

ANAEROBIC ORGANISMS IN ACUTE AND CHRONIC
PULMONARY DISEASES

APPROVED:

J. B. McBryde
Major Professor

W. Johnston
Minor Professor

W. S. Drew
Director of the Department of Biology

Robert B. Toulouse
Dean of the Graduate School

**ANAEROBIC ORGANISMS IN ACUTE AND CHRONIC
PULMONARY DISEASES**

THESIS

**Presented to the Graduate Council of the
North Texas State College in Partial
Fulfillment of the Requirements**

For the Degree of

MASTER OF SCIENCE

By

George Hugh Riddel, B. S.

Denton, Texas

August, 1958

TABLE OF CONTENTS

LIST OF TABLES	Page iv
Chapter	
I. INTRODUCTION	1
Review of Literature	
The Problem	
II. MATERIALS AND LABORATORY WORK	4
Materials	
Laboratory Work	
III. EXPERIMENTAL DATA AND DISCUSSION	7
Experimental Data	
IV. SUMMARY AND CONCLUSIONS	32
Summary	
Conclusions	
BIBLIOGRAPHY	34

LIST OF TABLES

Table		Page
I.	Patients Diagnosed as Having a Pulmonary Infection and Admitted to the Hospital . . .	8
II.	Patients Admitted to the Hospital With Some Condition Other Than Pulmonary. However, at the Time of Admittance or During the Convalescent Period Contracted a Pulmonary Ailment of a Chronic Type	18
III.	Patients Seen in an Out-Patient Clinic Suffering With a Chronic Type of Pulmonary Infection	25

CHAPTER I

INTRODUCTION

Since a great deal of time is involved in isolating strict anaerobic bacterial organisms, these, with reference to their clinical importance in diseases of the respiratory tract, have been ignored generally. Most of the anaerobic organisms which have been studied clinically have been isolated from gangrenous material, abscesses, septicemias, and cases of puerperal sepsis. This study has been devoted to a determination as to whether anaerobic organisms are involved in pulmonary diseases, particularly those of the chronic type.

Review of Literature

An interest in anaerobic organisms of the upper respiratory tract began about 1927 when Branham (1) isolated seventeen strains from naso-pharyngeal washings of twenty-six persons.

Long and Muellerschoen (4) in 1933 substantiated a previous work which showed that gram-negative anaerobic bacterial organisms constitute a part of the normal flora of the naso-pharynx. However, they found that these organisms are more often characteristic of those patients who suffer more frequently from upper respiratory tract infections. They believed that under proper conditions these anaerobic organisms became opportunists and assumed a pathogenic condition.

Cohen (2) in 1933 isolated a number of anaerobic bacterial organisms from patients suffering from lung abscesses. During the same year Cohen (3) reported that 80 per cent of the gram-negative rod-shaped organisms found in lung abscesses gave a positive Shwartzman Phenomenon reaction employed for the presence of toxic factors.

The Problem

The purpose of this investigation was to determine whether anaerobic bacterial organisms could be found in chronic pulmonary diseases as well as in acute respiratory infections. The problem has consisted of, first, the collection of sputum samples from chronic pulmonary cases; second, the inoculation of these samples into both aerobic and anaerobic culture media; third, the determination of the presence or absence and number, if present, of anaerobic organisms; and finally, an evaluation of the results obtained with respect to the problem involved.

BIBLIOGRAPHY - CHAPTER I

1. Branham, S. H., "Anaerobic Microorganisms in Naso-Pharynx Washings," Journal of Infectious Diseases, XLI (1927), 203-207.
2. Cohen, J., "Anaerobic Gram-Negative Bacilli Isolated from Abscess of the Lung," Journal of Infectious Diseases, LII (1933), 185-91.
3. Cohen, J., "The Bacteriology of Abscess of the Lung and Methods for Its Study," Archives of Surgery, XXIV (1932), 171-88.
4. Long, P. H. and Muellerschoen, B., "Incidence of Anaerobic, Filter-Passing Organisms in Normal and Abnormal Respiratory Tract Conditions," Journal of Infectious Diseases, LII (1933), 121-25.

CHAPTER II

MATERIALS AND LABORATORY WORK

Materials

Materials used in pursuing this problem were cardboard sputum containers, trypsin, tryptose broth, thioglycollate broth, rabbit's blood agar plates, and a Brewer Anaerobic Jar. These were obtained from the Bacteriology Laboratory and Stock Room of Parkland Memorial Hospital, Dallas, Texas.

Laboratory Work

Sterile cardboard sputum containers used in the collection of sputum specimens were distributed to the various nurses' stations in the hospital. Upon receipt of the collected specimens in the hospital bacteriology laboratory, trypsin was added to each immediately in order to digest the protein. Elimination of such extraneous material facilitated the procurement of a more satisfactory and representative sample for the later inoculations. Each sputum specimen was inoculated into both tryptose and thioglycollate broth for the routine culture study. In addition one rabbit's blood agar plate was inoculated for the culturing of anaerobic organisms.

