformly enlarged and tender on palpation. In all severe cases more or less edema of the face and extremities is present. This may be marked and may appear as early as the third day of the disease.

Digestive Tract—At the onset of the disease the appetite is usually good and food is well retained and assimilated. About the beginning of the second week nausea and vomiting develop and continue in fatal cases to the end. In some cases nausea is present from the onset. Constipation is usually present from the beginning. Abdominal tympanites usually appears one or two hours before death. The liver is somewhat, though not markedly enlarged. Pain on pressure is absent.

Urinary System—The urine is reduced to about one-half its normal amount and is slightly above normal in

color. A small amount of albumin has been found in each of the five cases examined. Hemoglobinuria is absent or very slight. Both granular and blood casts were present in specimens from each of the five cases.

Respiratory System—The respiration rate sometimes reaches 60 per minute in the adult, though ordinarily it does not run above 36 per minute. Like the pulse rate it is frequently out of all proportion to the temperature. It is regular, but usually shallow. It may be labored and accompanied by rattling due to accumulation of mucus in the upper air passages, during the last day or two of life. Cheyne-Stokes respiration has not been observed. Hypostatic pneumonia sometimes develops. Lobar pneumonia occasionally occurs as a complication and usually hastens the end.

Complications—The symptoms above noted are sometimes complicated by gangrene, hypostatic pneumonia, articular rheumatism, etc. Two physicians have noted epistaxis, but none has been present in any of the cases seen by the writers.

PROGNOSIS.

Dr. Maxey says, concerning the cases in Idaho: "The prognosis in spotted fever is, as a rule, very favorable if the patient is transferred to the lower valleys, where he can have home comforts and proper care. The disease appears to be more malignant in some localities than it is in others, and in one year more than in another."

In Montana cases of the mild type of the disease which show no spots, are as yet too indefinitely differentiated to permit of their inclusion with those of the severe type which invariably develop the eruption. That such cases exist there can be no doubt. They are never fatal. On the other hand the cases which are marked by the eruption have a mortality of 70 to 80 per cent. Death usually occurs between the sixth and fourteenth days, though it has occurred as early as third and as late as the eighteenth day.

Many cases in which the initial symptoms are mild become rapidly fatal.

MORBID ANATOMY.

Six autopsies were made by the writers, in from three to twenty-four hours after death of the patient.⁴ Two of these were on adult males, two adult females, one four-year-old male and one five-year-old female. The macroscopic lesions were very uniform throughout the series of cases and may be summarized as follows: Intense rigor mortis appeared early. The skin over all dependent portions of the body presented a marbled appearance. Over the nondependent portions it was covered with a

3. It will be noted that these counts were made in an altitude of about 3,500 feet, where the normal count is above rather than under 5,500,000.

4. Five were made earlier than eleven hours after death.

petechial rash. In all cases small wounds of the skin due to tick bites were present.

The pleura was normal. The lungs showed hypostatic congestion. The pericardium was normal. The heart was normal in size except in one adult female, in which it was about two-thirds the normal volume. The epicardium usually contained a few petechial hemorrhages near the base of the left ventricle. The myocardium was softened. The endocardium showed no lesions. The right ventricle was filled with dark fluid blood; the left was almost empty or contained only a small clot.

The spleen was enlarged, being from three to three and one-half times its normal weight. The capsule was distended and thinned. On section the tissue was found dark red and so soft as to be in most cases diffuent. The outlines of the Malpighian bodies were obliterated. The omentum covering the spleen was usually congested. In some instances the dependent portions of the stomach wall were hyperemic.

The intestines were normal—except slight hypostatic congestion in two cases—throughout their entire extent. Their glands were not enlarged nor abnormal in color. The liver was slightly enlarged, pale in color and of normal consistence.

In all cases one or both kidneys showed small subcapsular hemorrhages on the ventral surface. The capsule stripped readily. The cortex on section was congested. The bladder was normal and contained a small amount of urine slightly darker than normal. The uterus in the three females examined was apparently not affected.

The meninges of the brain and spinal cord showed a slight congestion apparently hypostatic. There was no basilar (or other) meningitis. There was no increase of fluid in the ventricles of the brain. The tissues of the brain and spinal cord were normal in color and consistency.

