per 100 c.c. of blood. Lactose shows only a very slight rise, 4 milligrams, and that at the end of the second hour, as was the case with the other disachrade, cane sugar. I have been unable to consult the literature and so will offer the figures for what they are worth.

18 (1478)

The bacteriology of infectious gaseous gangrene.

By MARSHALL C. PEASE.

[*From the New York Post-Graduate Medical School.*]

Infectious gaseous gangrene can no longer be conceived of as being necessarily a monomicrobic disease. On the contrary it is frequently the result of an association of bacteria, not all of which are by themselves pathogenic or even under the most favorable condition of animal inoculation capable of causing a pathological lesion. The causative agents of infectious gaseous gangrene are found in a certain group of anaërobes, all of which are capable of elaborating a powerful toxin which has not only a local but also a systemic action. Death in gaseous gangrene is not the direct result of the local lesion but of the absorption of toxin into the general circulation with a consequent general toxemia.

The spread of the local lesion is dependent upon local tissue necrosis. The tissue necrosis in turn is dependent upon the elaboration of bacterial toxins, which are distributed along the line of the muscle sheaths and facia, and through the lymph spaces. There is no evidence that the toxin producing the local tissue necrosis differs from the toxin which is the cause of the general toxemia. If for any reason toxins are not elaborated within the wound or are not absorbed from the wound a gaseous gangrene does not develop despite the fact that there may be within the wound a large number of potentially pathogenic anaërobes.

All the aërobes can be dismissed as a cause of infectious gaseous gangrene. Any effects which they produce are in the nature of a complication. At the most their rôle in this disease process is confined to the absorption of oxygen, the turning upon

themselves of the processes which tend to produce an immunity and in causing the death of tissue thus preparing a favorable media for the multiplication of the anaërobes. They have never been isolated in pure culture from a case of infectious gaseous gangrene and have never produced typical lesions when inoculated into animals.

There are a number of anaërobes which cause characteristic lesion in animal inoculations and one or more of which are always isolated from cases of gaseous gangrene. In the following arrangement the organisms that are found in cases of gaseous gangrene are grouped with regard to their importance as causal agents of infectious gaseous gangrene; and there is in addition an indication of their main action toward the carbohydrates and proteids.

GROUP I.

Essential Causal Agents of Gaseous Gangrene.

Saccharolytic:

1. *Vibrion septique.*
2. *B. œdematiens* (*B. Novyii*).
3. *B. welchii.*

Proteolytic:

B. histolyticus.

GROUP II.

Accessory Agents of Gaseous Gangrene.

Comprises organisms capable of causing gaseous phlegmons (even of a severe type). Probably rarely or never an essential agent of gaseous gangrene. Important in association with the essential causal agents and generally unimportant when occurring alone.

I. Anaërobes:

A. Proteolytic group:

B. sporogenes.

B. aërofœtidus.

B. Saccharolytic group:

B. fallax.

II. Aërobes:

B. coli.

B. proteus.

(Both very doubtful as causal agents of true gaseous gangrene.)

GROUP III.

Organisms Merely Present in Gaseous Gangrene.

Never essential causal agents, though they may be capable of causing complications; and may have an importance in symbiosis with other organisms; and may be a cause of a great modification of the clinical picture.

A. Anaërobes:

Proteolytic:

B. putrificus.

B. bifermentans (also has a powerful saccharolytic action).

B. tetani.

B. tertius.

B. Aërobes.

Cocci:

Streptococci, staphylococci and diplococci.

Bacilli. (Gram negative.)

B. proteus, coli, pyocyaneous, etc.

Bacilli. (Gram positive.)

B. anthracoides group

B. subtilis group

B. mesentericus and *myscoides* group, etc.

The pathogenicity of this entire series exhibits great variation. There are strains of *B. welchii* and *B. œdematiens* that have almost no virulence. The *B. welchii* is notable in this respect, a few strains showing great pathogenicity, while many others have little or none; and the average is not sufficiently high to make it an easy matter to produce an antitoxin of high titer. Under exceptional circumstances the *B. sporogenes, fallax* and *aërofœtidus* are capable of producing a lesion alone, though as a rule these lesions are of a benign character of a type of a gaseous phlegmon. In infectious gaseous gangrene these organisms are commonly associated with organisms of greater pathogenicity such as the *B. welchii* or *œdematiens*, so that their rôle approaches that of accessory micro-

örganisms. In a bacteriological analysis of 308 cases of gaseous gangrene, of which 91 were derived from Weinberg's series and 217 from wounded American soldiers, the percentage of incidence of the various pathogenic anaërobes is as follows:

	Per Cent.
B. welchii	85
B. sporogenes	35.4
B. œdematiens	12.6
Vibrion septique	17.2
B. fallax	6.4

This is not the true incidence of the *B. œdematiens, fallax, histolyticus* or *aërofœtidus* as the difficulties in the isolation of these organisms in pure culture is great, but it does serve to emphasize the fact that infectious gaseous gangrene is usually a mixed infection.

In this group of 308 cases of infectious gaseous gangrene only 79 were infected with a single pathogenic anaërobe, the remaining 229 having from two to six anaërobes in the local lesion, and nearly always at least two pathogenic anaërobes.

19 (1479)

Hydration effects of amino-compounds.

By D. T. MACDOUGAL and H. A. SPOEHR.

[*From Desert Laboratory, Tucson, Arizona.*]

The chief interest in the results presented in this brief paper depends upon the following facts and conditions:

A. The amino-compounds furnish the only known solutions in which agar and other pentosans or mucilages undergo a greater hydration than in distilled water. Tentative conclusions to this effect have been confirmed by all of the results obtained during the past year.[1]

B. The pentosans, or anhydrides of the 5-carbon sugars are universally and abundantly present in plant cells, originating by transformations of wall-material, starch, etc., in any part of

[1] MacDougal, D. T. and H. A. Spoehr, "The effect of organic acids and their amino-compounds on the hydration of agar and on a biocolloid," PROC. SOC. FOR EXPER. BIOL. AND MED., 1918, xvi: 33–35.