The materials set up for aerobic cultures were incubated at 37° C. for twenty-four hours and then examined for growth. Tentative identifications of the aerobic organisms were made

and the quantity of growth was recorded as slight, moderate, or heavy. This information was used further in a comparison of the growth here with that on the corresponding anaerobic blood agar plate. Each different type colony which was suspected of being pathogenic was picked and streaked to another blood agar plate for aerobic culture. This was done in order to obtain a pure culture for identification and antibiotic sensitivity study.

The properly inoculated anaerobic blood agar plates were placed in a Brewer Anaerobic Jar. The jar was evacuated of air by a vacuum pump and refilled with methane gas. This operation was repeated three consecutive times or until the blood plates assumed a cyanotic condition. The container of anaerobic plates was placed in an incubator at 37° C. for a minimum of seven and a maximum of ten days. Twice each day, once in the morning and once in the evening, the blood agar plates were examined through the Brewer Jar in order to see if they had retained their cyanotic condition.

At the end of the incubation period the anaerobic plates were examined and compared with the corresponding aerobic plates in order to see if anaerobic organisms were actually present. The colonies which were suspected of being anaerobic were picked and sub-cultured on each an aerobic and another anaerobic blood plate. If the organisms grew on the aerobic sub-cultured plate this eliminated any possibilities for their being strict anaerobes. However, if growth occurred

only on the anaerobic subculture this would indicate the presence of a strict anaerobic organism. To eliminate any doubt whatsoever the presumptive anaerobic organism was again subcultured to another aerobic blood agar plate. If no growth occurred this time the organism was pronounced a strict anaerobe.

During the course of this investigation, in most cases at least, if anaerobic organisms were present a very characteristic putrid odor was noted. Furthermore, most of the anaerobic organisms encountered developed a coal black colony. This facilitated markedly the task of each identification.

CHAPTER III

EXPERIMENTAL DATA AND DISCUSSION

Experimental Data

Sputum specimens were collected from 120 patients in Parkland Memorial Hospital, Dallas, Texas. These patients who were suffering from some pulmonary disease, for laboratory diagnostic convenience, were placed in three distinct groups. The first group, which consisted of fifty-two patients, were admitted to the hospital with a diagnosed pulmonary infection. In the second group there were thirty patients who were admitted to the hospital because of some condition other than pulmonary. However, either at the time of admittance or during the convalescent period these patients contracted a pulmonary ailment of a chronic type. The third group consisted of thirty-eight pulmonary cases which were seen in an out-patient clinic. Members of this group were suffering from a chronic type of pulmonary infection and had been diagnosed as having a "pulmonary disease of undetermined origin."

An observation of Table I shows that thirty-one of the fifty-two patients in Group I were diagnosed as having pneumonia. Laboratory procedures revealed that out of these thirty-one pneumonia patients the sputum of seventeen grew anaerobic bacterial organisms. Among these, there were

TABLE I

PATIENTS DIAGNOSED AS HAVING A PULMONARY INFECTION
AND ADMITTED TO THE HOSPITAL

Patient Number	Diagnosis	Aerobic Culture	Anaerobic Culture
1	Pneumonia	Moderate heavy type 4 <u>Diplococcus Pneumoniae</u> Heavy growth <u>Neisseria flava</u> Moderate growth <u>Streptococcus viridans</u>	Heavy growth anaerobic streptococcus (black colonies)
2	Pneumonia	Heavy growth <u>Streptococcus viridans</u> Few colonies <u>Neisseria catarrhalis</u>	Moderate growth anaerobic streptococcus (black colonies)
3	Pneumonia	Moderate growth <u>Streptococcus viridans</u> Few colonies <u>Diplococcus pneumoniae</u> Few colonies coagulase negative <u>Staphylococcus albus</u>	Moderate growth anaerobic streptococcus (black colonies)
4	Pneumonia	Heavy growth <u>Neisseria catarrhalis</u> Heavy growth <u>Streptococcus viridans</u>	Moderate growth anaerobic streptococcus (black colonies) Moderate growth bacteroides
5	Pneumonia	Heavy growth <u>Neisseria catarrhalis</u>	Moderate growth bacteroides
6	Pneumonia	Heavy growth <u>Neisseria catarrhalis</u> Moderate growth <u>Streptococcus viridans</u>	Few-moderate anaerobic streptococcus (black colonies)