MORBID HISTOLOGY.

Portions of skin taken from purpuric areas, lung, heart muscle, spleen, omentum, liver, kidney, meninges, brain and spinal cord were each fixed in 95 per cent. alcohol, 4 per cent. formaldehyd and Zenker's fluid. These have not yet been all examined from every case, but from the examinations already made (of tissues fixed in alcohol and Zenker's fluid) it may be stated that there is throughout a congestion of the capillaries. Many red blood cells in the congested capillaries contain parasites.

In the spleen, lever and kidney are numerous phagocytes, each containing from one to eight faintly outlined red blood cells, in nearly every one of which is a parasite. In the lungs many cells filled with pigment are found. The myocardium shows acute inflammation with

segmentation. The spleen is engorged with red blood cells and leucocytes. The stroma is not increased in amount. In the liver fatty degeneration is very pronounced. The kidney shows an acute parenchymatous nephritis. Blood preparations taken from organs at autopsy as well as those from living patient show a marked poikilocytosis and anemia.

ETIOLOGY.

General Consideration—In studying the etiology of this disease the following facts have appeared to be of most significance:

The disease is definitely limited in locality, being sharply cut off from the eastern side of the valley by the Bitter Root river.

It is confined entirely to one season of the year, namely, from March to July.

It attacks alike patients of any age and either sex.

All the symptoms and lesions indicate that the disease is due to a specific infection.

There is not even a suspicion of its ever having been transferred directly from one human being to another, except in one instance, in which an infant, born while the mother was suffering from the disease, died four days later with marked purpura.

In no instance have two or more persons with the same food or water supply been stricken with the disease within a short time of each other.

There are no symptoms nor lesions which point to the digestive tract, respiratory or genito-urinary organs as the avenue of infection.

In all the cases examined by the writers there were small wounds of the skin, said to have been made by the bites of ticks. In nine of the cases this history was definite and positive. In one—a child—no history of tick bites was obtained, though the skin wounds were present and ticks were numerous about the premises where the child had been playing. In three of the cases there was a history of a single severe bite, two, three and five days respectively before the onset of symptoms.

Bacteria—In six cases direct coverslip preparations were made from the patient's blood during life. No bacteria were found in any of these. In five of these cases cultures on Löffler's blood serum, plain agar and in bouillon were made from the same source as the coverslip preparations, after scrubbing the skin thoroughly with alcohol and permitting it to dry. Cultures from two of the cases showed a few cocci which were determined by subcultures to be *Staphylococcus epidermidis albus*.

At the six autopsies held—3, 7, 8, 10, 11 and 24 hours after death respectively—direct coverslip preparations were made from subcutaneous tissue, lung, pericardial fluid, heart's blood, spleen, liver and kidney. In but three

autopsies was the central nervous system examined. Here coverslip preparations were made from the meninges and substance of the brain and spinal cord. The coverslip preparations were stained with eosin and Löffler's methylene blue, with eosin and Unna's alkaline methylene blue and by Gram's method. No bacteria were found in any of them except a few cocci in one skin preparation (in which case cultures showed the presence of *Staphylococcus epidermidis albus*), and in the preparations from the spleen, removed at the autopsy 24 hours after death, in which was present a large spore-bearing bacillus. (See description under "cultures.")

At the autopsies cultures were made from all the sources noted under coverslip preparations—and in addition in three instances from the intestinal contents—on Löffler's blood-serum, nutrient agar and in bouillon. About 1 c.c. each of spleen pulp and heart's blood were also sown into flasks containing 250 c.c. each of bouillon. The spleen in five cases, after removal of coverslip preparations, cultures and small pieces for histologic examinations (and weighing) was wrapped in gauze, which has been wrung out of 1:1000 sublimate solution, and incubated for 24 hours. Direct coverslip preparations and cultures of Löffler's blood serum, agar and in bouillon, were then made from the incubated organ.

All cultures were examined macroscopically and in coverslip preparations stained with Löffler's methylene blue. Great care was taken in all sowings to avoid contaminations, and in only two tubes did such occur, in each instance due to a single colony of mould. The cultures were grown only aëroically. The bacteria found were as follows:

Staphylococcus epidermidis albus from the skin in two cases.

