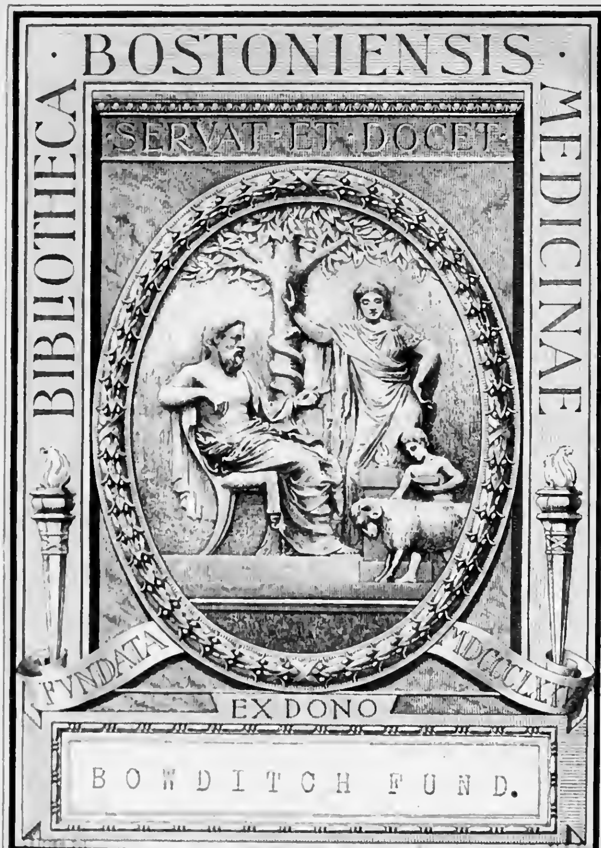


THE DIAGNOSIS AND TREATMENT OF PULMONARY TUBERCULOSIS

BY

FRANCIS M. POTTENGER, A.M., M.D.

Monrovia, California

Medical Director of the Pottenger Sanatorium for Diseases of the Lungs and Throat, Monrovia, Cal.; Professor of Clinical Medicine, Medical Department, University of Southern California; Chief of Medical Staff of the Helping Station of the Southern California Anti-Tuberculosis League, Los Angeles, Cal.; Fellow of the American Academy of Medicine; Member of the American Climatological Association; Member of the American Therapeutic Society; Corresponding Member of the International Anti-Tuberculosis Association, etc.

NEW YORK

WILLIAM WOOD AND COMPANY

MDCCCCVIII

7011

*Printed by
The Maple Press Co.,
York, Pa.*

TO

MY PARENTS

WHOSE INFLUENCE AND WISE COUNSEL EVER HAVE

BEEN AN INSPIRATION TO HIGHER

IDEALS AND MORE FAITHFUL WORK

CONTENTS.

CHAPTER I.

THE PROBABLE TIME OF INFECTION IN TUBERCULOSIS 1–5

Symptoms of tuberculosis develop long after infection; Tendency to spread; Tuberculosis often unrecognized; Childhood a probable time when infection commonly occurs; Proof of latency; Latency an important feature of tuberculosis; Picture of the development of tuberculosis in the body.

CHAPTER II.

THE SYMPTOMS AND SIGNS OF EARLY PULMONARY TUBERCULOSIS . . 6–12

Progress in diagnosis; Meaning of early diagnosis; Heredity; Opportunity of infection; Later children more susceptible; Clinical history: Cause of symptoms; Malaise; Nervous symptoms; Respiration; Cough; Sputum; Hoarseness; "Colds" and bronchial catarrhs; Circulatory system; Gastro-intestinal system; Anemia; Pain; Night or sleep sweats; Spitting of blood; Pleurisy.

CHAPTER III.

EXAMINATION OF THE PATIENT FOR EARLY TUBERCULOSIS . . . 13–24

General rules for examination; Ear or stethoscope; Percussion instruments; Light or heavy percussion; Differences in the apices; Inspection: Inspection of the patient; Lagging; Pupils; Red line on gums; Larynx; Differences in elevation of acromial ends of clavicle; Retractions and depressions. Palpation: Enlarged glands; Increased fremitus; Lagging; Palpatory percussion; Quality of percussion note; Pitch; Apical outline. Auscultation: Difficulties and errors in auscultation; Cause of vesicular murmur; Rough breathing; Weak breathing; Prolonged expiration; Harsh vesicular or peurile; Cogwheel breathing; Rales; Pleural sounds; Subclavian murmur.

CHAPTER IV.

DIAGNOSIS OF EARLY PULMONARY TUBERCULOSIS 25–46

Bacilli not to be relied on for early tuberculosis; Importance of diagnosis; Candor with patient; Hemoptysis; General picture of early tuberculosis; Neurasthenic type; Sudden onset; Repeated "colds;" Temperature; Physical examination; Examination of sputum; Homogeneous smear; Staining for bacilli, "splitter," spores or sporoids; Differential diagnosis of tuberculosis caused by bacilli of the human and bovine types; Differential stain for human and bovine bacilli; Picric acid stain for tubercle bacilli; Particles of mucus taken from larynx for examination; Spengler's digestion method; Ilkewitsch's method of centrifugation; Röntgen rays; Tuberculin test; Fears of tuberculin; Virchow's opinion; Can tuberculin set up activity in latent foci? Can tuberculin cause acute miliary tuberculosis? Reaction; Local reaction; General reaction; When should test dose be given? Dosage for tuberculin test; Is the test reliable? How give tuberculin test; Site of injection; Contra-indications; What preparation should be used? Who shall administer the tuberculin test? Tuberculin test as proof of cure; Tuberculin diagnosis in infancy and childhood (Pirquet). Opthalmo-Tuberculin Test.

CHAPTER V.

SYMPTOMS AND SIGNS OF ADVANCED PULMONARY TUBERCULOSIS AND ITS COMPLICATIONS 47-59

Clinical history in advanced pulmonary tuberculosis: Cough; Sputum; Digestive disturbances; Circulatory system; Nervous system; Colds and bronchial catarrhs; Hoarseness; Pain; Night sweats; Temperature; Cessation of menstrual flow.

CHAPTER VI.

PHYSICAL EXAMINATION OF THE PATIENT IN ADVANCED PULMONARY TUBERCULOSIS 60-78

Inspection: Inspection of patient; Condition of integument over chest; Shape of the chest; Phthisical chest; Ankylosis of the union of first rib with sternum; Movements of the chest; Cardiac impulse; Diaphragm phenomenon. Palpation: Vocal fremitus; Friction fremitus; Detection of changes in lung by palpation; Lagging; Palpatory percussion. Percussion: What can be elicited by percussion? Auenbrugger's method; Ebstein's touch percussion; Auscultatory percussion and auscultatory stroking; Elastic tube percussion; The ordinary method of percussion; Outline lung boundary; Mobility of lower lung boundaries; Differentiation of intercostal neuralgia and pleural pains; Heart outline; Various percussion notes; Percussion note in acute miliary tuberculosis; Acute pneumonic phthisis; Chronic tuberculosis; Percussion over cavities. Auscultation: Weakened respiratory murmur; Increased respiratory murmur; Prolonged expiration; Normal bronchial breathing; Pathological bronchial breathing; Amphoric breathing; Mixed breathing; Rough breathing; Adventitious sounds; Rales; Effect of cough on rales; Size of rales; Constancy of rales; Metallic rales; Dry rales; Rales and sounds of pleural origin; Voice transmission.

CHAPTER VII.

DISPLACEMENT OF THE THORACIC VISCERA IN ADVANCED PULMONARY TUBERCULOSIS 79-91

Normal changes in position of organs of respiration; Inspiratory thorax; Expiratory thorax; Normal changes in position of heart; Position of heart depends on pericardium; Size of pericardium affects the position of the heart; Movability of heart depends also upon condition of aorta; Normal outline of the lungs; Normal outline of the heart; Importance of recognizing change in outline; Cause of displacement; Displacement of the lung; Effect of displacement of the lungs; Displacement of the heart; Detection of apex beat difficult; Effect of changed position upon the heart and lungs; Management of patients who have displacement; Aids in detecting displacement.

CHAPTER VIII.

Prognosis in Tuberculosis 92–100

Nature of the infection; Extent of the disease important; Why incipient tuberculosis is most curable; Responsibility of cure in tuberculosis upon family physician; Patient's responsibility in diagnosis; Patient's responsibility in cure; Prognosis in advanced cases; Heart in prognosis; Digestive system; Loss of weight; Temperature; Individual resistance; Former environment; Financial condition; Temperament; Age; Complications; Hemoptysis; Pregnancy; Number of bacilli and prognosis; How long treatment necessary.

CHAPTER IX.

Prophylaxis 101–113

Dust infection; Droplet infection; Infection through ingestion; Bacilli do not multiply outside the body; Personal prophylaxis; Effect of sunlight upon bacilli; Tuberculosis a house disease; Lighting and ventilation of homes and the tubercle bacillus; Danger in ordinary method of sweeping and dusting houses; Burden of prophylaxis not entirely upon the afflicted; Prophylaxis in childhood; Prophylaxis for those predisposed to tuberculosis; Modern methods of prophylaxis and cure; Education; Health board control; Dispensaries; Classes in tuberculosis; Sanatoria; Hospitals; Sanatoria and hospitals not dangerous to their surroundings; A lesson from Davos.