TABLE I--Continued

Patient Number	Diagnosis	Aerobic Culture	Anaerobic Culture
7	Pneumonia	Moderate-heavy growth <u>Diplococcus pneumoniae</u> Moderate growth <u>Neisseria catarrhalis</u> Moderate growth <u>Streptococcus viridans</u>	Few-moderate anaerobic streptococcus (black colonies)
8	Pneumonia	Heavy growth <u>Streptococcus viridans</u> Few colonies <u>Neisseria catarrhalis</u>	Few-moderate anaerobic streptococcus (black colonies)
9	Pneumonia	Moderate growth <u>Neisseria catarrhalis</u> Moderate growth <u>Streptococcus viridans</u>	Few-moderate anaerobic streptococcus (gray colonies) Few <u>Bacillus ramosus</u>
10	Pneumonia	Moderate growth <u>Diplococcus pneumoniae</u> Moderate growth <u>Streptococcus viridans</u> Moderate growth <u>Neisseria catarrhalis</u>	Few anaerobic streptococcus (gray colonies)
11	Pneumonia	Heavy growth <u>Streptococcus viridans</u>	Few colonies anaerobic streptococcus (black colonies)
12	Pneumonia	Heavy growth <u>Neisseria catarrhalis</u> Moderate <u>Diplococcus pneumoniae</u> Moderate <u>Streptococcus viridans</u>	Few colonies anaerobic streptococcus (black colonies)

TABLE I--Continued

Patient Number	Diagnosis	Aerobic Culture	Anaerobic Culture
13	Pneumonia	Heavy growth <u>Neisseria flava</u> Few <u>Streptococcus viridans</u>	Few colonies anaerobic streptococcus (black colonies)
14	Pneumonia	Heavy growth <u>Streptococcus viridans</u> Few colonies <u>Neisseria catarrhalis</u>	Few colonies anaerobic streptococcus (black colonies)
15	Pneumonia	Heavy growth <u>Neisseria catarrhalis</u> Moderate growth <u>Diplococcus pneumoniae</u>	Few colonies anaerobic streptococcus (black colonies)
16	Pneumonia	Heavy growth <u>Streptococcus viridans</u> Heavy growth <u>Neisseria catarrhalis</u> Few colonies <u>Diplococcus pneumoniae</u>	Rare colony anaerobic streptococcus (black colonies)
17	Pneumonia	Heavy growth coagulase positive <u>Staphylococcus aureus</u> Moderate growth <u>Streptococcus fecalis</u> Few colonies <u>Streptococcus viridans</u>	Rare anaerobic colony. Gram-positive cocco-bacillus
18	Pneumonia	Few colonies <u>Streptococcus viridans</u>	No anaerobic organisms seen
19	Pneumonia	Heavy growth <u>Streptococcus viridans</u> Moderate growth <u>Neisseria catarrhalis</u>	No anaerobic organisms seen

TABLE I--Continued

Patient Number	Diagnosis	Aerobic Culture	Anaerobic Culture
20	Pneumonia	Moderate growth <u>Streptococcus viridans</u>	No anaerobic organism seen
21	Pneumonia	Heavy growth <u>Streptococcus viridans</u> Moderate growth <u>Neisseria catarrhalis</u>	No anaerobic organisms seen
22	Pneumonia	Moderate growth <u>Streptococcus zymogenes</u> Few colonies <u>Aerobacter aerogenes</u> Few gram-negative saprophytic rods	No anaerobic organisms seen
23	Pneumonia	Heavy growth <u>Streptococcus viridans</u> Heavy growth <u>Neisseria catarrhalis</u>	No anaerobic organisms seen
24	Pneumonia	Very heavy growth <u>Neisseria catarrhalis</u>	No anaerobic organisms seen
25	Pneumonia	Moderate growth <u>Diplococcus pneumoniae</u>	No anaerobic organisms seen
26	Pneumonia	Heavy growth <u>Streptococcus fecalis</u> Heavy growth <u>Neisseria flava</u> Moderate growth <u>Streptococcus viridans</u>	No anaerobic organisms seen

TABLE I--Continued

Patient Number	Diagnosis	Aerobic Culture	Anaerobic Culture
27	Pneumonia	Heavy growth <u>Neisseria catarrhalis</u> Few colonies <u>Streptococcus viridans</u> Rare colony beta homolytic <u>Streptococcus pyogenes</u>	No anaerobic organisms seen
28	Pneumonia	Over grown with <u>Pseudomonas aeruginosa</u>	No anaerobic organisms seen
29	Pneumonia	Heavy growth <u>Neisseria flava</u> Few colonies <u>Streptococcus viridans</u>	No anaerobic organisms seen
30	Pneumonia	Heavy growth coagulase positive <u>Staphylococcus aureus</u> Heavy growth <u>Pseudomonas aeruginosa</u>	No anaerobic organisms seen
31	Pneumonia	Heavy growth <u>Streptococcus viridans</u> Moderate growth <u>Neisseria catarrhalis</u>	No anaerobic organisms seen
32	Tuber- culosis	Heavy growth <u>Diplococcus pneumoniae</u> Moderate growth <u>Neisseria catarrhalis</u>	Few-moderate anaerobic streptococci (black colonies)
33	Tuber- culosis?	Heavy growth <u>Streptococcus viridans</u> Heavy growth <u>Neisseria catarrhalis</u>	No anaerobic organisms seen