Staphylococcus pyogenes aureus from the skin in one of the above cases.

Bacillus coli communis was sparingly present in cultures from the spleen in autopsy No. 4 (dead 10½ hours). This bacillus was also present mixed with but a few other organisms in all cultures from the intestinal contents.

The spleen from autopsy No. 5 showed a bacillus 0.5 microns in thickness and 5 to 7 microns in length. The organism was square ended and contained spores. It stained deeply by methylene blue and also retained Gram's stain. There was no visible growth on or in any of the artificial media, though it has grown in the incubated spleen. The organism was presumably an anaërobic putrefactive bacillus.

No growth whatever was present in any cultures excepting those above noted. It will thus be seen that no bacteria were obtained in any cultures from any case which were of etiologic significance.

Protozoa—A few ovoidal bodies were seen within red blood cells in stained direct coverslip preparations from cases 2, 3, 4, 5 and 6 early in the investigation. The character of these bodies was not determined, however, until microscopic examination of the fresh blood in case 7 was made. Similar examinations were made of the blood in cases 8, 9 and 10. In part of the examinations a warm stage was used, but in most of them it was not used, since it was found that if the blood were placed directly under the microscope and examined by artificial (lamp) light, in a warm room, the temperature was sufficiently high to preserve the organisms alive for several hours. In one instance they were successfully kept under observation in this manner for 5½ hours. In all of the examinations made of freshly-drawn blood (12 in all from 4 cases) intracellular parasites showing ameboid movements were found. In several of these observations extracellular forms were also found.

In the observations on freshly-drawn blood usually several fields were searched (with Zeiss obj. 1-12, Oc. 4) before any red cell was found containing a parasite. The same is true of stained coverslip preparations made from the blood of the living patient or at autopsy. Probably not more than one red cell in five hundred in the circulating blood is ordinarily infected. In one observation, however, made on the seventh day of illness in an adult male, on fresh blood many red cells containing parasites were found. In this specimen fields contained from 125 to 175 red cells (estimated). Of these fields, two contained 11 infected red cells, each of which held one or two parasites. Another field contained 9 infected cells, another 7, and three contained 5 infected cells each. Nearly every field held one or more infected cells.⁵

Another similar observation on the fresh blood from the same patient, made forty-eight hours later, revealed only a very small number of the infected red cells. In the meantime no material change in the clinical symptoms had occurred.

In direct coverslip preparations, and in sections from the lung, heart muscle, spleen, liver and kidney great numbers of red blood cells were found which contained one or more parasites each. In the spleen, liver and kidney were many phagocytes, which had absorbed one to eight infected red blood cells each. These were also present in preparations from other organs, though not in such large numbers.

The organism varies greatly in size, form and staining reaction at various stages of its development.

The smallest forms (phase 1) when seen in fresh (unstained) preparations or in freshly-dried preparations, un-

5. The counts in this examination were made after the specimen had been for 3½ hours under observation at a temperature of about 33 C.

stained but mounted in iodized gum-acacia, are intracellular, ovoidal in form, about one micron in thickness and one and one-half to two microns in length. They resemble slightly hyaline bodies in malaria, and very much the micro-organism of Texas fever. A few, but certainly not nearly all of these bodies are stained by Löffler's methylene blue. When so stained the smaller extremity takes up more of the stain than does the larger extremity, which remains but faintly blue, even after prolonged staining. Perhaps one in ten of the red cells which are infected with this form of organism contains two instead of one of the bodies. When the organisms are in pairs within a cell, their long axes usually lie in the same straight line, though they may be placed at an angle as acute as 60 degrees. Their lesser extremities are often toward each other, though distinctly separated by a small interval. These bodies have occasionally been seen to change their position within the red cell, though the presence of pseudopodia or any other evidence of ameboid movement except the transference from place to place has not been observed in bodies of this size.

Several gradations in size, in both single and paired organisms, have occasionally been observed up to phase 2. This phase is marked by an organism solitary within the red cell, and usually ovoidal in form, though it may be elongated, ellipsoidal or spheroidal. It is from two to three microns thick and three to five microns long.