CHAPTER X.

The Principles Underlying the Treatment of Tuberculosis . . 114–121

Curability of Tuberculosis; Nature of cure in tuberculosis; How immunity is produced; Antibodies specific; Normal health offers resistance to disease; Immunity the ultimate aim of treatment in tuberculosis; Classification of remedial measures; Hygienic treatment not all; Tubercle vaccines specific; Rational treatment; Method of treatment very important.

CHAPTER XI.

The Open-air Treatment of Tuberculosis 122–128

Fresh air first recommended by Bodington, 1840; Fresh air not specific; What is the effect of open air? How outside and inside air differ; Open air hardens patient; Effect on nervous system; Open air improves digestion and assimilation; Lessens danger of new and secondary infection; Open air lessens temperature; Is there danger at beginning of treatment? Clothing for the tuberculous; Wet weather no contraindication; How derive most benefit from open air; Wrong and insufficient instruction cause many deaths; Open-air treatment at home.

CHAPTER XII.

Diet in Tuberculosis with Hints for the Management of the More Common Gastro-intestinal Complications. 129–141

Present system of diet unsatisfactory; Overfeeding; Evil effects of overfeeding; Rational diet; Importance of milk in the dietary; Modification of milk; How administer milk so the patient does not fear it; Can milk and fruit be eaten together? Milk should be chewed; How much milk should be taken? Kumyss; What are best foods for the tuberculous; Proteids; Fats; Carbohydrates; Minute details as to diet necessary; Appetite not safe guide; Gastric neuroses of toxic origin; Organic diseases of the gastro-intestinal tract; Hyperchlorhydria; Hypochlorhydria; Dilatation of the stomach; Constipation; Non-tuberculous diarrhea; Tuberculous diarrhea.

CHAPTER XIII.

Rest and Exercise in the Treatment of Tuberculosis 142–152

Value of rest; Value of exercise; Rest in fever; Rest in non-febrile cases; Effect of rest upon cough; Rest in hemoptysis; The heart and rest; The heart and exercise; Rest and dyspnea; Rest when weight is much reduced; When shall a patient exercise? What form of exercise is most suitable? Overexertion; Rest and exercise for the lung; Motion of lung not only unnecessary but harmful; Deep-breathing favors aspiration of mucus into new parts; Have breathing exercises any part in the treatment?

CHAPTER XIV.

Hydrotherapy in Tuberculosis 153–164

Value of hydrotherapy in tuberculosis; Relief of temperature least important function of hydrotherapy; Reaction; Effect upon the skin; Effect upon other organs; Conditions governing bath; Alcohol baths; Cold sponge; Tepid sponge; The dripping sheet; The wet jacket; Throat compress; Cleansing bath.

CHAPTER XV.

The Specific Treatment of Tuberculosis 165–208

Nature of cure in tuberculosis; Discovery of tuberculin; What is tuberculin? Dosage of Koch's tuberculin; Convenient method of making dilutions; Hope aroused by Koch's discovery; Koch's rules for treatment; Koch's rules disregarded; Reaction against tuberculin; Some good results; Tuberculin revived; Other preparations of tuberculin and allied products; Tuberculin, Denys'; Perlsucht Tuberculin (Spengler); Tuberculin (Beraneck); Koch's new tuberculin, T. R.; Bacillus emulsion (T. E., Koch); Watery extract of tubercle bacilli (von Ruck); Perlsucht emulsion (P. E. Spengler); T. B. Vaccine and P. B. Vaccine (Spengler); Tulase; How do tuberculin and allied products act? Koch's original view of the manner in which tuberculin acts; Biedert's view; Trudeau's view; Wright's view; Evidence of immunizing power, animal experimentation; Agglutinating power of blood increased; Blood alkalinity; Increase in opsonic power of blood serum; Effect of tuberculin upon cells and leucocytes; Effect of tuberculin and allied products upon infected areas; Increase of fibroid tissue; Tuberculin reaction; Secondary reaction; Should tuberculin be used on a patient with fever? Hypersensibility; Change of toxins in treatment; Site of injection; Wright's method of employing tuberculin; Negative phase; Clinical results; Disease shows less tendency to spread; Disease heals more surely and more quickly; Tuberculin relatively of more value in the treatment of advanced cases; Bacilli disappear from sputum; Tuberculous complications disappear; Permanency of results; Limitations; Who shall employ specific remedies? If so valuable, why not recognized? Antitubercle serum.

CHAPTER XVI.

HYPEREMIA 209–215

Active versus passive hyperemia; Theories of disease; Role of the blood in infection and immunity; Blood prevented from entering infected areas; Effect of hyperemia; Chronic heart disease and tuberculosis; Preciseness in method necessary; Hyperemia in joint tuberculosis; Hyperemia in pulmonary tuberculosis; Hyperemia caused by reflected sunlight; Hyperemia caused by the use of tuberculin; Hyperemia from position.

CHAPTER XVII.

THE SANATORIUM TREATMENT OF TUBERCULOSIS 216–228

Sanatorium depends on its head; Buildings; Pavilion and cottage systems; An improved bungalow; Choice of patients for a sanatorium; Difficulty of treating advanced cases; What complications are a barrier to treatment? Length of treatment; Why a sanatorium is superior to the home or an open resort; Air of hopefulness pervades sanatoria.

CHAPTER XVIII.

CLIMATE AS A FACTOR IN THE TREATMENT OF TUBERCULOSIS . . . 229–241

Climate always important; Climate more important to the sick than to the well; No specific climate for tuberculosis; Good use of bad climate better than bad use of good climate; Important considerations in choice of climates; Primary effect of climatic treatment; Climate must be suited to the reactive powers of the patient; Climatic conditions of nearby places differ; High altitude thought to confer immunity; Immunity not peculiar to altitude; Not high altitude but certain conditions accompanying it causes this apparent immunity; Sunlight important in the treatment of tuberculosis; Relative merits of high and low altitudes in tuberculosis; High altitude treatment contrary to the principle of rest in inflammations; Parts adjacent to heart heal slowly; Tuberculosis common in athletes; High altitude calls for strong reactive powers; Wherein lies the value of climatic treatment?

CHAPTER XIX.

THE COMPLICATIONS OF PULMONARY TUBERCULOSIS AND THEIR TREATMENT 242–270

Tuberculous laryngitis: Frequency; Diagnosis; Prognosis; Treatment. Tuberculosis of the intestines: Frequency; Site of ulceration; Symptoms; Diagnosis; Treatment. Fistula in ano. Tuberculosis of the lymphatic glands: Frequency of glandular involvement; Treatment of tuberculous glands in children; Glands the seat of softening; Treatment of suppurating glands. Pleurisy: Frequency; Varieties; Symptoms; Physical signs remaining after pleurisy; Treatment of pleurisies. Pneumothorax: Seriousness of pneumothorax; Symptoms; Treatment. Mixed infection: Chills; Fever; Diet; Serum treatment of mixed infection; Convalescence from mixed infection. Hemoptysis: Frequency; Cause of hemoptysis; Hemoptysis epidemic; Treatment of hemoptysis. Tuberculosis of the genito-urinary tract. Syphilis. Pregnancy.

CHAPTER XX.

Treatment of Symptoms 271–279

Cough: Effect of cough; Cause of cough; Key to treatment. Night or sleep sweats: Cause of night or sleep sweats; Treatment. Fever. Pain. Insomnia. Dyspnea.

CHAPTER XXI.

The Relationship Between the Physician and the Patient . . 280–285

Candor between physician and patient necessary; Great responsibility on physicians; The patient must know that he has tuberculosis; Deceptive terms not permissible; The patient should be told in a humane manner; Co-operation of patient and physician necessary; Intelligent patients, best patients; Mutual interest of physician and patient; Tuberculous patients need physician's guidance; Patients need mental support of their physician.

CHAPTER XXII.

Results and Permanency of Results in Pulmonary Tuberculosis. 286–300

The beginning of systematic treatment of tuberculosis; Effect of Koch's discovery; Idea of treatment grows slowly; American pioneers in phthisio-therapy; Tuberculosis yields readily to treatment; Cure depends upon earliness of diagnosis; Never a time too early to begin treatment; Cure of tuberculosis an investment; Treatment greatly prolongs life; Results of treatment compared with results in other diseases; Sanatorium and hospital results compared; Permanency of results; Premature interruption of treatment prevents favorable results; What is a cure? Rales and permanency of results.

APPENDIX.

CHAPTER I.

The Duty of the State in the Prevention of the Spread of Tuberculosis and its Especial Duty in Establishing State Sanatoria 301–306

CHAPTER II.

A Study of Tuberculous Infection 307–318

CHAPTER III.

Culture Products in the Treatment of Tuberculosis . . . 319–337

CHAPTER IV.