TABLE I---Continued

Patient Number	Diagnosis	Aerobic Culture	Anaerobic Culture
34	Tuber- culosis?	Heavy growth <u>Streptococcus viridans</u> Moderate growth <u>Neisseria catarrhalis</u>	No anaerobic organism seen
35	Tuber- culosis	Heavy growth <u>Streptococcus viridans</u> Heavy growth <u>Neisseria catarrhalis</u> Few colonies <u>Aerobacter aerogenes</u>	No anaerobic organisms seen
36	Chronic Pulmonary Disease	Heavy growth coagulase positive <u>Staphylococcus aureus</u> Heavy growth <u>Pseudomonas aeruginosa</u>	Heavy growth anaerobic streptococci (gray colonies)
37	Chronic Pulmonary disease	Heavy growth <u>Streptococcus viridans</u> Moderate growth coagulase positive <u>Staphylococcus aureus</u>	Moderate growth anaerobic streptococci (black colonies)
38	Chronic Pulmonary Disease	Heavy growth <u>Streptococcus viridans</u> Moderate growth <u>Streptococcus fecalis</u> Few colonies coagulase positive <u>Staphylococcus aureus</u> Few colonies <u>Pseudomonas aeruginosa</u>	No anaerobic organisms seen

TABLE I--Continued

Patient Number	Diagnosis	Aerobic Culture	Anaerobic Culture
39	Chronic Pulmonary Disease	Moderate growth <u>Streptococcus viridans</u> Few colonies <u>Neisseria catarrhalis</u>	No anaerobic organisms seen
40	Lung Abscess	Heavy growth <u>Neisseria flava</u> Moderate growth <u>Streptococcus viridans</u> Few-moderate <u>Diplococcus pneumoniae</u>	Loaded with anaerobic streptococci (black colonies)
41	Lung Abscess	Heavy growth <u>Diplococcus pneumoniae</u> Moderate growth <u>Neisseria catarrhalis</u>	Rare colony anaerobic streptococci (black colonies)
42	Lung Abscess	Moderate growth <u>Streptococcus viridans</u>	No anaerobic colonies seen
43	Bronchiectasis	Heavy growth <u>Neisseria flava</u> Moderate growth <u>Streptococcus viridans</u> Few-moderate <u>Diplococcus pneumoniae</u>	Heavy growth anaerobic streptococci (gray colonies)
44	Bronchiectasis	Heavy growth <u>Pseudomonas aeruginosa</u> Moderate growth <u>Streptococcus viridans</u>	Heavy growth anaerobic streptococci (gray colonies)
45	Bronchiectasis	Heavy growth <u>Neisseria catarrhalis</u> Moderate growth <u>Streptococcus viridans</u>	Rare colony anaerobic streptococci (gray colonies)

TABLE I--Continued

Patient Number	Diagnosis	Aerobic Culture	Anaerobic Culture
46	Bronchitis	Heavy growth <u>Neisseria catarrhalis</u> Few colonies <u>Streptococcus viridans</u>	No anaerobic organism seen
47	Bronchitis	Heavy growth <u>Neisseria flava</u> Few colonies <u>Streptococcus viridans</u>	No anaerobic organisms seen
48	Lung Con- gestion	Heavy growth <u>Streptococcus viridans</u> Moderate <u>Neisseria catarrhalis</u>	Moderate growth anaerobic streptococci (black colonies)
49	Lung Con- gestion	Heavy growth <u>Streptococcus viridans</u> Few colonies <u>Neisseria flava</u>	No anaerobic organisms seen
50	Pharyn- gitis	Heavy growth <u>Streptococcus viridans</u> Moderate growth <u>Neisseria catarrhalis</u>	No anaerobic organisms seen
51	Asthma	Heavy growth <u>Streptococcus viridans</u> Moderate growth <u>Neisseria flava</u>	No anaerobic organisms seen
52	Non- specific cough	Heavy growth <u>Diplococcus pneumoniae</u> Few colonies <u>Neisseria flava</u>	No anaerobic organisms seen

thirteen responsible for anaerobic streptococci producing black colonies, and two anaerobic streptococci producing gray colonies. A species of bacterioides was isolated from each of two patients. Bacillus ramosus was isolated from one patient. One species of an anaerobic cocco-bacillus was isolated from another patient. Twelve of the thirty-one Group I patients were found to possess pathogenic aerobes. Among this number there were eight showing the presence of Diplococcus pneumoniae, one with a coagulase positive Staphylococcus aureus, one with a Pseudomonas aeruginosa, one with a Pseudomonas aeruginosa and a Staphylococcus aureus combination, and one with a Streptococcus pyogenes. However, eight of the twelve patients showed a combination of anaerobic bacteria along with the aerobes. Anaerobic bacteria were isolated from nine of the thirty-one Group I patients without finding any trace of pathogenic aerobes. Neither pathogenic aerobic nor anaerobic bacterial organisms were isolated from the remaining eleven of the thirty-one patients in Group I. Normal flora only was encountered.

Reference to Table I shows that there were four diagnosed cases of tuberculosis among the patients of Group I. From one of these a black colony anaerobic streptococcus was isolated, and from one other there was one pathogenic aerobe. The remainder revealed nothing other than normal flora isolates.

