rose to normal on the twentieth day. (Table II.) The pulse rate usually increased during the irradiation (average 20 p. c.), returning to normal soon after. Body temperature remained elevated about 1° C. for two days after the last irradiation.

Control dogs placed behind a screen at the same distance from the lamp while the experimental animal was being irradiated showed no changes in blood pressure, pulse rate or body temperature.

This is a preliminary report.

[1] Allen, F. M., *J. Met. Res.*, 1923, iv, 431.

3438

## Action of Bacilli of Paratyphoid, Dysentery and Metadysentery Groups on Various Starches.

ALDO CASTELLANI.

*From the Tropical Department, Tulane University.*

The action of certain bacteria on potato starch has been studied, but very little is known on the action of bacteria on the less common starches. For some time I have carried out researches on the action of bacilli of the paratyphoid, dysentery and metadysentery groups on various starches, and on the possibility of using starch reactions in the differentiation of organisms of these groups.

Fifteen starches have been used, *viz.*, arrowroot, barley, bean, canna, corn, ginger, lentil, oat, pea, potato, rice, sago, tapioca, yam, wheat. The so-called soluble forms have been used, but solution is seldom complete.*

*Technique.* Tubes containing 1 per cent solution of the various starches in peptone water are used, each tube containing a Durham's

TABLE I.

*Action on starches of B. paratyphosus A and B. paratyphosus C.*

| | Arrowroot | Barley | Bean | Canna | Corn | Ginger | Lentil | Oat | Pea | Potato | Rice | Sago | Tapioca | Wheat | Yam |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *B. paratyphosus* B | 0 | 0 | 0 | 0 | 0 | A | 0 | 0 | 0 | A | 0 | A | 0 | A | A |
| *B. paratyphosus* A | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | A | A | A | 0 | 0 |
| *B. paratyphosus* C | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

The readings were taken after 3 weeks incubation at 37° C. After 6 weeks, the readings were the same but paratyphosus C produced a slight acidity in tapioca.

* The starches were obtained from the Eli Lilly Co., Indianapolis.

TABLE II.

*Action on starches of B. dysenteriae Shiga-Kruse, B. dysenteriae Flexner, B. dysenteriae Y.*

| | Potatoes | Ginger |
|---|---|---|
| *B. dysenteriae* Shiga-Kruse | 0 | 0 |
| *B. dysenteriae* Flexner | A | A |
| *B. dysenteriae* Y | 0 | 0 |
| *B. dysenteriae* Duval | 0 | 0 |

The readings given in the table are those taken after 3 weeks incubation at 37° C.

fermentation tube, or saccharymeters may be used. It must be noted that many starches do not dissolve completely. The tubes are inoculated with the different organisms and placed in the incubator at 37° for 21 days, readings being taken on the 7th day, the 14th day and the 21st day.

I suggested some years ago the term "metadysentery bacilli" to denote a group of bacilli capable of producing dysenteric symptoms in man but culturally different from the true dysentery bacilli (Shiga-Kruse, Flexner, Hiss-Russell). These bacilli are characterized by the following features:

1. Like the true dysentery bacilli they do not produce gas in any sugar.

2. In contrast to the true dysentery bacilli they either produce acidity in lactose and clot milk, or produce acidity in lactose without clotting milk, or clot milk without producing acidity in lactose.

There are several species of the metadysentery bacilli which Chalmers and I grouped into two genera: Lankoides (milk clotted), Dysenteroides (milk not clotted). The two principal species are *B. ceylonensis* A and *B. ceylonensis* B, and my experiments have been carried out with these two germs; the results are collected in Table III.

Discussion and Conclusions. With the strains in my possession it is possible to differentiate by means of their starch reactions be-

TABLE III.

*Action on starches of certain bacilli of the metadysentery group.*

| | Arrowroot | Barley | Bean | Canna | Corn | Ginger | Lentil | Oat | Pea | Potato | Rice | Sago | Tapioca | Wheat | Yam |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *B. ceylonensis* B, Cast. 1907 | | | | | | | | | | | | | | | |
| *B. ceylonensis* B | 0 | A | 0 | A | A | A | 0 | 0 | 0 | A | A | 0 (decol) | 0 | A | 0 |
| *B. ceylonensis* A, Cast. 1907 | | | | | | | | | | | | | | | |
| *B. ceylonensis* A | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | A | A | A | 0 |

The readings given in the table are those taken after 3 weeks incubation at 37° C.

tween *B. paratyphosus* A, *B. paratyphosus* B, *B. paratyphosus* C; between *B. dysenteriae* Shiga, *B. dysenteriae* Flexner, *B. dysenteriae* Y (Hiss and Russell); between *B. ceylonensis* A and *B. ceylonensis* B.

*B. paratyphosus* B produces acidity (and often gas) in wheat, ginger, potato, sago; *B. paratyphosus* A does not touch wheat, ginger or potato; it touches sago, rice and tapioca; *B. paratyphosus* C does not touch any starch the first 3 weeks, then may produce acidity in tapioca; *B. dysenteriae* Shiga does not touch potato or ginger; Flexner produces acidity in both; Y does not touch them; Duval does not touch them. It is interesting to note that a strain received from a well known laboratory marked Flexner did not touch potato or ginger; further investigation showed this organism to be inert on maltose and to be highly agglutinated by Y serum. *B. ceylonensis* B produces acidity in ginger, corn, potato, rice; *B. ceylonensis* A produces acidity in sago, tapioca, wheat.

If further investigation should prove that all strains of these various organisms have permanent starch reactions, this might be an additional means for differentiating them.

*Addendum.* It is well known that different starches differ microscopically, their granules being of different appearance. They differ also in all probability biologically and biochemically, as some starches are fermented by certain microorganisms, other starches by other organisms. The testing of a given starch by means of various organisms assist in the identification of that particular starch.

3439

## "Symbiotic Fermentation Phenomenon," Its Use in Differentiation of Microorganisms and Identification of Carbon Compounds.

ALDO CASTELLANI.

*From the Department of Tropical Medicine, Tulane University.*

The phenomenon called symbiotic fermentation may be defined as follows: "Two microorganisms neither of which alone produces fermentation with gas in certain carbohydrates may do so when living in symbiosis or when artificially mixed." I noted the phenomenon in 1904 and 1905[1]; I observed that ordinary baker's yeast in Ceylon and England, as a rule, consisted of two or more organisms