A Critical Study of Tuberculin and Allied Products Based upon a Collective Investigation. 338–351

ILLUSTRATIONS.

PLATE PAGE

1. Splitter (spores and sporoids) from sputum. 31

FIG.

1. Chart illustrating tuberculin test. 10
2. Stethoscope, percussion hammer and pleximeter. 14
3. (a) and (b). Changes in apical outline 20
4. Artificial mixture of pure cultures of human and bovine bacilli stained by Spengler's "Hüllenmethode." 36
5. Natural mixture of bacilli of bovine and human type in sputum stained by Spengler's "Hüllenmethode" after being first stained by acid fuchsin (2 per cent). 36
6. Temperature curve of inactive chronic pulmonary tuberculosis. . 53
7. Temperature curve showing activity in chronic pulmonary tuberculosis. 53
8. Temperature curve showing hectic type. 54
9. Temperature curve of a complicating tuberculous pneumonia. . 54
10. Temperature curve of acute miliary tuberculosis superimposed upon a chronic pulmonary tuberculosis. 55
11. Curve showing temperature persistently below normal. . . . 55
12. Curve showing temperature persistently above normal, probably caused by a closed focus. 56
13. Temperature curve showing pre-menstrual rise in patient with early tuberculosis. 57
14. Temperature curve showing menstrual rise in patient with advanced tuberculosis. 58
15. Illustrating the method of delivering the stroke in the author's elastic tube percussion. 68 68
16. Showing size of soft elastic tube used by the author in elastic tube percussion. 69
17. (a) and (b). Schematic representation of chest of child and adult showing descent of anterior wall of thorax and intra-thoracic viscera as adult life approaches. 80
18. Thorax representing the outlines of the intra-thoracic organs as usually found in a healthy adult. 82
19. Showing displacement of thoracic viscera resulting from contraction of left lung and compensatory emphysema of the right. . 85

Fig.		Page
20.	Displacement of thoracic viscera, same cause as in Fig. 19.	86
21.	Displacement of thoracic viscera, same cause as in Figs. 19 and 20.	87
22.	Drip sheet, first position (Baruch).	159
23.	Drip sheet, second position (Baruch).	160
24.	Drip sheet, turning (Baruch).	161
25.	Drip sheet, friction (Baruch).	162
26.	Wet jacket.	163
27.	Throat compress—properly applied.	163
28.	A and B. Chart illustrating the antagonistic action of vaccines made from bacilli of the human and bovine types.	179
29.	Chart of patient running fever for prolonged time. Reduced after a few doses of the proper vaccine.	180
30.	Chart illustrating same as Fig. 29.	180
31.	Chart illustrating same as Fig. 29.	181
32.	Chart illustrating the increase in the opsonic index after injection of tubercle bacillus vaccine (Wright).	185
33.	Chart showing the tuberculin reaction as affecting the pulse rather than the temperature.	188
34.	A, B, C and D show the improvement in lung condition made from March 18 to July 3, by a patient who was treated by injections of tuberculin during the course of a chronic prolonged fever as shown in Fig. 35.	190–191
35.	A, B, C and D. Temperature curve of patient whose findings on auscultation are shown in Fig. 34.	192–193
36.	Floor plan of portion of Pottenger Sanatorium.	218
37.	Pottenger Sanatorium Bungalow.	219
38.	Floor plan of Pottenger Sanatorium Bungalow.	220
39.	Paravertebral triangle of dullness (Grocco's sign) (Thayer and Fabyan).	252
40.	Transverse section of chest in an artificially produced right pleural effusion showing displacement of mediastinum (Baduel and Siciliano).	253
41.	Chart showing favorable action of streptolytic serum.	260
42.	Chart showing favorable actionof nitroglycerine and veratrum viride in lowering blood pressure.	264

INTRODUCTORY.

A number of books have appeared recently treating of the subject of Tuberculosis. These have been written from different standpoints, as is natural in dealing with a disease which has so many phases. As yet, however, no book has appeared which endeavors to give a full discussion of the diagnosis, both early and late, of tuberculosis, nor has any of them considered the treatment of tuberculosis in the light of modern studies in immunity.

In treating the subject of diagnosis, the author has attempted, wherever possible, to explain the cause of symptoms and the rationale of the physical signs. In many instances he is not in accord with the usual explanations and has suggested modifications.

He has described his new method of elastic tube percussion and endeavored to point out its advantages and limitations.

He has also described more fully than can be usually found in works of this character the effect of advanced tuberculosis on the heart, also the contractions and compensatory emphysemas which occur on the part of the lung, in order to carry on the functions of respiration where one or both of these organs are seriously damaged.

Tuberculosis is a disease caused by a specific micro-organism and like all such diseases it is cured by the establishment of immunity. This fact has been kept uppermost in mind in discussing the treatment of the disease. The author has endeavored to discuss clearly and impartially those measures which are of greatest value in bringing about improvement or cure. He has endeavored to define the possibilities of each measure and to show its limitations.

Remedial measures may be divided into six classes:

First.—Those which aid in bringing about immunity by endeavoring to restore the natural resisting power of the patient to a point as nearly normal as is consistent with the condition present. Among such measures we must class fresh air, hygienic measures, proper diet, hydrotherapy and suitable tonics.

Second.—Those which aid in bringing about immunity by artificially stimulating the body cells to the production of more specific protective substances. In this class belongs vaccination or treatment by injection of the specific products of the bacillus, such as tuberculin, extracts of tubercle bacilli and bacillus emulsion.

Third.—Those which aid in establishing immunity by supplying to the organism specific protective substances which have been produced by vaccinating some animal such as the horse or cow. Under this head come the various antitoxic sera.

Fourth.—Those measures which cause an increased flow of blood or lymph to the seat of infection, bringing a greater amount of specific antibodies in contact with the bacilli thus causing their destruction. Bier's hyperemia, Finsen light, and poulticing are measures whose action are explained in this manner.

Fifth.—Remedies and measures which relieve symptoms.

Sixth.—Those which are directed toward the cure of accompanying mixed infection.

It is the author's desire in the preparation of this book to stimulate his readers to take a broader view of tuberculosis than that usually taken. He has endeavored to show that the diagnosis of tuberculosis consists in more than finding bacilli in the sputum, and that its cure consists in more than the adoption of fresh air.

If he shall have contributed only a little to the early diagnosis of tuberculosis, and shall have placed the various therapeutic measures in a light whereby they may be shorn of their mystery and applied more intelligently in the treatment of this disease, his purpose shall have been accomplished.

In order to make the discussion more complete the author has digressed, at times, to consider other subjects in relation to the main theme; and while this has caused some repetition, it has seemed necessary in order to present the subject to its best advantage. Remembering that books of this kind are either used for reference or read by single chapters rather than as a whole, it is believed that this will be appreciated by the reader.

The author has endeavored to describe his own experience in the diagnosis and treatment of tuberculosis, and has undertaken to give no opinion which his experience would not warrant.

The author is indebted to his associate, Dr. Charles C. Browning, for many helpful suggestions; to Dr. Boardman Reed, for reading and criticising the chapter on Diet; to Profs. Weichselbaum, Tandler, Maragliano, and Bier, Privat Docent Störk and Dr. Carl Spengler for many courtesies and special opportunities afforded for the investigation of special subjects; to his wife, Adelaide B. Pottenger, Dr. Seth D. Dice, Miss C. M. Brown and Miss Laura Bennett for reading and correcting the manuscript and rendering other valuable assistance.

F. M. P.

Los Angeles, California,
January, 1908.

PULMONARY TUBERCULOSIS

CHAPTER I.

THE PROBABLE TIME OF INFECTION IN TUBERCULOSIS.

Formerly, it was believed that tuberculosis was inherited and that the disease often remained in the body for years in an undeveloped form. When the heredity theory was attacked, many who had held to it would not accept the theory of post-natal infection, because they often failed to find a history of exposure to infection immediately prior to the time that the disease was discovered. In acute infections the period of incubation is usually short and the source of infection is in many cases traceable. The same was expected in tuberculosis, and a failure to find it retarded the acceptance of the theory.

Symptoms of Tuberculosis Develop Long After Infection.

It is probable that the first entrance of tubercle bacilli into the body, with the formation of the first tubercles, causes few if any recognizable symptoms. Tuberculosis as we know it, as we are able to detect it, is a process more or less advanced A tubercle is a tiny structure, about the size of a millet seed. In order to be able to detect a tuberculous focus, the area of involvement must be of considerable size (some authors claim as large as a marble). Thus it can readily be seen that we diagnose the disease after it has extended.

Tendency to Spread.