Still further reference to Table I reveals that there were four diagnosed cases of chronic pulmonary diseases in Group I. Laboratory diagnoses showed that two of these possessed anaerobic streptococci, one of which produced a black colony while the other produced a gray colony. Each of these cases showed the presence of pathogenic aerobes combined with anaerobes. One case possessed an aerobic pathogen while the fourth showed only normal pulmonary flora.

A final observation of Table I shows that among the patients of Group I there were three diagnosed cases of lung abscess, three of bronchiectasis, one of lung congestion, one of pharyngitis and asthma, and one of a non-specific cough. Two of the cases of lung abscess were diagnosed as having anaerobic streptococci, both of which produced black colonies. Both of these showed additional pathogenic aerobes. The third case showed only normal flora. Each one of the three cases of bronchiectasis showed the presence of anaerobic streptococci, all of which produced gray colonies. Two of these cases showed a combination of aerobic pathogens with the anaerobes. The one case of lung congestion grew a gray colony producing anaerobic streptococcus with combined normal flora.

An observation of Table II shows that the patients in Group II had been diagnosed as four hypertensive cardiovascular disease, four deferred heart failure, two congestive heart failure, three cirrhosis of the liver, two

TABLE II

PATIENTS ADMITTED TO THE HOSPITAL WITH SOME CONDITION OTHER THAN PULMONARY. HOWEVER, AT THE TIME OF ADMITTANCE OR DURING THE CONVALESCENT PERIOD CONTRACTED A PULMONARY AILMENT OF A CHRONIC TYPE

Patient Number	Diagnosis	Aerobic Culture	Anaerobic Culture
1	Hypertensive Cardiovascular Disease	Heavy growth coagulase positive <u>Staphylococcus aureus</u> Moderate growth <u>Streptococcus viridans</u> Few colonies <u>Aerobacter aerogenes</u> Few colonies <u>Monilia</u> species	No anaerobic organism seen
2	Hypertensive Cardiovascular Disease	Moderate growth <u>Pseudomonas aeruginosa</u> Few colonies coagulase negative <u>Staphylococcus albus</u>	No anaerobic organisms seen
3	Hypertensive Cardiovascular Disease	Heavy growth <u>Streptococcus viridans</u> Moderate growth <u>Neisseria catarrhalis</u>	No anaerobic organisms seen
4	Hypertensive Cardiovascular Disease	Heavy growth coagulase positive <u>Staphylococcus aureus</u>	No anaerobic organisms seen

TABLE II---Continued

Patient Number	Diagnosis	Aerobic Culture	Anaerobic Culture
5	Deferred	Heavy growth <u>Streptococcus viridans</u> Moderate growth <u>Neisseria catarrhalis</u>	Few colonies anaerobic streptococcus (gray colonies)
6	Deferred	Heavy growth <u>Streptococcus viridans</u> Few colonies <u>Neisseria catarrhalis</u>	Rare colony anaerobic streptococcus (black colonies)
7	Deferred	Heavy growth <u>Streptococcus viridans</u> Moderate growth <u>Neisseria catarrhalis</u>	No anaerobic organisms seen
8	Deferred	Heavy growth <u>Streptococcus viridans</u> Moderate growth coagulase positive <u>Staphylococcus aureus</u>	No anaerobic organisms seen
9	Congestive Heart Failure	Heavy growth <u>Neisseria catarrhalis</u> Moderate growth coagulase positive <u>Staphylococcus aureus</u>	Heavy growth bacteroides Moderate growth anaerobic streptococcus (black colonies)
10	Congestive Heart Failure	Moderate growth <u>Neisseria catarrhalis</u> Moderate growth <u>Streptococcus viridans</u>	Heavy growth anaerobic streptococcus (black colonies)

TABLE II--Continued

Patient Number	Diagnosis	Aerobic Culture	Anaerobic Culture
11	Liver Cirrhosis	Moderate growth <u>Streptococcus viridans</u> Moderate growth <u>Neisseria catarrhalis</u>	Few colonies anaerobic streptococci (black colonies)
12	Liver Cirrhosis	Heavy growth <u>Neisseria catarrhalis</u> Moderate growth <u>Streptococcus viridans</u>	No anaerobic organisms seen
13	Liver Cirrhosis	Moderate growth <u>Streptococcus viridans</u> Moderate growth <u>Neisseria catarrhalis</u>	No anaerobic organisms seen
14	Cardio-vascular Accident	Moderate growth coagulase positive <u>Staphylococcus aureus</u> Moderate growth coagulase negative <u>Staphylococcus albus</u>	No anaerobic organisms seen
15	Cardio-vascular Accident	Heavy growth <u>Pseudomonas aeruginosa</u> Moderate growth coagulase positive <u>Staphylococcus aureus</u>	No anaerobic organisms seen
16	Myocardial Infarction	Heavy growth <u>Streptococcus viridans</u> Moderate growth <u>Neisseria catarrhalis</u>	Rare-few colonies anaerobic Streptococci (black colonies)