This type in freshly-drawn blood frequently exhibits active ameboid movements. These consist in the elongation of the organism, the projection of the pseudopodia in one or more directions, the final retraction of all pseudopodia and the assumption of the ovoidal form. Such an organism was kept under observation for three and one-half hours. During the first hour and one-half the ameboid movements were very active, changes occurring more rapidly than they could be properly sketched. At the end of this time a reddish brown pigment (?) granule 0.5 microns in diameter was apparently extruded from the body of the organism into the protoplasm of the cell. After this the pseudopodia were all retracted, the organism which had previously been much elongated and curved, slowly straightened out, became shorter and thicker, and finally came to rest, two hours and forty-five minutes after the beginning of the observation, as an ovoidal body about three microns in diameter at its thickest portion and five microns long. No further change occurred in the remaining forty-five minutes during which it was under observation.

In the freshly-drawn blood are sometimes found bodies (phase 3?) occasionally in pairs, and then resembling diplococci, which are about 0.5 to 1 micron in diameter and exhibiting active Brownian movement. In stained coverslip preparations from the blood of the living pa-

tient these bodies are occasionally seen. They vary much more in size than do cocci of one species, and sometimes, also, are ovoidal in shape. They stain but faintly with Löffler's methylene blue, and, indeed, in all respects resemble the smallest intracellular forms except that they are smaller, extracellular, less numerous and more diplococcus-like. In direct coverslip preparations made from the blood at autopsy no extracellular forms have as yet been found.

In marked contrast to the small number of infected cells in the circulating blood, is the great number of infected cells in the congested capillaries in the tissues removed at autopsy. Here from 1 to 5 per cent. of the red cells contain each a large parasite. This is especially marked in the lung, spleen, liver and kidney. In these organs many red cells are also included in phagocytes, being faintly outlined within the protoplasm of the latter and each containing a large parasite. The ovoidal form, however, of most of the parasites appears to be lost shortly after death, since although many of this form are present in the tissues from autopsy No. 6 (made three hours after death), but very few are present in the tissues from autopsies No. 1 and 2, made seven and eight hours after death. In these tissues the organisms are almost all spheroidal. In the tissues removed at autopsy the parasites are metachromatic to methylene blue. Sections stained in eosin followed by Unna's or Löffler's alkaline methylene blue and then decolorized in water and alcohol until the nuclei of the cells are a very light shade of blue, show the parasites still stained an intense blue. The same general appearance is obtained by staining sections twenty-four hours in Nocht-Romanowsky's blood stain, then washing out in water and alcohol. These stains have given the most satisfactory results, though the organisms may also be stained by fuchsin, hematoxylin, Jenner's blood stain, etc.

So far no differentiation of the protoplasm in the large organisms seen in the tissues has been made out by any stain. In a very few instances, however, small, intracellular ovoidal types have been found after death, and these have stained lightly though more intensely than in fresh blood.

It will thus be seen that the organism, while it resembles in its smaller form very markedly the *Pyrosoma bigeminum* of Texas fever, yet differs from that organism in being larger, and in its larger forms exhibiting active ameboid movements with the projection of pseudopodia. The absence of pigment from the organism of spotted fever would apparently separate it from the malarial group and place it with that of Texas fever. The writers, however, prefer to make a fuller study of the life history of the organism before attempting to classify it more definitely than as a hematozoön.

INOCULATION EXPERIMENTS.

About 0.5 c.c. each of the spleen pulp and heart's blood removed at autopsy No. 6 was inoculated, four hours after the death of the patient, into the breast muscle of two pigeons and also subcutaneously in the right groin of two white rabbits. The blood of the pigeons was examined for several days thereafter, but the organisms were not found. The rabbits, on the day following inoculation, showed a rise of temperature⁶ of one degree C. At this time intracellular organisms were found in the blood of both rabbits, and continued present in specimens collected on successive days for two weeks. One of the animals was then killed. At autopsy the spleen was enlarged and darker than normal. It was not softened. There were no macroscopic lesions in any other organ. The tissues were preserved in 95 per cent. alcohol, Zenker's fluid and 4 per cent. formaldehyd. They have not yet been examined. The second rabbit is still alive, four weeks after the inoculation, and still shows the organisms present, though they are becoming very difficult to find.

MODE OF INFECTION.