In fact, this tendency to spread is one of the characteristics of the disease and the one thing which causes tuberculosis to destroy life. There is always a battle fought when an infection occurs. On one side, we have the tubercle bacilli; on the other, the defensive forces of the individual attacked. If the latter are sufficient, the invaders are destroyed; if not, the bacilli are deposited in the tissues and form a focus from which they continue to attack their host, endeavoring to establish themselves in new tissue. Often, while the defensive forces are not sufficient to destroy the invading organisms, they are sufficient to check the progress of the invaders and prevent them from entering new tissue. In nature's effort to protect the host, she sometimes throws a wall around the bacilli, and retains them imprisoned; sometimes she converts the seat of infection into calcified areas; and, again, she causes a necrosis of tissue with breaking down and scattering and, sometimes, expulsion of the germs. When the bacilli are walled off or encapsulated as it is called, they may retain their vitality for years and yet may never cause any further trouble. On the other hand, the patient's resisting power may be lowered; or some inflammatory disease may affect the air passages, such as bronchitis, la grippe or pneumonia; or through some action on the part of the germs themselves, the encapsulating wall may be broken down and the bacilli may escape and form new tubercles in previously healthy tissues. At this stage of the disease the patient may show some symptoms, which after a time may become quiescent. This process of alternating activity and quiescence continues until the symptoms become more and more manifest and then the patient becomes alarmed and seeks advice. Doubtless most patients who seek our advice have had the infection for at least several months and, more probably, years.

The following case illustrates very well the manner in which tuberculosis may remain in the system for years and years; and then, through a softening of the encapsulating wall, the bacilli may be set free and the disease make itself plainly recognizable.

Mrs. H. L. S., aged 62, had associated with her father, who was suffering from tuberculosis at the time of her birth until his death which occurred when she was two years old. When she was eight years of age, her mother, with whom she had lived during a portion of the latter's illness, also died of tuberculosis. The patient showed no special symptoms, except that she was not very strong, until she was seventeen years of age when she became "run down," lost her appetite and endurance, lost weight, became hoarse and had night sweats. She was forced to leave her school and was told that her lungs were weak. The patient regained her health and showed no further symptoms for some time. She married and at the age of 30, gave premature birth to a child, which died after a few days. After confinement, she regained her strength very slowly, suffered from repeated colds and coughed severely. She was again pronounced to have weak lungs, and was treated with cod liver oil and whiskey, and sent to North Carolina for a change of climate. She once more regained her health and showed no further signs of trouble until, about three and one-half years ago, she had an attack of whooping cough. Since then, her cough has continued with a gradual increase in its severity, and in the amount of expectoration; and, during the past year her strength has gradually failed. Upon consulting her physician for some other trouble, it was found that she was suffering from chronic bronchitis, with emphysema and that she had a tuberculous lesion occupying the upper portion of both lungs extending to the fourth rib anteriorly and to the middle of the scapula posteriorly.

Tuberculosis Often Unrecognized.

A careful inquiry into the probable time of infection in tuberculosis, together with the consideration of symptoms or groups of symptoms which suggest the presence of a tuberculous infection, will show that individuals who become so much diseased as to cause symptoms sufficient to enable the diagnosis to be made, often have shown other symptoms or groups of symptoms at various times in their lives, and yet have not gone on to the full development of an advanced process.

It is generally conceded that post-mortem tuberculosis is much more common than clinical signs would indicate. May it not be equally true that clinical tuberculosis often goes unrecognized? I believe it behooves us to bear tuberculous infection constantly in mind. There is no question but that neurasthenia in young anemic girls is often due to a tuberculous deposit in the lung. May not slow development, malnutrition, and a lack of endurance in childhood and adolescence be due to this same cause? I have no doubt but that improved methods of diagnosis will reveal a tuberculous condition to be present as a cause of many of the symptoms above referred to and thus clear up the etiology of certain conditions which have always been misunderstood, and which have always been treated in a most unsatisfactory and unscientific manner.

Childhood a Probable Time When Infection Commonly Occurs.

Unfortunately, it is difficult to tell the exact time when a given infection has taken place; nevertheless, evidence is strong that childhood is a time when it is very prone to occur. The old theory of heredity, of course, brought all infection down to the time of birth. Behring, in order to substantiate his theory of infection from cattle, claims that all infection takes place during the milk using period of the child, and that it is due to the passage of the bacilli which are ingested with the milk through the mucous membrane of the digestive tract. While we do not agree with this extreme statement, and while we do not think that milk is by any means the sole carrier of tuberculosis, yet, as pointed out in a former paper (A Study of Tuberculous Infection: New York Medical Journal, March 12, 1903. See Appendix, Chap. II) we believe that:

"1. Tuberculous infection is very common in early childhood.

"2. A large proportion of those patients who, although infected, do not show acute symptoms during childhood, develop active tuberculosis in later life.

"3. In seeking the cause of this frequent infection, aside from the habits of the child and the carelessness of the parent bringing it in frequent contact with the bacillus, all those things which lower vitality at this time must be considered; and, I would call special attention to the fact that there is a connection which seems more than coincidence in the time that tuberculous infection takes place and the time that the child is most apt to suffer from catarrhal conditions of the stomach and bowels.

"4. More attention should be given to the care and feeding of children, so that their systems may be resistant to infection.

"5. All tuberculous children, whether they have lesions in the glands, bones, lungs, or any other part of the body, should be treated for their disease."

Proofs of Latency.

That a focus of infection may lie dormant in the system, enclosing bacilli which are virulent, is shown by the fact that the disease can be produced by inoculating animals with glands of individuals in whom no symptoms whatever were recognized during life. Another proof is the usual manner in which the disease often starts up after an acute illness, when no opportunity for a new infection could have occurred. The only satisfactory manner of accounting for the symptoms at these times is to suppose a previous infection, and recognize the possibility of the bacilli lying in a state of quiescence. The presumption is quite strong that tuberculosis is primarily a glandular disease, the bacilli gaining entrance through the mucous membrane and being either destroyed or deposited in the lymphatic glands. From this focus of infection bacilli may find their way to other parts.

That a tuberculous infiltration may remain for a long time without ulceration is proven by our observation of the larynx. Often infiltrations may be observed here for months and even years without ulceration taking place. That the same thing occurs in the lung, we have every reason for believing, from both clinical symptoms and post-mortem findings.

Latency an Important Feature of Tuberculosis.

Not until we recognize this feature of tuberculosis, can we understand the disease. It is not like diphtheria and scarlet fever, which show an infection, a definite incubation, and then a fully developed disease. It is a slow disease, much more chronic than has been suspected. Infection may take place in childhood, but death may not occur until adolescence or even old age. The bacilli may remain in the lung during an entire lifetime and produce no recognizable symptoms; they may remain and produce symptoms at times and yet never cause advanced tuberculosis; or, being there, they may cause an active disease at any time.

Picture of the Development of Tuberculosis in the Body.

The picture of tuberculosis, as I form it, is that of a localized infection, which every now and then shows a tendency to spread to new tissue, especially to that surrounding the parts affected. With the infection of new tissue, symptoms either slight or severe may be produced according to the area involved, the toxins produced and the susceptibility of the individual. From the time that infection occurs until the time that a severe disease is present may be a brief period only or it may be years. The picture is that of a series of quiescences and activities. When the disease has once become thoroughly active and has involved a considerable area of tissue, it will less often attain the condition of arrestment or quiescence; but, even if it does not do this, the same process goes on with an attempt at extension on the part of the invaders and an attempt at defense on the part of the host, with first one successful and then the other, until, finally, the disease is beyond the control of the protective forces of the body.

CHAPTER II.

THE SYMPTOMS AND SIGNS OF EARLY PULMONARY TUBERCULOSIS.

Progress in Diagnosis.

Owing to the fact that tuberculosis is a communicable disease, an early diagnosis should always be made for the protection of those who must associate intimately with the afflicted; and, since the curability of the disease has been established, an early diagnosis is necessary, in order to give the patient the best chance of cure.

Our conception of early diagnosis has changed very greatly in recent years. Before the discovery of the tubercle bacillus, the disease was rarely recognized until it was far advanced; but, when it was learned that the expectoration of patients suffering from tuberculosis contained the germs, examinations soon established the fact that tuberculosis was present before the advent of grave symptoms. By the use of the microscope, then, a great step forward was made in diagnosis.

It was soon noted that in many cases where bacilli could not be found in the sputum, the same symptoms, in part, were present as where bacilli were found. This was described at first as a pre-tubercular stage. More careful training in physical examination, however, together with the tuberculin test, proves this to be not a pre-tubercular but an early stage, before the germs appear, or at least before they are found in the sputum.

Meaning of Early Diagnosis.

What we now understand by an early diagnosis is a diagnosis at this period, before the disease is advanced and without depending upon the finding of bacilli in the sputum. There is no excuse for any man failing to diagnose tuberculosis when bacilli are in the sputum, but to be able to diagnose it before they appear is much more difficult.

To be able to make an early diagnosis, the examiner must be thoroughly trained in making examinations and must take time to study his patient in detail.

To make a diagnosis of tuberculosis in the stage before the appearance of bacilli in the sputum, requires care, but a care which is repaid by the saving of lives.

Since it is so important that an early diagnosis be made in this disease, I deem it wise to deal with early and late diagnosis in different chapters so as not to confound the signs of the two.