TABLE II--Continued

Patient Number	Diagnosis	Aerobic Culture	Anaerobic Culture
17	Myocardial Infarction	Moderate growth <u>Aerobacter aerogenes</u> Moderate growth <u>Streptococcus fecalis</u>	No anaerobic organisms seen
18	Sickle Cell Anemia	Loaded with <u>Neisseria flava</u> Moderate growth <u>Streptococcus viridans</u>	Moderate growth anaerobic streptococci (black colonies)
19	Anemia	Moderate growth <u>Streptococcus fecalis</u> Few colonies <u>Streptococcus viridans</u> Few colonies <u>Neisseria catarrhalis</u>	No anaerobic organisms seen
20	Infectious Hepatitis	Heavy growth <u>Streptococcus viridans</u> Few colonies <u>Neisseria flava</u>	Few colonies anaerobic streptococci (black colonies)
21	Infectious Hepatitis	Heavy growth <u>Streptococcus viridans</u> Few colonies <u>Neisseria flava</u>	No anaerobic organisms seen
22	Diabetes	Heavy growth <u>Neisseria catarrhalis</u> Heavy growth <u>Streptococcus viridans</u>	Few colonies anaerobic streptococci (black colonies)
23	Diabetes	Heavy growth coagulase positive <u>Staphylococcus aureus</u>	No anaerobic organisms seen

TABLE II--Continued

Patient Number	Diagnosis	Aerobic Culture	Anaerobic Culture
24	Rheumatic Fever	Heavy growth <u>Neisseria catarrhalis</u> Heavy growth <u>Streptococcus viridans</u> Few colonies <u>Neisseria flava</u>	No anaerobic organisms seen
25	Mumps	Heavy growth <u>Streptococcus viridans</u> Moderate growth <u>Neisseria flava</u>	Rare growth anaerobic streptococci (black colonies)
26	Heart Failure	Heavy growth <u>Streptococcus viridans</u> Moderate growth <u>Neisseria flava</u>	Loaded with anaerobic streptococci (black colonies)
27	Upper Gastro-intestinal Bleeding	Moderate growth <u>Diplococcus pneumoniae</u> Moderate growth <u>Streptococcus viridans</u> Few colonies <u>Neisseria catarrhalis</u>	Heavy growth anaerobic streptococci (black colonies)
28	Ovarian Tumor	Heavy growth <u>Streptococcus viridans</u> Moderate growth <u>Neisseria catarrhalis</u>	No anaerobic organisms seen
29	Glomerulonephritis	Heavy growth <u>Streptococcus viridans</u> Moderate growth <u>Neisseria flava</u>	Moderate growth anaerobic streptococci (black colonies)

TABLE II--Continued

Patient Number	Diagnosis	Aerobic Culture	Anaerobic Culture
30	Peptic Ulcer	Moderate growth coagulase positive <u>Staphylococcus aureus</u> Moderate growth <u>Pseudomonas aeruginosa</u> Moderate growth <u>Streptococcus viridans</u>	No anaerobic organisms seen

cardiovascular accidents, two myocardial infarctions, two anemias, two infectious hepatitis, two diabetes, one rheumatic fever, one mumps, one heart failure, one upper gastrointestinal bleeding, one ovarian tumor, one glomerulonephritis, and one peptic ulcer. From the sputum specimens of the thirty Group II patients anaerobic streptococci were isolated from thirteen. In this number there were twelve of the black and one of the gray colony type. From one patient an anaerobic bacterioides was found in combination with an anaerobic streptococcus. Aerobic pathogenic organisms were isolated from ten of the thirty Group II patients. Of this number five showed Staphylococcus aureus, two Pseudomonas aeruginosa and Staphylococcus aureus in combination, one Pseudomonas aeruginosa, and one Diplococcus pneumoniae. Among this series of patients there were only two from

which a combination of anaerobic and aerobic organisms were isolated.

An inspection of Table III reveals that the thirty-eight patients in Group III had been given a diagnosis of undetermined origin. However, all appeared to have some respiratory infection at the time of the visit to the outpatient clinic. Laboratory diagnoses of the sputum of twenty-one of the Group III patients showed the presence of anaerobic streptococci, nineteen of the black and two of the gray colony type. Further studies showed that sputum from seven of the group cultured aerobic pathogenic organisms. Among this number were four with Diplococcus pneumoniae, one with Streptococcus pyogenes, one with a coagulase positive Staphylococcus aureus, and one with a Pseudomonas aeruginosa. Two of the aerobic pathogenic organisms were isolated in combination with anaerobic streptococci. Sputum of the remaining twelve cases in this group showed nothing but normal flora.

