Tissues contain considerable quantities of metabolizable carbohydrate which consist of free sugar, glycogen and other polysaccharides. These sugars are readily metabolized by many pathogenic microorganisms (unpublished data) when added to culture medium or serum; the products in every instance have been the same as are obtained from glucose.

Summary and Conclusions. *Diplococcus pneumoniæ, Eberthella typhosa,* and *Escherichia coli* were grown 24 hours at 37.5°C in meat infusion or meat extract culture medium enriched with 1% of peptone, 0.7 to 1.8% of $Na_2HPO_4 . 12\ H_2O$, and 1% of glucose. The pneumococcus was grown under anaerobic as well as highly aerobic conditions. The principal products were lactic acid, formic acid, acetic acid, and ethyl alcohol. The last 3 products appeared in the approximate ratio of 2 to 1 to 1. The reactions representing their formation most likely are: Glucose → hexose diphosphate → 2 triosephosphate → glycerophosphate and phosphoglycerate. Glycerophosphate → C_2H_5OH + HCOOH. Phosphoglycerate → phosphopyruvate → CH_3COOH + HCOOH. These are anaerobic mechanisms. Only a trace of CO_2 was obtained from pneumococci.

Rapidly growing bacteria may metabolize sugar almost entirely by anaerobic mechanisms when grown under relatively aerobic conditions. The same intermediary reactions are probably also utilized by microörganisms when growing in tissues in the course of an infection.

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Occurrence of Sporadic Bacillemia in Experimental Tuberculosis in Dogs.

JOHN S. HOWE. (Introduced by A. J. Nedzel.)

From the Department of Pathology, Bacteriology and Public Health, University of Illinois College of Medicine, Chicago, Ill.

Wilson[1] in summarizing the work on bacillemia in human tuberculosis up to 1933, concludes that bacillemia, detectable by present methods, is, except as a transitory phenomenon, rarely present until the disease has assumed an acute phase. Because of this discrepancy between the reported rare occurrence of bacillemia and the common demonstration of hematogenous tuberculous lesions at necropsy, it

[1] Wilson, G. S., *Tuberculous Bacillemia,* London, 1933.

seems important to determine the frequency and significance of bacillemia as a transitory phenomenon in tuberculosis.

Corper,[2] using dogs as experimental animals, reports that large doses of tubercle bacilli given intravenously produced a rapidly fatal bacillemia without the formation of tubercles. Smaller doses of tubercle bacilli produced no bacillemia and no tuberculous lesions. A search of the literature reveals no report of daily blood-cultures over a period of several months, which would seem to be the most adequate means of determining the frequency of transitory or sporadic bacillemia.

In our experiment, dogs were used because of the relative ease of obtaining an adequate quantity of blood daily for culture, and because the relative resistance of the dog to tuberculosis is more closely parallel to that of the human, than is the low resistance of the rabbit and guinea pig.

Experimental tuberculosis was produced in dogs by the intravenous injection of large doses of a virulent human type of tubercle bacilli (H37) in a suspension of Kaolan, mineral oil, and normal saline. This method was found to produce embolic tubercles limited largely to the lungs and tending to heal or to progress slowly.

Tuberculous abscesses were produced by injection of a similar suspension of tubercle bacilli into the chest wall of dogs. These lesions tended to break down and discharge for a time and then heal.

Seventeen dogs in all were injected by the intravenous method and 3 into the chest wall, with doses of tubercle bacilli varying from 3 to 20 mg. Femoral arterial punctures were performed daily on all dogs, and from 3 to 5 cc of arterial blood withdrawn and injected directly into guinea pigs, either subcutaneously or intraäbdominally. Arterial blood was used because of the theoretical consideration stressed by Bock,[3] that the nearer the point of origin of the bacilli the blood is obtained, the greater the chance of demonstrating bacillemia. This is particularly true since the blood sample is obtained before it passes through the peripheral capillary bed. Direct inoculation of guinea pigs was used in preference to other culture methods, since it has been shown by Saenz[4] that guinea pig inoculation is both more sensitive and more reliable than cultural methods.

Endermal tuberculin-tests were done on all the guinea pigs before inoculation with the blood and at intervals afterward, up to 3 months after inoculation, when all were sacrificed and necropsied. The pres-

2 Corper, H. J., and Vidal, C. B., *Am. Rev. Tuberculosis*, 1935, **32**, 575.

3 Bock, H. E., *Klin. Wchnschr.*, 1936, **15**, 1138.

4 Saenz, A., *Ann. Inst. Pasteur*, 1934, **52**, 645.

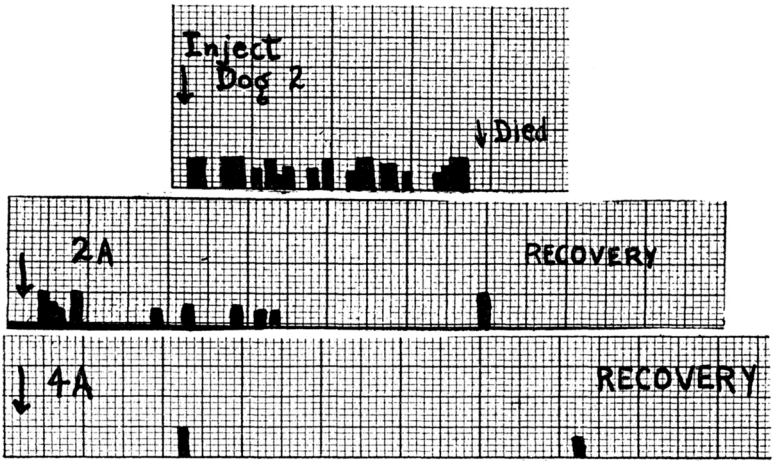

FIG. 1.

Showing the distribution of the sporadic bacillemia in a dog injected intravenously with a heavy dose of tubercle bacilli (2), one injected intravenously with a moderate dose (2A), and one injected subcutaneously with a moderate dose (4A). Each small square represents one day of observation, with the arrow indicating the time of injection. The heavy black squares indicate days on which bacillemia was demonstrated, with the height of the black square indicating roughly the degree of bacillemia.

ence of tuberculosis was established on the basis of the characteristic gross and microscopic pathology of injection-tuberculosis, supported by positive tuberculin-reactions and microscopic examination of smears for tubercle bacilli.

In the course of daily observations ranging from 1 to 3 months, 15 of the 17 dogs injected intravenously showed tubercle bacilli present in at least one blood sample. Three of these dogs dying of progressive tuberculosis showed the heaviest and most frequent periods of bacillemia, but 12 of the 14 dogs that recovered showed bacillemia on at least one day, and usually on several days at scattered intervals throughout the experiment.

Two of 3 dogs injected subcutaneously into the chest wall also showed sporadic bacillemia on at least one occasion.

The protocol of 2 typical dogs injected intravenously with a heavy and a moderate dose of bacilli and of a dog injected subcutaneously is appended.

These preliminary results indicate that even in an animal (dog) having a relatively high resistance to tuberculous infection, sporadic bacillemia occurs in a high percentage of animals infected experimentally, whether by the intravenous or subcutaneous route. This sporadic bacillemia depends quantitatively to some extent on the outcome of the infection, but is demonstrated even in a high percentage of animals that recover.