

the hopeless character of general paralysis a trial of this same method might be recommended, and here also the principle of combined therapy should be borne in mind.

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 —(<sup>2</sup>) We have pleasure in recording our indebtedness to the Carnegie Trustees for a grant in aid of the expenses connected with the experiments on which the observations in this communication are founded. We have also to thank Dr. Carswell and Dr. Marr for permission to examine cases in Duke Street Hospital and Woodilee Mental Hospital.

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*A Bacteriological Investigation into General Paralysis of the Insane, and a Table of Blood-counts.* By  
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THIS research was carried on in the laboratory at Horton Asylum, and was directed to that vexed question as to whether the *Bacillus paralyticans* (which Dr. Ford Robertson has described) was the cause of general paralysis of the insane or not.

I was led into this research by the following incident: One morning, whilst making a *post-mortem* on a case of general paralysis which had died from an acute attack of erysipelas, I noticed that the spleen showed on section numerous little hæmorrhagic-like areas scattered throughout its substance. An agar tube was inoculated from the pulp, and next day there appeared a diffuse greyish-white growth which proved to be a bacillus, showing a chromatin point at each end. There were long and short forms present which produced strong acid formation and gas in glucose broth and was Gram-negative. A few streptococci were also present. A stained paraffin section of the same spleen showed short, thick, curved chains of these bacilli. A section of the kidney showed the same organisms, but they tended to remain separate rather than form short chains.

Thinking that this might possibly be the bacillus mentioned by Ford Robertson, I began to search for them in the spleen, liver, kidneys, lungs and brain of every case of general paralysis which died in the asylum.

Smear preparations were made, sections cut and stained, and

various media were inoculated with the pulp from the interior of these organs.

I also tried to draw blood and pulp from the spleens during life for examination, but was not successful, possibly because the spleens were too firm in consistence.

Later, I commenced searching the blood for the bacilli after death by drawing the blood aseptically from the right auricle, and incubating part of it in bouillon broth and part by itself, while the remainder was smeared on various media. Also in a few cases the blood was drawn aseptically from the median basilic vein before death and treated similarly.

The results are as follows :

*General paralytics* examined, 40 cases.

*Controls* from other classes of lunatics, 50 cases.

*Blood before Death.*

*General paralysis of the insane* (4 cases) : 2 cases showed bacilli ; 2 cases remained sterile. No controls were taken.

*Blood after Death.*

*General paralysis of the insane* (14 cases) : 4 cases showed bacilli ; 1 case showed staphylococci ; 4 cases showed diplococci ; 5 cases remained sterile.

*Controls* (37 cases) : 7 cases showed bacilli ; 3 cases showed staphylococci ; 7 cases showed diplococci ; 20 cases remained sterile.

The blood was in these cases drawn off at varying times after death, ranging from three to twenty-hour hours, but the presence of organisms had little relation to the time. Often the blood drawn twenty-four hours after death was quite sterile, and *vice-versâ*, that drawn off soon after showed organisms.

*Kidneys after Death.*

*General paralysis of the insane* (6 cases) : 2 cases showed bacilli ; 4 cases were sterile.

*Controls* (3 cases) : All sterile.

*Spleen after Death.*

*General paralysis of the insane* (15 cases) : 7 cases showed bacilli ; 8 cases were sterile.

*Controls (15 cases):* 3 cases showed bacilli ; 12 cases were sterile.

*Liver after Death.*

*General paralysis of the insane (7 cases):* 2 cases showed bacilli ; 5 cases were sterile.

*Controls (3 cases):* All sterile.

*Lungs after Death.*

*General paralysis of the insane (4 cases):* 3 cases showed bacilli ; 1 case showed pneumococci.

*Controls (2 cases):* 1 case showed bacilli ; 1 case (section) showed no organisms.

*Pia Mater.*

*General paralysis of the insane (3 cases):* 1 case showed bacilli ; 2 cases were sterile.

*Control (1 case):* Sterile.

*Brain.*

In 5 cases examination was made of sections from different parts of the brain :—Cortex, sides of lateral ventricles (frosted), floor of fourth ventricle, and cerebellum.

In only one case, was a small focus of bacilli found, *viz.*, in a piece of cortex from Broca's area.

*Nature of the Bacilli Found in the Various Cases.*

The bacilli in most of the cases resembled that which has been described, and seemed to belong to the intestinal group.

As a rule there were two forms distinguishable, *viz.*, long and short. Many showed chromatin points at the ends and in young cultures some were motile, the short forms being more actively motile than the long forms.

The following shows the general type of the majority. This was a bacillus cultivated from a small cyst in the choroid plexus in the third ventricle of the brain of a case of general paralysis of the insane, and also isolated from the spleen.

It showed long and short forms with metachrome ends and motile in young cultures :

(1) *Slope agar*.—At 37° C. growth began to appear in about eight hours after inoculation. In twenty-four hours there was a diffuse greyish-white translucent growth.

(2) *Gelatin*.—A whitish translucent-like growth, with slow liquefaction. No gas produced in a shake gelatin. In old gelatin cultures the bacilli assumed large involution forms with distinct metachrome ends.