TABLE III

PATIENTS SEEN IN AN OUT-PATIENT CLINIC SUFFERING WITH A CHRONIC
TYPE OF PULMONARY INFECTION

Patient Number	Diagnosis	Aerobic Culture	Anaerobic Culture
1	Undetermined	Heavy growth <u>Streptococcus viridans</u> Heavy growth <u>Neisseria catarrhalis</u>	Heavy growth anaerobic streptococci (gray colonies) Few colonies anaerobic streptococci (black colonies)
2	Undetermined	Heavy growth <u>Streptococcus viridans</u> Few colonies <u>Neisseria catarrhalis</u>	Heavy growth anaerobic streptococci (black colonies)
3	Undetermined	Moderate growth <u>Diplococcus pneumoniae</u> Moderate growth <u>Streptococcus viridans</u> Few colonies <u>Neisseria catarrhalis</u>	Heavy growth anaerobic streptococci (black colonies)
4	Undetermined	Loaded with <u>Streptococcus viridans</u> Heavy growth <u>Neisseria catarrhalis</u>	Heavy growth anaerobic streptococci (black colonies)
5	Undetermined	Heavy growth <u>Neisseria catarrhalis</u> Heavy growth <u>Streptococcus viridans</u>	Moderate growth anaerobic streptococci (gray colonies)

TABLE III--Continued

Patient Number	Diagnosis	Aerobic Culture	Anaerobic Culture
6	Undetermined	Heavy growth <u>Neisseria flava</u> Moderate growth <u>Streptococcus viridans</u>	Moderate growth anaerobic streptococci (black colonies)
7	Undetermined	Heavy growth <u>Streptococcus viridans</u> Few-moderate growth <u>Neisseria catarrhalis</u>	Moderate-heavy growth anaerobic streptococci (black colonies)
8	Undetermined	Few colonies <u>Streptococcus viridans</u> Few colonies <u>Neisseria catarrhalis</u>	Moderate growth anaerobic streptococci (black colonies)
9	Undetermined	Heavy growth <u>Streptococcus viridans</u> Moderate growth <u>Neisseria catarrhalis</u> Few colonies <u>Diplococcus pneumoniae</u>	Moderate growth anaerobic streptococci (black colonies)
10	Undetermined	Moderate growth <u>Streptococcus pyogenes</u> Moderate growth <u>Streptococcus viridans</u> Moderate growth <u>Neisseria catarrhalis</u>	Moderate growth anaerobic streptococci (black colonies)
11	Undetermined	Heavy growth <u>Streptococcus viridans</u> Moderate growth <u>Neisseria catarrhalis</u>	Few-moderate growth anaerobic streptococcus (black colonies)

TABLE III--Continued

Patient Number	Diagnosis	Aerobic Culture	Anaerobic Culture
12	Undeter-mined	Loaded with <u>Streptococcus viridans</u>	Few-moderate growth anaerobic streptococcus (black colonies)
13	Undeter-mined	Moderate growth <u>Escherichia coli</u> Moderate growth <u>Neisseria catarrhalis</u> Moderate growth <u>Streptococcus viridans</u> Moderate growth <u>Streptococcus fecalis</u>	Few-moderate growth anaerobic streptococci (black colonies)
14	Undeter-mined	Heavy growth <u>Streptococcus viridans</u> Heavy growth <u>Neisseria flava</u>	Few-moderate growth anaerobic streptococci (black colonies)
15	Undeter-mined	Heavy growth <u>Streptococcus viridans</u> Moderate growth <u>Neisseria catarrhalis</u>	Few-moderate growth anaerobic streptococci (black colonies)
16	Undeter-mined	Heavy growth <u>Neisseria flava</u> Moderate growth <u>Streptococcus viridans</u>	Few colonies anaerobic streptococci (black colonies)
17	Undeter-mined	Heavy growth <u>Streptococcus viridans</u> Moderate growth <u>Neisseria catarrhalis</u>	Few colonies anaerobic streptococci (black colonies)

TABLE III--Continued

Patient Number	Diagnosis	Aerobic Culture	Anaerobic Culture
18	Undetermined	Moderate growth <u>Streptococcus fecalis</u> Moderate growth <u>Streptococcus viridans</u>	Rare growth anaerobic streptococci (black colonies)
19	Undetermined	Heavy growth <u>Neisseria flava</u> Moderate growth <u>Streptococcus viridans</u> Few colonies <u>Streptococcus zymogenes</u>	Rare colonies anaerobic streptococci (black colonies)
20	Undetermined	Heavy growth <u>Neisseria flava</u> Moderate growth <u>Aerobacter aerogenes</u> Few colonies <u>Streptococcus viridans</u>	Rare colonies anaerobic streptococci (black colonies)
21	Undetermined	Heavy growth <u>Streptococcus viridans</u> Moderate growth <u>Neisseria catarrhalis</u>	Rare growth anaerobic streptococci (black colonies)
22	Undetermined	Heavy growth <u>Neisseria catarrhalis</u> Moderate growth <u>Streptococcus viridans</u>	No anaerobic organisms seen
23	Undetermined	Moderate growth <u>Neisseria catarrhalis</u>	No anaerobic organisms seen

