

THE IDENTITY OF PROTEUS INFECTION AND HOSPITAL GANGRENE.¹

A CASE OF MIXED INFECTION WITH *ÆROGENES CAPSULATUS*
AND *PROTEUS VULGARIS*.

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THE patient is a boy, eight years old, living near the Ogeechee Swamp and suffering from chronic malaria. June 4, 1902, he received a compound comminuted fracture of the middle of the left thigh by the accidental discharge of a shot-gun loaded with bird-shot. The local physician made a digital examination of the wound, and sent the patient to Drs. Corbin and Lattimore, in Savannah, for amputation of the thigh. When examined just before the operation, and about thirty hours after the accident, the wound was already stinking and discharging a dark, watery fluid. The charge of shot had passed through the middle of the femur, and pulverized the bone so completely that there was no possibility of saving the leg even if the wound had not been infected. The thigh was amputated as high as possible, and none of the lacerated tissues were left behind. The lower edges of the flaps were sutured and the angles of the wounds packed with gauze. Temperature reached 100° F. during the night; pulse, 140. At the dressing the next day the wound was very offensive and discharged a dark, watery fluid. The surface of the wound was covered with a dark gray slough not easily detached. There was not much inflammatory reaction. The middle of the anterior flap was already gangrenous, and a similar area of gangrene the size of half a silver dollar was located at the inner angle of the wound. The gangrenous areas were of a yellowish-green color, and the epidermis was lifted up by small air-vesicles. A distinct

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gaseous crepitation was felt when the flaps were pressed upon. Material was taken for a bacteriological examination, the result of which is reported below. At the second dressing the gangrene had extended a little, involving the lower half of the anterior flap and the edge of the posterior flap. After this the gangrene ceased spreading and gaseous crepitation could not be felt after the second dressing. The odor of the wound continued to be most offensive, resembling stinking meat. After a week, the gangrenous part of the anterior flap sloughed off, leaving the posterior flap exposed and covered with a dark gray slough which seemed to involve the fascia and subcutaneous tissue and leave the muscles unaffected. Subsequently, the sloughs separated and left the individual muscles standing out distinctly. After the sloughs came away the wound became less offensive and began to discharge ordinary pus. After three weeks the wound was granulating nicely, and there is every promise of a speedy recovery.

Bacteriological Examination.—Cover-glass smears from the sloughs show two distinct forms of bacilli. One is a long, thick bacillus about six microns in length and occurring frequently in pairs, with the ends joined together and sometimes side by side. The other is a short, thick bacillus with rounded ends resembling in form an oval coccus.

Stab and slant cultures were made on Löffler's blood serum, and bouillon cultures were also made. After twenty-four hours there was considerable development of gas in the blood serum stab culture, and cover-glass smears showed the same two bacilli, but the larger variety was relatively much more abundant. By Gram's method the larger bacilli stained deeply and showed numerous spores, about eight to twelve to each organism. The other bacilli were decolorized completely. There were no ordinary pus cocci present. Welch's acetic acid and gentian violet capsular stain showed the larger bacilli to be surrounded by a thick, transparent capsule, square at the ends. Examination in the hanging drop failed to show any motion in the larger bacilli. In bouillon and on slant cultures the large bacilli grew very scantily. The presence in the wound of this large anaërobic, capsulated, non-motile, gas-producing bacillus, which stains by Gram's method and produces spores in blood serum cultures, leaves no doubt of its being the *Ærogenes capsulatus* of Welch.

The other bacillus was about two or three microns in length,

but varied greatly in size. They were extremely motile when examined in the hanging drop, resembling in appearance a culture of typhoid bacilli. They were decolorized by Gram's method and grew profusely on the ordinary culture media at room temperature in the summer and produced a very offensive odor. In bouillon the medium was rendered turbid, and a white sediment formed at the bottom. The individual bacteria were larger than those from the wound.

Colonies upon the blood serum streak cultures were opaque and sent out branches. They produced considerable water of condensation, and subsequently liquefied the medium. All of these peculiarities are characteristic of the *Proteus vulgaris*.

The *Ærogenes capsulatus* was first reported as the organism of emphysematous gangrene by Welch, of Johns Hopkins, in 1892, and since then a considerable number of cases have been observed, the majority of them being fatal. Welch found that when inoculated into mice the cultures varied greatly in virulence, and some were not pathogenic. In our case we either had a non-virulent culture or the free access of air after amputation prevented further growth of the organisms. They seemed to have produced no trouble after the first few days.

Regarding the *Proteus vulgaris*, the available literature is limited. The organism has long been known as one of the common bacteria of putrefaction, and produces several toxins, principally æthylendiamine and gadinine. There is some discussion as to whether the *Proteus vulgaris* is a true pathogenic organism or simply a stink-producing parasite, but there is considerable evidence to support the view that it is truly pathogenic.¹

In looking over the "Surgical History of the War of the Rebellion," I was impressed with the great similarity of our case and those described and lithographed under the name of hospital gangrene. (Surgical, Vol. ii, pp. 739 and 928; Vol. iii, p. 823.)

¹ Since this case was first reported, a very able article by Dr. Martin W. Ware, on the *Proteus vulgaris* in surgery, has appeared in the July number of this Journal.

This disease was common in the Armies of Virginia and Tennessee, and was reported as being especially frequent in Sherman's army in Georgia. The disease was characterized by Acting Assistant Surgeon W. W. Keen as, "The typhus of wounds; a most unwelcomed guest to any hospital, and most of all a military hospital." When once introduced, the disease would go through a surgical ward, infecting nearly all the cases. At the hospital in Annapolis, for example, a few prisoners were brought in from Richmond with hospital gangrene, and in a few days sixty cases had developed. In the hospital at Louisville 343 cases occurred within a year. Acting Assistant Surgeon C. H. Cleveland describes the appearance of the disease as follows: "Hospital gangrene as it has been presented to us at the hospital assumes a great variety of appearances. In the early stages it has appeared as a dusky, almost black, mass of dead and rotten flesh occupying the seat of the disease, and surrounded by a reddish ring of slightly swollen integument, while the adjacent tissues do not appear to be affected. When a surface already divested of its skin is affected with the disease, the first invasion appears to give the surface an ashy gray color with pultaceous consistency and the peculiar odor of *spoiled meat* by which the disease is readily recognized. When the muscular tissue has become infected, and when small blood-vessels have become ruptured, a dark, grumous, almost black, dirty appearance of the diseased surfaces is presented and accompanied by a powerful fœtid odor, and usually with invasion of the disease under the skin."

Assistant Surgeon J. J. Woodward, who was sent to Annapolis to study the pathology of the disease, divides the cases into two classes. In the first class the sloughs form and extend without much swelling or involvement of the neighboring structures; and in the second class "the tissues about to be invaded are red, hard, and swollen, and made up of spherical granular cells quite identical with pus-cells."

Cleveland's description applies to all the important features of our case so accurately that there is no doubt of the identity of the two diseases. It belongs to Class I of Wood-

ward, and it is to be noted that the ordinary pus cocci were not present in the early days of the disease. Cases in Class II of Woodward were probably cases of mixed infection of the *Proteus vulgaris* and streptococcus.

This case, together with the report of many similar cases in this region during the Civil War, would suggest that the soil of Georgia may be peculiarly rich in pathogenic bacteria, and will well repay further investigation.