Heredity. Since the overthrow of the theory of heredity as the cause of tuberculosis, the importance of the family history has declined. While it seems well established that there are very few instances in which tuberculosis has been transmitted directly from parent to offspring, nevertheless, family history is important as an index of resistance to disease and as it bears upon the longevity of the patient. It shows also certain characteristics, certain elements of weakness and strength that may be transmitted.

There seems to be a tendency among some writers to ignore heredity as having anything at all to do with tuberculosis. I believe this is a great mistake. No one can shut his eyes to the importance of inherited characteristics. We know that physical characteristics are transmitted to the offspring. The same contour of face, the same characteristic features, the same shape of chest or of limb, and the same color of the eye and hair are found in the offspring as in the parents.

A discussion of polydactylism throws some light on this subject. Clement Lucas (Guy's Hospital Reports, Vol. XXV) studied the family history of some patients who fell into his hands having an increase in the number of digits. Referring to them he said: "Altogether the great grandmother of my patients appears to be responsible for abnormalities occurring in no less than twenty-four persons out of a total of eighty descendants, or thirty per cent of those carrying her blood."

When we see such marks of heredity as above mentioned appertaining to physical characteristics and normal tissue, it seems to me that it requires very little, if any, stretch of the imagination to believe that it is probable that a tissue of low resisting power might be transmitted from parent to offspring, whereby the child is rendered more susceptible to the influence of the tubercle bacillus. While recognizing environment as being the greatest factor, yet I believe we have gone too far in our disregard for the influences of heredity.

Opportunity of Infection. An important point to investigate in family history is whether or not the suspected individual has been associated with any member or members of the family who have had tuberculosis. In making this inquiry it must be remembered that an association years before may be the direct cause of an infection at the present time. An association in childhood offers as great, if not greater opportunity for infection to take place than an association in later life. Many experiments have been made which show that the floors of rooms occupied by tuberculous patients are more apt to be contaminated than any other part of the room, hence the exposure to the child crawling about on the floor, and infecting his hands, which he constantly puts in his mouth, is the greatest. That bacilli can lie inactive in the tissues, is a fact well established, and it is not at all improbable that in many cases of tuberculosis which are diagnosed in later life, the bacilli causing the first infection were taken into the system during childhood.

Later Children more Susceptible.

Brehmer pointed out the fact that the later children in large families are more susceptible to tuberculosis than the earlier ones. This might be accounted for partly by the fact that the mother is more or less exhausted by repeated child-bearing. It would seem also that the difficulty of providing suitable food for larger families might react against the later children of the poor.

CLINICAL HISTORY.

Too little attention is usually given to clinical history. In tuberculosis, a carefully taken clinical history will usually give sufficient data upon which to base a probable diagnosis, and until the members of the medical profession become more skillful in the use of the stethoscope, they will be obliged to rely very largely upon evidence obtained by clinical history for the suggestion of the presence of tuberculosis.

The infection with tubercle bacilli, the formation of tubercles and the establishment of tuberculosis are accompanied by certain symptoms, with which we are more or less acquainted.

Cause of Symptoms.

That many of these symptoms are toxic in origin, seems certain, for they are identical with those which are produced by varying doses of tuberculin. Malaise, depressed appetite, nervous irritability, elevation of temperature and pulse-rate are found as the physiological effects of small doses of tuberculin and as early signs of tuberculosis.

In accounting for the symptoms of early tuberculosis, we must also bear in mind the fact that we have the lesion in one of the vital organs of the body, and that the local lesion involves branches of the nerve which supplies not only the organs of respiration, but also those of circulation and digestion. It is also probable that reflex action plays a certain part.

Malaise.

Malaise is one of the most constant symptoms of early tuberculosis. Patients complain of "being run down." They have a feeling of languor, being more or less tired without apparent cause. Tasks (either physical or mental), ordinarily performed with ease, become difficult. Sleep is disturbed and does not bring proper rest.

Nervous Symptoms.

Upon the part of the nervous system certain symptoms appear. The patient often shows a change in disposition. He may become irritable or melancholic. Neurasthenia is usually present to some degree. The writer believes that a tubercular process is often (though undiscovered) the cause of neurasthenia. There is also present a vaso motor disturbance. Patients experience a flushed feeling upon the least excitement and often suffer from cold hands and feet and sensations of chilliness. Sweating, especially in the axilla, is noted, the perspiration often running down the sides in great beads while the patient is undergoing examination.

Respiration. Respiration may be hurried and the patient may complain of shortness of breath.

Cough. Cough may or may not be present. As a rule, if cough is present, it is only a slight hack and not at all constant. It may be noted only after exertion, after prolonged conversation, after laughing or after taking a deep breath. It is usually accompanied by a tickling sensation in the larynx, making the patient think that the throat is the seat of the trouble.

Sputum. At first, no sputum is present. Later, some mucus or muco-purulent sputum is raised, which may or may not contain bacilli. When sputum is present it should always be examined, and repeated examinations should be made before a negative opinion is given; in fact, a negative opinion should not be given in early cases as a result of microscopical findings.

Hoarseness. Hoarseness is present as an early symptom, in many cases. This can be due to either reflex stimulation of the branches of the vagus in the lung, or to pressure caused by enlarged tuberculous glands on the recurrent laryngeal nerve or to the latter being bound down by apical pleural adhesions.

"Colds" and Bronchial Catarrhs. Patients suffering from early tuberculosis are subject to frequent "colds" and attacks of bronchial catarrh. These rarely begin as head colds nor do they run the course of ordinary colds in the head, but last often a month or more. Sometimes the patient will not be free from "colds" and bronchial catarrh for two or three months at a time. Any "cold" that lasts for a month is suspicious.

Circulatory System. An instability on the part of the heart is noted. The number of heart beats is usually increased. With a slight lesion, the pulse-rate may reach as high as 120. This tachycardia is most pronounced in young patients. In some cases, instead of the pulse-rate being constantly high, it is variable. At rest, it may approach or reach the normal, but with the least exertion, mental or physical, it may reach 100 or even more.

The tachycardia of early tuberculosis is accompanied by a lowered blood pressure. The irritation of the tubercle toxin causes a dilatation of the arterioles.

Gastro-intestinal System. Early tuberculosis causes instability in all the principal systems of the body. In this, the gastro-intestinal tract is no exception. The tongue is usually slightly coated. The appetite is capricious. There may be any condition from a slight impairment of appetite to an absolute disgust for food. Usually, the body weight suffers a slight decrease; it may be only a pound or two or it may be several pounds.

Anemia. The blood forming organs seem to suffer early in the disease, for anemia is a tolerably constant symptom of early tuberculosis.

Temperature. The temperature curve gives us very important information in early tuberculosis. There are two important features to be noted in the temperature of tuberculosis, one, the slight elevation in the after part of the day, the other, a subnormal temperature in the morning. Both are very characteristic. They are much more marked when the disease is advanced. In suspected cases, I am in the habit of giving the patient a thermometer, whose accuracy is known, and a temperature chart, and have the temperature taken and recorded every two hours of the day, from time of

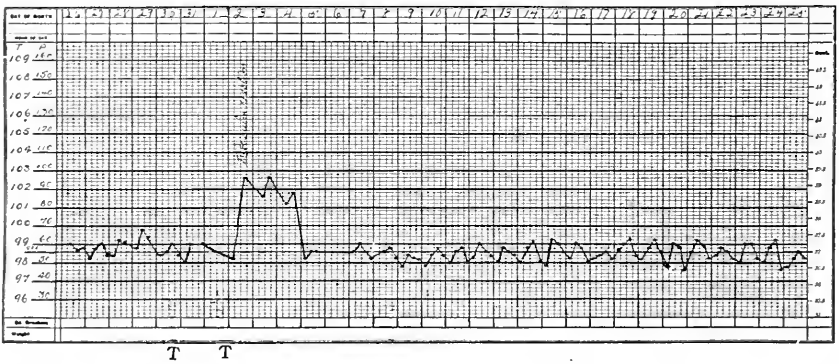


FIG. 1.—Temperature curve in early tuberculosis. Diagnosis made by the tuberculin test. On the thirtieth 1 mg. ("T") old tuberculin was given without effect. On the first, 3 mg. ("T") were given with the resultant high reaction lasting three days. A steadying of the temperature is noted for the next few days, which is quite usual.

waking in the morning until ten o'clock at night. Such a chart, to be of value, should be kept at least a week. It is well to measure the temperature after exertion and in women for a few days before, during and for a few days after the menstrual period. Figure 1 shows the temperature chart of an early case of tuberculosis. In this case the diagnosis was made by the injection of tuberculin. (The temperature following the injection in this case ran exceptionally high. I rarely obtain more than one degree.)

The rise of temperature, as a rule, amounts to only a fraction of a degree and rarely more than a degree. This rise is rarely constant, however. Tuberculosis may be present and yet the patient have a normal temperature. On the other hand, a slight rise of temperature taken by itself has no diagnostic significance. When other probable causes for a rise in temperature have been excluded, and some of the other symptoms of early tuberculosis are present, then the temperature is of great significance.

In a person showing other signs of tuberculosis, but with a normal temperature, a rise after exertion or, in the female, during the menstrual period, should be looked upon as suspicious.