Since there is no suspicion of spotted fever ever having been transferred directly from man to man, and since there is no symptomatic or postmortem evidence of entrance of the disease, either by way of the digestive tract, respiratory or genito-urinary systems, the writers were led to examine the skin for evidence of direct inoculation by the bite of some temporarily parasitic animal. As has been noted above, in each case under observation, during the investigation, evidence of tick bites was present. But it is true that in the locality in which the cases occur many persons in the spring of the year are bitten by ticks and yet show no symptoms of spotted fever. However, the following facts would seem to suggest the hypothesis that the disease is conveyed to man by means of this arachnid:

1. Ticks are known to appear in the spring as soon as the snow melts from the sunny exposures; in other words, in the Bitter Root valley, as early as February 15. They are, however, chilled and inactive until the latter part of March or first of April, and do not become very numerous until the latter part of April. In relation to this, scattering cases of spotted fever appear during the latter part of March and first of April, and are most numerous during May and June.

2. Ticks become less numerous about the middle of June, and finally disappear about the middle of July. In connection with this it should be noted that cases of

spotted fever become less and less numerous from the middle of June to the middle of July, after the 20th of which month no cases have been observed.

3. The occurrence of spotted fever in isolated cases in a region sharply limited on one side by a river, would indicate the conveyance of the germ to man (if by any animal whatsoever) by a temporarily parasitic animal which travels slowly and not widely, and which is not carried far by the wind, etc. The tick answers this description.

4. All hematozoa of warm-blooded animals, of which the life cycle is now known, pass, at least, one phase of their development within the body of some host (usually an insect or arachnid) other than the one whose blood cells they invade. This is probably also true of the hematozoön of "spotted fever."

5. The malarial organism, the hematozoön which in man most nearly resembles that of spotted fever, is conveyed to man by the bite of an insect. The organism of Texas fever, in cattle, which is apparently a very close relative of the germ causing spotted fever, is conveyed to cattle through the bite of ticks. It is perhaps unnecessary to note that of the many genera of mosquitoes only one carries the malarial organism to man, and of the many genera of ticks only one carries the Texas fever organism to cattle; further, that even in these specific genera by no means all of the individuals are affected with the pathogenic parasite.

6. There are at least three (probably more) species of ticks within the region in which spotted fever occurs, and the specific selection noted under No. 5 may apply to these.

7. All of the patients, eleven, coming under observation during this investigation had been bitten by ticks. In three cases a history was given of a single severe tick bite two, three and five days, respectively, before the onset of the disease.

8. There is apparently no other insect, arachnid or other biting creature within the infected locality, which would fulfill the conditions indicated in the above outline as does the tick. For instance, it may be noted that the mosquitoes probably do not appear until a later date than that on which the earliest cases of "spotted fever" have developed, while they remain for several weeks after the spotted fever ceases. They move about freely and are readily carried by the wind. Were they the infection agents one mosquito would probably infect two or more persons in the same family, and the disease would not be limited by the river. Bedbugs and fleas are present throughout the year and, from their persistent activity, would probably infect more than one individual in a family, were they the carriers of the disease.

6. This may have been physiologic, though the animals were in a basement in a temperature of 20 centigrade, and were not excited.

The extreme isolation of cases of spotted fever, their occasional development in localities removed many miles from the site of any previous case, and the long period existing between the death or convalescence of the last case of any one year before the development of the first case in the following year, would point to the possibility of the red blood cells of some one of the lower warmblooded animals being the normal habitat of the parasitic protozoön in that stage of its life cycle not passed within the body of some arachnid. Of the animals within the infected region, the common gray gopher would probably best fulfill the conditions of such a parasitism.

The writers are at present attempting to obtain data which shall confirm or demolish the above hypotheses.

A detailed report of the investigation will be published later by the Montana State Board of Health.

The writers desire to express their thanks to the Montana State University for the use of apparatus, stains, chemicals, etc.; to the Northern Pacific Beneficial Association, and Drs. J. J. Buckley and E. W. Spottswood, chief and assistant surgeons of its hospital at Missoula for the free use of its laboratory, apparatus, etc., and to the physicians of Missoula and the Bitter Root Valley, who have been most generous and enthusiastic in their assistance.

Missoula, Mont., July 1, 1902.

