cipitate when poured into three volumes of absolute alcohol. This precipitate, when collected, thoroughly washed until wholly free from acid, dried and pulverized, induces, when injected into animals, the symptoms and lesions of colon intoxication. So far this method of extracting the cellular toxins has been applied to the colon bacillus, and the bacilli of anthrax and diphtheria. These pathogenic organisms have all yielded, when treated with dilute sulphuric acid, toxins which, when injected into animals either subcutaneously or intraperitoneally, induce the symptoms and lesions which follow inoculation with virulent living cultures. The space limitation has already been exceeded, and we will have to omit a discussion of the properties of these intracellular toxins.

A BACTERIAL SOFT ROT OF CERTAIN CRUCIFEROUS PLANTS AND AMORPHOPHALLUS SIMLENSE.*

For several years the writers have had under observation a soft rot of certain cruciferous plants, particularly cabbage and cauliflower. During epidemics of black rot, *Pseudomonas campestris* (Pam.) Smith, in both cabbage and cauliflower it often happens that much damage is done by a soft rot. At first this soft rot was supposed to be merely a virulent form of black rot; but it was found that severe attacks of soft rot may occur in fields where there is little or no black rot. Especially is this true of seed cabbage. On Long Island the production of cabbage seed is an important industry, and one of the chief enemies to the crop is a soft rot which attacks the plants during winter storage in trenches and also at the time of blooming. In storage the plants are attacked just below the head. In the field this portion of the stem rots, causing the plant to suddenly wilt and die while in bloom.

In the cauliflower fields on Long Island one may find at any time during August, September and October plants which have suddenly collapsed with soft rot of the stem. From a plant thus affected the writers, in September, 1901, isolated an organism which in their notes was designated 0.2 E. Pure cultures of this organism were inoculated into cabbage and cauliflower plants in pots in the greenhouse in the following manner: A leaf springing from the fleshy portion of the stem was cut off close to the stem with a sterilized scalpel. Through the sterile surface thus formed the stem was punctured to the center by means of a needle which had been first sterilized and then dipped into a fresh culture of the organism. Finally the wound was smeared over with melted grafting wax. In this manner numerous plants of cabbage and cauliflower were inoculated at various times between March 10 and June 17. With one exception all of these plants became much rotten at the point of inoculation, whereas in the same number of check plants none showed any rot or discoloration whatever. The extent of the rotting seemed to depend largely upon the condition of the plant. On thrifty young plants it progressed with wonderful rapidity. Thrifty cabbage plants, two months old, nine inches high and with stems of the size of a lead pencil were so much rotted at the end of forty hours after inoculation that their own weight caused them to break over at the point of inoculation. On old, woody, slow-growing plants unmistakable signs of rot appear in from two to four days after inoculation; but in the majority of cases such plants are only checked in growth and not killed outright.

In most cases the rot first appears as a slight discoloration around the point of inoculation, works very rapidly for a few days, then stops. At first the rotten tissue is soft and mushy and watersoaked in appearance, but it soon dries and mostly disappears, leaving only a cavity lined with shreds of dry, blackened tissue.

Cabbage and cauliflower leaves inoculated in the petioles usually become broken over and soft rotten at the point of inoculation within forty-eight hours. Inoculations made in the blade of the leaf produce no marked results unless a large vein is punctured, in which case soft rot follows as with petiole inoculations. However, on the leaves of plants under bell-jars circular, dead, brown spots sometimes

* A preliminary report read before Section G of the A. A. A. S. at Pittsburgh, Pa., June 30, 1902.

appear in the parenchyma around the points of inoculation. Inoculations on the heads of cauliflower plants under bell-jars bring about an active soft rot which in a few days involves the whole head.

Young plants of kohlrabi and Brussels sprouts were caused to rot by inoculation in the stem, rutabagas by inoculation in the leaf petioles and radish and flat turnip by inoculation in the fleshy root.

Ten seed cabbages in full bloom and growing in the open air were inoculated with a pure culture by making a puncture in the enlarged portion of the stem where the head was originally attached. The wounds were covered with grafting wax. There were ten check plants. On the eighth day after inoculation three plants died from soft rot at the point of inoculation. None of the check plants were affected. Since May 28, when these plants were inoculated, there has been but a single shower upon them. This, coupled with the prevailing low temperature, may explain why more have not yet died.

The organism was also tested on slices of uncooked carrot, turnip, potato, onion and parsnip. Within twenty-four hours there were large areas of soft rot around the points of inoculation on all of these vegetables. Up to this time the organism was supposed to be different from *Bacillus carotovorus* Jones because it rots cabbage and cauliflower with avidity, whereas Jones states* specifically that *B. carotovorus* is without effect when inoculated on cauliflower; but the behavior of 0.2 E on uncooked vegetables aroused the suspicion that it might, nevertheless, be related to *B. carotovorus*. Accordingly, an authentic culture of *B. carotovorus* was obtained from Professor Jones and inoculated into cauliflower and cabbage plants. There followed a virulent soft rot strikingly like that caused by 0.2 E. The two organisms were then grown in parallel cultures on various culture media and found to behave in about the same way. Thus it appears highly probable that the germ 0.2 E is closely related to, if not identical with, *Bacillus carotovorus* Jones.

Besides 0.2 E there have been isolated several other similar organisms which produce soft rot when inoculated into cabbage and cauliflower plants. Two such germs were obtained from rutabagas affected with a destructive soft rot in a garden at Phelps, N. Y., in 1901; one from stored cabbages on Long Island; several from seed cabbage plants dying with stem rot while in bloom; and two from *Amorphophallus simlense,* a member of the Araceæ cultivated by florists. Since 1897 the writers have each year observed a destructive soft rot which attacks the petioles of *A. simlense* during June and July and causes the death of many leaves. The petioles of this plant are often two feet in length, an inch in diameter at the base and very juicy. The bacterial nature of this disease has been proved by inoculation experiments made in 1897, 1900 and 1901. Quite recently the *Amorphophallus* germs have been compared with 0.2 E and the other cabbage rot organisms and found to agree very closely with them. The *Amorphophallus* germs inoculated into cabbage plants produce soft rot and 0.2 E, and the germs from rutabaga when inoculated into *Amorphophallus* produce a soft rot of that plant.

Thus we have several bacterial forms which produce a violent soft rot of cabbage, cauliflower and several other crucifers and at least four of them also attack *Amorphophallus simlense.* It is likely that the list of host plants, and, perhaps, also the number of organisms, will be enlarged by future studies. The relationship of the various forms has not been fully worked out, but the present indications are that we have here to do with a group of organisms closely related to each other and to *Bacillus carotovorus* Jones, but presenting certain minor differences which may cause them to rank as varieties of *B. carotovorus* or, possibly, as separate species.

When completed, a full account of this investigation will be published in a bulletin of the New York Agricultural Experiment Sta-

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* Jones, L. R., 'A Soft Rot of Carrot and Other Vegetables.' *Ann. Rep. Vermont Exp. Sta.*, 13: 310, 1900; also, *Centralbl. f. Bakt. Parasitenk. u. Infektionskr.*, II. Abt., 7: 15.