The importance of having the temperature taken correctly cannot be overrated, for an elevation of half a degree may cause a change in a probable diagnosis.

The temperature should be taken, preferably in the rectum; but for obvious reasons, this is usually disregarded, and the mouth used instead.

When the mouth is used, the temperature should not be taken for at least a quarter of an hour after drinking or eating; and, if the patient has been drinking anything very hot or very cold the temperature of the mouth may be influenced for a still longer time. If the patient has been talking or holding the mouth open (as in mouth breathers) he must keep it closed for some little time (ten to fifteen minutes) before the temperature is measured; especially is this true when the outside temperature is cold.

Thermometers should be held longer than is indicated by their registering time. For accuracy five minutes is none too long to hold any thermometer. This is no reflection on the thermometer, but takes cognizance of the fact that the temperature of the mouth is not the accurate temperature unless the above precautions are observed, and by holding the instrument five minutes, much error will be eliminated. The patient should not talk while the temperature is being measured, nor should the thermometer be removed from the mouth.

For the sake of accuracy, these minute instructions must be given to the patients.

Pain. It is unfortunate that pain is not a more constant and more significant symptom of early tuberculosis. It is often present, but it is so variable that, taken alone, it has scarcely any significance, but when associated with other symptoms demands consideration. This pain is most apt to be in the supraclavicular, supraspinous or interscapular region, although it may appear lower down in the chest. It is usually of a dull, sometimes of a boring nature. It must be remembered that in these early cases the apices are often the seat of pleural pain.

While many chest pains may be insignificant, they should be carefully investigated, and other accompanying symptoms of tuberculosis searched for, before they are declared to be of no consequence. Pains in the chest will often send patients to the physician and if they are associated with or caused by the presence of tuberculous foci, the physician should not let the opportunity of making a diagnosis escape him.

Night or Sleep Sweats. There seems to be a lack of appreciation of what is meant by night sweats. The sweats in early tuberculosis are not as severe as those which accompany the later stage of the disease. They may more appropriately be called sleep sweats, for they may occur whenever the patient falls asleep, whether it be at night or during the day.

Spitting of Blood. The spitting of blood must always be considered as a symptom of tuberculosis until definitely proven otherwise. Among scientific physicians the expression "throat hemorrhage" can no longer satisfactorily account for the spitting of blood.

Hemoptysis is often the first sign that there is anything wrong with the patient. This may amount to only a streak or spot of blood as it often does, or it may be quite severe. The amount has no significance as to the extent of the disease, except that as far as I am aware, a fatal hemorrhage has never occurred in early tuberculosis. These small amounts of blood are most likely extravasations, while the larger ones are due to the opening of vessels. Bacilli may frequently be found in the sputum following hemoptysis.

An early hemoptysis should always afford the patient the advantage of early treatment.

Pleurisy. A history of pleurisy should always make us look carefully for tuberculosis elsewhere. While it is true that there are non-tuberculous pleurisies, yet, at the same time, tuberculosis follows in these cases so often that a patient giving a history of pleurisy should be examined with extreme care. Koch reports that 73.2 per cent of a series of pleurisies with effusion reacted to tuberculin. (Transactions British Tuberculosis Congress, Vol. III, page 15.)

The more knowledge we have of tuberculosis the greater our belief in the tuberculous nature of nearly all pleurisies. Tuberculous foci which are inactive and which may be unrecognizable by ordinary examinations may be the cause of pleurisy. An effusion in the lower part of the pleura may be due to a tuberculous process at the apex, the fluid being poured out and gravitating to the lowest part.

CHAPTER III.

EXAMINATION OF THE PATIENT FOR EARLY TUBERCULOSIS.

General Rules for Examination. The room in which the patient is to be examined should be well lighted and warm. The patient should remove all clothing to the waist, so that all portions of the chest may be examined. A loose shawl of some washable material should be thrown over the patient for warmth and to avoid unnecessary exposure. It is very essential that that portion of the chest which is being examined be bare, so as to afford every opportunity of detecting the most delicate changes in the respiratory note. The changes in early tuberculosis are very slight and a garment, no matter how thin, will interfere to some extent. The handkerchief or chest cloth used by some examiners is subject to the same objections as a thin vest or shirt and should be dispensed with. It is sometimes said that it is indelicate to expose female patients in this manner. Nothing is indelicate unless made so, and since physicians should always be gentlemen, this objection has no weight. I have never yet met a female patient who objected to this necessary exposure. They see its importance and desire to have the best opinion of the examiner and know that it cannot be given otherwise.

The chest should be examined methodically. Every portion should be carefully gone over. The supraclavicular and supraspinous fossæ should be most thoroughly examined. When auscultation is being practiced the stethoscope should be placed from two to four times over every intercostal space so as to practically cover the entire chest. Figure 34 on page 190 illustrates the chart that I use in recording the findings on auscultation.

It is wise to make a chart of the chest in all cases, so that examinations made at different times may be compared. Such a chart, to be exact, should be made as the examination progresses. For this, either an assistant is needed, or a stethoscope which fastens to the chest by the suction of a vacuum chamber (see Fig. 2 page 14) should be employed. The character of the breathing together with whatever other signs are present should be recorded on the portion of the chart which corresponds to the portion of the chest examined. If the record is not made as the examination proceeds, the examiner will most likely forget many of the details necessary for accuracy.

The patient should sit on a stool without support for the arms. While the anterior part of the chest is being examined, he should sit erect, with his arms hanging to the side; and while the posterior, he should fold his arms and bend slightly forward.

Ear or Stethoscope

Various examiners differ in their opinion as to the relative value of the ear and stethoscope. It is often said that the best instruments are those which one always has with him. This has been said so much that it is accepted largely because of its constant repetition, and, accordingly, it has been decided that the ear is better than a stethoscope and that the finger is better than a percussion hammer and pleximeter. Following this same argument, all instruments of precision would have to be discarded, and the eye would have to be considered better than the microscope. The truth of the matter is that both have their advantages and disadvantages.

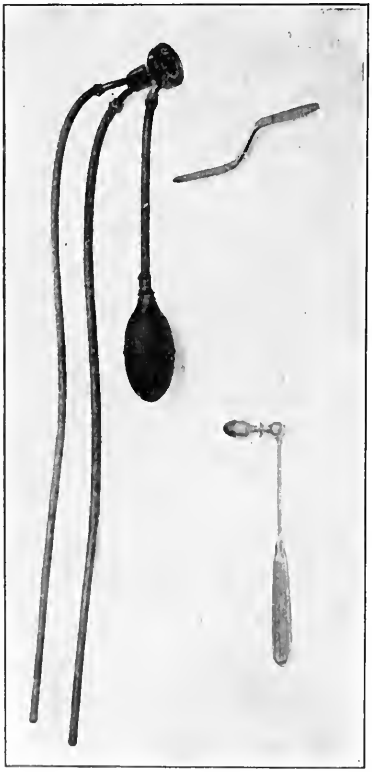


Fig. 2.—(a), Stethoscope; (b), percussion hammer; (c), pleximeter.

The advantages of the ear are, that it is always with one and that the sounds are heard without exaggeration. The disadvantages are, first, it is impossible to apply the ear to certain portions of the chest, as the supraclavicular fossæ and axillæ. Secondly, patients' skins are not always clean and are often covered with perspiration, so it is very unpleasant. Again, the rubbing of the ear, face or beard against the chest often interferes with the proper interpretation of the sound. Besides these disadvantages, it is much more difficult to listen to a definite circumscribed area when the ear is employed directly than when a stethoscope is used.

The choice of a stethoscope is a very important matter. Many of the modern stethoscopes are so constructed that they greatly magnify the sound; others cause such a modification of it by the roar of the instrument itself that they are objectionable.

The best instrument is that which conveys to the ear the sounds produced in the chest with as little exaggeration or diminution as possible. What is wanted is the natural sound.

The accompanying cut (Fig. 2, a) illustrates the instrument which I prefer.

It consists of a body made of hard rubber. The body has two chambers, one in the center with which the ear pieces are connected and an outside one connected with a rubber bulb. By pressing the air out of the bulb a partial vacuum is formed in this outer chamber so that when it is pressed on the chest wall it will be held by the suction caused by the attempt of the bulb to expand. This outer chamber also acts as a barrier to extraneous sounds, and confines our attention to a definite point. The instrument is completed by the attachment to the inner chamber of two soft rubber tubes which are used to carry the sounds to the ears.

This instrument has the advantage that it does not appreciably magnify the sounds; by its vacuum chamber it excludes extraneous sounds; and, if allowed to hang by its own weight, it offers exact conditions for comparison at different examinations. The sounds which one hears vary with the pressure upon the stethoscope, so it is very important in examining from time to time for comparison to make the same pressure. It is very difficult to do this unless we have an instrument such as the one here described which hangs on the chest without the uncertain pressure of the examiner.

Percussion Instruments.

There are two methods of percussion, immediate, where the stroke is delivered directly to the chest wall, and mediate, where the blow is received by a pleximeter interposed between the body surface and the blow.