The proper way to practice medicine is to recognize one's limitations rather than to be carried away with therapeutic optimism.—Hare.

have developed, 9 of these have died and one has recovered.

SEASON.

The disease occurs only in the spring. The earliest recorded case began March 17, and the latest about July 20, though most cases occur between May 15 and June 15. There are no records of any cases occurring between August 1 and March 17, though there are rumors of some cases having occurred as early as February.

PREVIOUS CONDITION OF PATIENT

The sex, age and general health of the patient appear to have no part in determining susceptibility to the disease. A large number of cases give a history of recent exposure to wet or cold or of over-exertion shortly before the attack. But in several cases all such history has been absolutely excluded. Many of the patients had suffered somewhat from indigestion and constipation immediately prior to the attack. In others no such condition existed.

TYPES OF THE DISEASE.

Most physicians in the Bitter Root valley who have had experience with the disease recognize but one type, a severe and usually fatal form, the principal diagnostic feature of which is the "spots." Several physicians, however, recognize in addition a mild type in which there are no spots. There is much difficulty in the accurate diagnosis of the mild type, and though its existence must be recognized, yet, during the investigation herewith reported, all of the examinations except one were made on cases of severe type. The type of the disease which appears in Idaho, as described by Dr. Maxey, is apparently very much milder than that of the severe form appearing in Montana, though the cases all show the peculiar eruption.

SYMPTOMS.

Onset—Many of the cases are preceded by a short period of malaise. This is followed by a well-marked chill. The chill is usually most severe at the beginning of the attack and recurs at irregular intervals though with decreasing severity. At the onset there is a severe aching in the bones and muscles with pains in the back and joints. The patient is usually very weak and headache may be severe. Constipation at this period is usually present. There is considerable restlessness. A bronchial cough is frequently present. The urine is usually small in amount and highly colored; albumin is sometimes present. The skin is dry and the tongue, even at the onset, is thickly coated. The coat at first white becomes brownish as the fever increases while the tongue becomes dry and cracked. Sordes appear early and may be quite pronounced. Indeed, the whole facies in these respects is very like typhoid.

Temperature—After the initial chill, fever rapidly develops, and may reach 103 to 104 F on the second day. It gradually increases and reaches its maximum in from five to seven days, when it may register from 105 to 107 F². Usually a slight evening increase and morning decrease is noted. The temperature occasionally becomes normal or subnormal eighteen to twenty-four hours before death. Where recovery occurs it usually is by lysis, much as in typhoid. The diminution of the fever begins about the end of the second week and reaches normal about two weeks later.

Skin—The eruption usually begins from the second to fifth day after the chill, first about the wrist and ankles or back. It then extends over the entire body—the abdomen usually being involved last. Sometimes it spreads very rapidly, the entire surface of the body being covered in twelve hours. More usually, however, one or two days pass before it reaches the maximum. The scalp, palms of the hands and soles of the feet are frequently covered with the rash. Occasionally, though perhaps rarely, purplish spots are found on the mucous membrane of the inside of the cheeks. The macules are at first rose colored and consist of circular spots, varying in size from one to five millimeters in diameter. The spots are not elevated. At first they disappear on pressure, but quickly reappear. They are sometimes tender to the touch. This appearance ordinarily rapidly changes, the macules becoming permanent, assuming a dark blue or purplish color and increasing in size until by confluence a mottled or marbled appearance may be given to the skin, especially in the dependent portions. In some cases the marbling covers the entire body. The color now no longer disappears on pressure. In some cases the eruption at no time becomes confluent and only small brownish or purplish petechiæ may be present, giving a speckled appearance which has been likened to that of a turkey's egg.

The skin ordinarily shows some jaundice. This may also be quite marked in the conjunctivæ, the vessels of which are injected from the onset. About the second week ordinarily the skin presents a glazed appearance. Desquamation begins about the third week and extends over the whole body, but is slight except over the most affected areas. The spots fade as the fever subsides, but may not entirely disappear for weeks or months, after convalescence is established. In some cases the skin becomes gangrenous over considerable areas, as on the elbows, fingers, toes, lobes of the ears, scrotum, etc.

There is a peculiar ashy paleness present, more readily

2. Rectal temperature. The difference between the rectal and axillary temperature is sometimes as much as two degrees F.