(3) *Glycerin agar*.—Growth not so profuse as on ordinary agar ; showed a pale, thin, whitish film.

(4) *Blood-serum*.—Growths not so profuse as on agar.

(5) *Potato*.—Pale, dim, dirty, yellowish growth.

(6) *Milk*.—No coagulation.

(7) *Glucose broth*.—Acid and gas produced.

(8) *Lactose broth*.—No acid and no gas.

(9) *Lactose, saccharose, dulcin, salicin*.—No acid, no gas.

(10) *Capaldi proshanes I*.—Nil.

(11) *Capaldi proshanes II*.—Nil.

(12) *Neutral red*.—Some fluorescence.

(13) *Bile salt single*.—Acid, but no gas.

(14) *Cane sugar 1 per cent*.—Gas and slight acid.

(15) *Peptone water*.—Indol reaction.

(16) *Gram-negative*.

The bacilli isolated from the blood of two cases before death showed similar characteristics.

A guinea-pig inoculated intra-venously with the bacilli of one of these cultures died in twenty-four hours, and the same bacilli were found in the spleen of the animal. This was the only occasion in which inoculation was tried. (Not at the asylum.)

With regard to agglutination tests very little was done. Three cases were tried with more or less negative results, the serum from general paralysis showing no more power of agglutination than that from a normal individual. The dilutions of serum used were 1 in 50 and 1 in 100.

Such are the results, which, I am sorry to say, are so indefinite.

It will be noticed that organisms were found more often in the general paralytics than in the controls.

This presence or absence of organisms had no relation to

the age of the patients, but I was inclined to believe that it had some relation to the vital condition of the patient before death. The general paralytic cases had been moribund for a considerable period before death, and I observed that among the controls nearly all those that had died from the *status epilepticus* which had continued for two or three days showed organisms.

It is just possible that these bacilli which appear to belong to the intestinal group may have invaded the blood during the moribund state of the patient, though in two cases they were observed in the blood long before death.

It is worthy of note that the patients in the third stage of general paralysis were as a rule constipated to an extreme degree. This may have been due to the fact that they were being fed almost entirely on milk.

The temperature of the bed-ridden third stage cases was as a rule subnormal, with occasional sharp rises up to 99° or 100° F., followed by a sudden fall. These variations in temperature took place at varying intervals of several days.

#### *The Blood in General Paralysis.*

I now give in tabulated form thirty blood-counts of twenty-six cases of general paralysis of the insane, all more or less well-advanced cases.

Name of patient.	Leucocytes per c.mm.	Red blood-corpuscles per c.mm.	Percentage of hæmoglobin.
H. A— . . . . .	9,500	4,300,000	85
C. H— . . . . .	8,400	4,400,000	90
R. C— . . . . .	6,800	4,600,000	95
H. B— . . . . .	5,600	5,400,000	80
T. C— . . . . .	10,000	4,800,000	85
A. T— . . . . .	6,200	4,900,000	100
R. G— . . . . .	9,500	5,600,000	95
W. S— . . . . .	8,100	4,270,000	85
R. J. B— . . . . .	10,000	4,750,000	90
G. C. B— . . . . .	12,000	4,900,000	85
G. J— . . . . .	17,800	4,275,000	90
A. H. M— . . . . .	7,200	5,000,000	90
Same during seizure	10,000	4,000,000	85

Name of patient.	Leucocytes per c.mm.	Red blood-corpuscles per c.mm.	Percentage of hæmoglobin.
Later afterslight seizure	7,000	4,000,000	85
T. P— . . . .	6,400	5,200,000	90
Same later . . . .	9,600	5,000,000	90
D. M— . . . .	3,400	2,750,000	75
W. C— . . . .	11,700	4,800,000	90
S. C— . . . .	26,000	5,400,000	85
C. T. W— . . . .	7,000	4,800,000	85
S. S— . . . .	8,700	5,500,000	95
S— . . . .	11,900	4,300,000	85
P. D— . . . .	7,800	5,000,000	85
B— . . . .	8,700	5,300,000	85
G. C— . . . .	10,000	5,400,000	85
L. S— . . . .	11,800	5,300,000	90
E. H— . . . .	9,300	4,700,000	80
E. W— . . . .	6,000	4,700,000	80
H. J. C— . . . .	7,000	4,250,000	85
Same later . . . .	7,200	4,000,000	85

Here the average number of leucocytes per c.mm. is 9353, which is somewhat higher than the average number found in the blood of healthy individuals, and the percentage of polymorphs was fairly high.

#### *Syphilis and General Paralysis.*

With regard to syphilis, evidence of that disease was obtained in over 60 *per cent.* of the cases, there being direct evidence from scars in the groins or on the glans penis. The remaining percentage had practically all exposed themselves to infection, and the absence of physical marks was no proof that they had not contracted that disease.

Before concluding I wish to express my thanks to Dr. Lord, the Medical Superintendent, for his valuable supervision, and also to Mr. Edward S. Dean, who assisted me greatly in this research.