We have finger-finger percussion, finger-pleximeter percussion, percussion hammer-finger percussion, percussion hammer-pleximeter percussion, direct percussion, and auscultatory percussion. When ordinary methods of percussion are employed it is largely a matter of personal preference on the part of the examiner which he will use, the finger or the pleximeter and percussion hammer. Figure 2, b and c, illustrate the instruments which I prefer when I do not use the fingers.

When the finger is used as a pleximeter, it is possible to learn to detect the condition of the underlying tissue by the resistance imparted to the finger. This is very important and becomes to the examiner, who is skilled in percussing in this manner, of more importance than the sound elicited by the stroke. When a pleximeter other than the finger is used, this feeling of resistance is lost.

The common methods of percussion and elastic tube percussion are especially adapted to the early diagnosis of tuberculosis. For a description of these various methods of percussion, in order to avoid repetition, I would refer my readers to pages 66–71.

Light or Heavy Percussion.

While it is well to practice both light and heavy percussion, yet light percussion is preferable in early tuberculosis. It is estimated that a light stroke will set up waves to a depth of two inches. A heavy stroke throws a great portion of the chest wall into vibration, hence affording unreliable evidence.

Whatever pleximeter is used, it should be applied to the intercostal space and should be placed gently against the skin. If pressed too firmly it causes too much of the chest wall to vibrate and gives the same effect as heavy percussion. If it be placed across the ribs, the entire thorax will be set into vibration by the stroke, producing faulty evidence.

Not only is it advisable to use light percussion, but also not to percuss too many times over the same area. Not more than two or three strokes should be given in succession. More than this is confusing and interferes with making a careful comparison. It is also well, after using the multiple stroke, to compare the tones elicited by single strokes. This latter method is very valuable in detecting slight changes.

Percussion should be carried on during shallow breathing, as there is a change in the note between shallow and deep breathing over the same area, as pointed out by Friedreich.

Difference in the Apices.

In making an examination for early tuberculosis, the natural differences between the two apices must be borne in mind. The right bronchus is of greater lumen than the left; in fact, it is practically a continuation of the trachea, hence air enters the right lung more directly than the left. The branch of the bronchus which supplies the right apex is given off before the bronchus enters the hilum of of the lung, while that which supplies the left is given off after the lung has been entered. So the sound which reaches the ear at the right apex is transmitted more directly and is not modified by passing through as much elastic lung tissue as is the sound at the left apex, hence it is more distinct and not as soft as that at the left apex.

The slightly exaggerated vocal fremitus usually found at the right apex is accounted for in the same manner.

The slight increase in the height of the pitch of the percussion note at the right apex when compared with the left is doubtless due to there being relatively less elastic lung tissue and more dense fibrous bronchial tissue superficially situated at the former point.

INSPECTION.

As a rule, inspection is very much neglected in examining patients suffering from tuberculosis. While in the advanced conditions, careful inspection of the chest will often give us a general idea of the extent of the disease present and of the changes which have occurred within; in early tuberculosis it gives us at best only meager information; for, in these cases, while the disease may have been present for some time, yet it has not become sufficiently extensive to cause any marked changes.

An opinion as to whether or not tuberculosis is present can never be given by simply looking at a patient. While in many cases the signs seem self-evident, in others we have no clue from outward appearances. Many individuals who appear thoroughly strong are suffering from tuberculosis.

Inspection of the Patient. Inspection of the patient often shows a condition of anemia. The face, conjunctiva and gums are pale. While the patient does not present the picture of grave disease, yet he often seems to be below the standard of health. Since anemias are nearly always secondary, this condition in a young individual should put us on our guard.

Lagging. At times, inspection shows a lagging on the part of the apex where the disease is located, but this can be detected much more readily by palpation. Tubercles in the lung may be so situated as either by their presence or by the accompanying inflammation to interfere with the entrance of the air to the part, hence cause the lagging. It seems to me, however, that the interference with the normal elasticity of the lung tissue is one of the most important factors that enters into the production of lagging, as well as into many of the other signs of early tuberculosis. The deposit of tubercles interferes with the expansion and contraction of the lung tissue.

Pupils. Sometimes there is found an inequality of the pupils, the one on the affected side being dilated. Such a disturbance may be present before the lung is involved, for it may be produced by irritation of the sympathetic nerve by enlarged bronchial tubercular glands or by fibers of the sympathetic being involved in apical pleural adhesions. Destrée, who has paid considerable attention to this sign, found it present in nearly all his cases. It is not constant: it may be present at one time and be absent at another. I have watched this sign for the past few years and find it very commonly present.

Harrington has discovered a widely dilated pupil which gives the same appearance as the eye under the influence of atropin. I have observed this sign, however, most often in cases moderately advanced.

Red Line on Gums. Sometimes a red line is found along the margin of the gums in early tuberculosis. While this is not a sign of great importance, yet it is one that is often found. Turban says of it: "I have myself repeatedly found this symptom very early in closed tuberculosis, especially in children, but it is often entirely wanting, particularly when attention is paid to the mouth."

Larynx. A careful inspection of the larynx will reveal deviation from the normal in many cases of early tuberculosis. The epiglottis is sometimes anemic and at times the nerve supply of the cords is interfered with. I have seen this interference in all degrees from that of a slight loss of tone to an apparent abductor paralysis. As mentioned above, hoarseness is present in many cases and with a little care in taking the history it will be found to be quite a common symptom of early tuberculosis. This can readily be accounted for by the fact that the recurrent laryngeal may be bound down by pleural adhesions at the apex or may be pressed upon by masses of tubercular glands.

Difference in Elevation of Acromial Ends of Clavicle.

Aufrecht calls attention to a difference of elevation in the acromial ends of the clavicle, that of the affected side being lower than the one on the sound side. He lays great stress on this symptom. My experience confirms this as being a comparatively early sign in certain cases, but its presence depends upon changes at the apex of greater magnitude than are necessary to furnish us evidence of the existence of tuberculosis. When we remember that many cases of tuberculosis are secondary infections or outbreaks of the disease in apices previously the seat of tubercles, we can understand this sign.

Retractions and Depressions.

While we should not expect to find retractions and depressions occurring immediately upon the deposit of bacilli, with the formation of tubercles in an apex, yet we must bear in mind that it is probable that much time elapses in most cases, even years in many, between the time when the bacilli enter the apex and when the disease comes to our notice. In such cases when the symptoms call our attention to the presence of the disease, it is simply a new activity, perhaps with extension, in an old focus. In this way retractions and depressions in such apices could have a bearing upon the symptoms of early tuberculosis.

PALPATION.

By the sense of touch, we can often secure valuable information in early tuberculosis. If we were to confine our examinations simply to the detection of fremitus, palpation would not be of much value in early tuberculosis, but palpation in its broader sense consists in deriving, by the sense of touch, whatever evidence we can of the presence of tuberculosis.

Enlarged Glands.

We should always examine into the conditions of the cervical and axillary glands. If enlarged, the probable duration of the enlargement should be considered.

Increased Fremitus.

Increased fremitus, if found, is an important symptom, though it is often absent.

Lagging.

Lagging can be detected very often by inspection, but it can be felt to much greater advantage. The examiner may sit facing the patient and lay his hands flat on the chest; or, a method which I much prefer, he may stand behind the patient, who is seated on a stool, and place the thumbs in the supraspinous fossæ and then extend the fingers down over the clavicle and upper ribs. The hands should be pressed firmly to the chest wall. Any tardiness upon the part of one of the apices to expand, or any lessening of the expansion can be easily noted in this manner. This sign has been very helpful to me in unilateral involvement, but where both apices are involved, of course it is untrustworthy. Where both apices are involved lagging is not so easily detected, and the true nature of the situation will be made evident only by percussion and auscultation.

Palpatory Percussion.

The finger should always be used as a pleximeter before percussion is finished, and the resistance should be noted. The resistance to the finger can be felt as early, if not earlier than the changes in pitch. Nothing outside of auscultation can be of so much value in the examination for early tuberculosis as a finger so educated as to detect slight differences in resistance upon percussion.

PERCUSSION.

There are several things to be noted on percussion in early tuberculosis, but dullness, which is so often looked for, is not one of them. There are usually, however, changes in the quality and the pitch of the note, and a change in the resistance noted by the finger on palpatory percussion as mentioned above. The determination of the outline of the apices is also of great value.

Quality of Percussion Note.

The deposit of tubercles in the lung changes the elasticity of the tissue, hence changes the quality of the note elicited upon percussion. The normal note changes to one of a tympanitic character. This tympany is a very common sign in early tuberculosis. It can often be demonstrated over a portion of, or an entire lobe which is the seat of recent tubercles.

Pitch.

In early tuberculosis we find the pitch of the percussion note to be higher than normal.

It is difficult for some observers to be able to differentiate slight changes in pitch. I have found it a valuable practice for myself as well as in teaching students to take the pitch from the stroke of the percussion hammer just as the singer does from the musical instrument. While that pitch is still in mind, strike the other apex or whatever part is to be compared. Then by changing to take the pitch of the new note, we can compare and learn to appreciate the slightest changes.