TABLE III--Continued

Patient Number	Diagnosis	Aerobic Culture	Anaerobic Culture
24	Undetermined	Moderate growth <u>Neisseria catarrhalis</u> Few colonies coagulase negative <u>Staphylococcus albus</u>	No anaerobic organisms seen
25	Undetermined	Few moderate <u>Diplococcus pneumoniae</u> Moderate growth <u>Streptococcus viridans</u>	No anaerobic organisms seen
26	Undetermined	Heavy growth <u>Streptococcus viridans</u> Few colonies <u>Neisseria catarrhalis</u>	No anaerobic organisms seen
27	Undetermined	Heavy growth <u>Diplococcus pneumoniae</u>	No anaerobic organisms seen
28	Undetermined	Few colonies coagulase negative <u>Staphylococcus albus</u>	No anaerobic organisms seen
29	Undetermined	Moderate growth <u>Streptococcus viridans</u> Few colonies coagulase negative <u>Staphylococcus albus</u>	No anaerobic organisms seen

TABLE III--Continued

Patient Number	Diagnosis	Aerobic Culture	Anaerobic Culture
30	Undetermined	Heavy growth <u>Neisseria catarrhalis</u> Heavy growth <u>Streptococcus viridans</u> Rare colonies coagulase positive <u>Staphylococcus aureus</u>	No anaerobic organisms seen
31	Undetermined	Heavy growth <u>Streptococcus viridans</u> Moderate growth <u>Neisseria catarrhalis</u>	No anaerobic organisms seen
32	Undetermined	Moderate growth <u>Streptococcus viridans</u> Moderate growth <u>Neisseria flavescens</u> Few colonies <u>Pseudomonas aeruginosa</u>	No anaerobic organisms seen
33	Undetermined	Heavy growth <u>Streptococcus viridans</u> Moderate growth <u>Neisseria catarrhalis</u>	No anaerobic organisms seen
34	Undetermined	Heavy growth <u>Streptococcus viridans</u> Moderate growth <u>Neisseria catarrhalis</u>	No anaerobic organisms seen
35	Undetermined	Heavy growth <u>Streptococcus viridans</u> Heavy growth <u>Neisseria catarrhalis</u>	No anaerobic organisms seen

TABLE III--Continued

Patient Number	Diagnosis	Aerobic Culture	Anaerobic Culture
36	Undeter- mined	Heavy growth <u>Streptococcus</u> <u>viridans</u> Moderate growth <u>Neisseria</u> <u>catarrhalis</u>	No anaerobic organisms seen
37	Undeter- mined	Heavy growth <u>Streptococcus</u> <u>viridans</u>	No anaerobic organisms seen
38	Undeter- mined	Moderate growth <u>Neisseria</u> <u>catarrhalis</u> Rare colonies <u>Streptococcus</u> <u>viridans</u>	No anaerobic organisms seen

CHAPTER IV

SUMMARY AND CONCLUSIONS

Summary

1. Sputum specimens were collected from 120 patients in Parkland Memorial Hospital, Dallas, Texas. Each of these patients had been diagnosed as having some type of pulmonary infection. Laboratory diagnostic tests were made on each sputum specimen in order to determine whether anaerobic bacterial organisms were present.

2. For convenience in making this study the patients were listed in three groups. The grouping was determined according to the diagnoses upon admittance to the hospital or out-patient clinic.

3. Studies of Group I, which consisted of fifty-two patients, revealed the presence of twenty-six individuals who possessed anaerobic bacteria. In addition twenty-one of the group possessed pathogenic aerobes. Fifteen of the twenty-one patients showed a combination of aerobic and anaerobic bacteria.

4. Studies of Group II, which consisted of thirty patients, showed that the sputum of thirteen of these grew anaerobic streptococci and that ten of these grew aerobic pathogenic organisms. Among the latter group there were two

patients who possessed a combination of aerobic and anaerobic pathogens.

5. An analysis of sputum specimens from Group III, which consisted of thirty-eight patients, showed that twenty-one of these grew anaerobic and seven grew aerobic pathogenic organisms. Both aerobic and anaerobic pathogens were isolated in combination from two of these patients.

Conclusions

From the tabulated results of bacteriological diagnoses of sputum specimens from 120 patients in Parkland Memorial Hospital, Dallas, Texas, it can be concluded that anaerobic bacterial organisms are related to and are possibly responsible for certain chronic types of pulmonary disease. Probably these are associated with the fulminating type of respiratory infection as secondary invaders.

BIBLIOGRAPHY

- Branham, S. H., "Anaerobic Microorganisms in Naso-Pharynx Washings," Journal of Infectious Diseases, XLI (1927), 203-207.
- Cohen, J., "Anaerobic Gram-Negative Bacilli Isolated from Abscess of the Lung," Journal of Infectious Diseases, LII (1933), 185-91.
- Cohen, J., "The Bacteriology of Abscess of the Lung and Methods for Its Study," Archives of Surgery, XXIV (1932), 171-88.
- Long, P. H., and Muellerschoen, B., "Incidence of Anaerobic, Filter-Passing Organisms in Normal and Abnormal Respiratory Tract Conditions," Journal of Infectious Diseases, LII (1933), 121-25.