Apical Outline.

Valuable information can be obtained by mapping out the outline of the apices. This must be done by very light percussion. The outline as determined by heavy percussion is not reliable, because it sets up vibrations in the chest wall and in tissue far beyond the slight areas of consolidation, which would, under light percussion, show in the percussion note. Auscultatory stroking is very valuable in determining the outline.

Contraction shows quite early in apical disease, and if the apex is carefully mapped out and the outline marked on the skin by a dermographic pencil, a simple glance (Fig. 3, a and b) will show whether or not retraction is present, if it is confined to one apex. In double involvement it is not so easy.

A contracted apex does not mean that active tuberculosis is present, but

Fig. 3. (a)

Fig. 3. (b)

Fig. 3.—a and b, show the change in apical outline resulting from apical involvement. Not only is the apex lowered but the area of resonance is narrowed

simply that for some cause or other either in the past or present, a pathological condition has caused a contraction of the lung tissue. The cause must be interpreted in the light of the clinical history and the findings upon auscultation.

AUSCULTATION.

The procedure which affords the most reliable information in examining for early tuberculosis is auscultation. To be an expert at it is to attain mastery of the key which unlocks the door to early diagnosis. The changes in the respiratory note characteristic of early tuberculosis are: Rough breathing; harsh, sharp vesicular and puerile breathing; prolonged expiration; weakened breathing and cogwheel breathing. These may or may not be accompanied by fine rales.

Whatever other signs or symptoms are found, they must always be interpreted in the light of the auscultatory findings.

It seems superfluous to say that it is necessary to have an accurate picture of the normal vesicular breathing, in order to be able to recognize abnormalities, yet it is a common experience to find men giving opinions as to the presence of early tuberculosis without having any definite idea of the normal vesicular murmur.

Difficulties and Errors in Auscultation.

Sometimes the respiratory note is very faint and heard only with great difficulty, owing to thick chest walls. Where nasal stenosis is present, the respiratory sound is also apt to be feeble. In such cases, the patient should be asked to breathe through the mouth. In patients who employ the abdominal form of breathing, the movement of the chest wall at the apices is limited and often the respiratory murmur in these parts is very indistinct.

When the chest is covered with hair, this can be either wet with water, rubbed with vaseline or, if especially annoying, it may be cut off.

There are numerous noises of muscular origin, with which the examiner should familiarize himself. These are sometimes heard at the apex, due to the contraction of the trapezius, sometimes over the scapula, due to a slipping under the scapula. These may be due to contractions of the muscles alone, or, in some instances, they are due to pressure on bundles of muscle fiber by the stethoscope.

At times, sounds simulating rales are also heard at the sternoclavicular articulation, and in some instances, it will be very difficult to differentiate between crepitations of pleural and intrapulmonary origin. While this differentiation must be made frequently in advanced cases, it will occasionally be required in early, suspected apical involvement.

Cause of Vesicular Murmur.

It seems strange that no thoroughly satisfactory explanation has been given to account for the sounds heard on auscultation of the normal and pathological chest. Laënnec assumed that normal vesicular breathing was due to the friction of the air rubbing against the walls of the fine bronchi and infundibula. More recently the theory has been advanced that vesicular breathing is nothing more than the blowing noise made as the air passes the larynx, modified by the air passages and lung tissue, and transmitted to the ear through the chest wall. As Sahli well says, neither of these theories are satisfactory. That vesicular breathing can be produced without the entrance of air into the lung at all, was demonstrated by Sahli (Correspondenzblatt für Schweitzer

Aertzte, 1892) upon a patient suffering from congenital fissure of the sternum. Upon increasing the intraabdominal tension as by straining, the lung tissue protruded to a considerable extent. Auscultation at this time showed a typical vesicular murmur caused by the filling of the alveoli.

It would seem from this experiment that the lung tissue has an important part in the production of the vesicular murmur.

It seems to me that, in order to form the proper conception of the cause of the normal vesicular murmur, we must remember that inspiration is a muscular act by which the lung capacity is forcibly increased. There is a stretching of the elastic tissue of the lung, with an opening up of the acini, and an inrush of air—these two elements causing the murmur. The inspiratory murmur is most likely due partly, if not largely, to the stretching of the elastic tissue, as shown by Sahli's experiment and as suggested by the sound elicited on compressing and stretching lung tissue. The inspiratory note begins with the commencement of the muscular effort and continues until this ceases, and is audible during the entire time. Expiration is due to the contraction of the elastic tissue following the passive muscular action of the expiratory phase; and since this is not forcible, but a gradual contraction, following up the passive muscular action, the sound is either inaudible or heard only at the beginning when, on account of the increased tension owing to the great distention of the elastic tissue, it forcibly expels some of the air. That this accounts for the audible expiratory sound is supported by the fact, that the expiratory sound is accentuated by deep inspiration, causing an overdistention of the air cells. The difference then between the inspiratory and expiratory murmur is that the former is caused by both the stretching of elastic tissue and the inrush of air, while the latter is due for the most part to the outward passing of the air—the former an active process, the latter largely passive.

Rough Breathing.

Rough breathing is the earliest sign of tuberculosis that can be heard upon auscultation. It is usually heard at the apex of the lung soon after the disease manifests itself.

Sahli has well described it thus: (Diagnostic Methods, 1905.) "Rough vesicular breathing is an impure, slightly uneven murmur heard during inspiration, as if stronger accompanying noises were admixed with the normal vesicular murmur. In order to prevent confusion with sharp or increased vesicular breathing the term impure breathing is more fitting. In creased breathing is exquisitely pure and generally very intense whereas rough breathing is more frequently weak and faint."

Such a respiratory note might be due to interference with the normal unobstructed flow of air into the air cells so that different acini become filled at different times; or it might be due to a thickening of the mucous membrane of the air passages, owing to the presence of tubercles; or to an obstruction of the air passages due to the presence of secretion; or to the admixture of the sounds produced by secretion with the normal sounds. It has also been suggested that the roughness might depend upon an emphysema which develops about the tubercles, the air entering the various air cells, not simultaneously but in succession. Turban believes it is due to the presence of nodules here and there, which by their presence compress bronchioles and interfere with the simultaneous dilatation of the air cells.

Weak Breathing.

Closely allied to the rough breathing is a weakening of the respiratory note. In fact, as mentioned above, rough breathing is a weakened breathing. Compared with other areas we find that the air does not enter a portion or it may be the entire apex as it should. Such a sign should make one suspicious of tuberculosis. The same causes as mentioned in the above paragraph are responsible for the weakened breathing. It may be due to an encroachment upon the lumen of the air vessels due to thickening of the walls or to secretion, or to a lessened elasticity of the lung tissue. Fixation by pleural adhesions and thickening of the apical pleura will also cause it.

Prolonged Expiration.

The expiration may or may not be prolonged in early tuberculosis; however, it can be readily seen that the same conditions which cause a rough or weak inspiratory murmur will set up a barrier to the egress of air from the air cells and will at the same time cause a retardation of contractile action upon a part of the lung tissue, giving rise to a prolongation of the respiratory note.

Harsh, Sharp Vesicular or Puerile.

Harsh, sharp vesicular or puerile breathing accompanies a process somewhat more advanced yet sufficiently early to be counted among the early signs. This may or may not be counted among the early signs; it may or may not be accompanied by prolonged expiration. This might be called intense vesicular breathing, and may be described thus: If normal vesicular breathing be represented by an attempt to pronounce the letter f, sharp vesicular would be represented by ff.

This sound is heard where the breathing is forced. In normal vesicular breathing, the air passes through elastic bronchial tubes surrounded by elastic tissue; but, through pathological thickening, the elasticity is interfered with and the tubes become more rigid, consequently a partial stenosis obtains which offers resistance to the air. The air enters by force and produces an intensified sound. Owing to the infiltration present, the sounds are conducted to the ear with more than natural ease.

Cogwheel Breathing.

Cogwheel breathing is allied to rough breathing. It is an interruption in the inspiratory murmur. It is due to an interference with the entrance of air into the air cells, and gives the idea of the air current overcoming one obstacle after another. It is supposed to be due to a valve-like swelling of the mucous membrane of the bronchioles or to the accumulation of secretion which gives way before the incoming air. It is a sign of a catarrhal condition and if found localized is usually associated with early tuberculosis.

Turban says this form of breathing usually occurs in zones between the tuberculous and healthy lung and seldom at the apices. My experience would confirm this. I have most often found it below the clavicle when the apex was affected.

Rales. It is not necessary to have rales present in order to establish a diagnosis of tuberculosis. In the earliest forms of the disease they are rarely found, although they soon make their appearance and when present they denote a catarrhal condition. They are usually of the fine crackling variety. Medium rales are not likely to be present until there is destruction of tissue. In order to detect rales, the patient should first be examined on quiet breathing, then forced breathing and finally after coughing. Sometimes by placing the patient on the well side, thus compressing the lung, the diseased lung is forced to greater activity, and rales which are not present on ordinary respiration may be elicited.

Sometimes a wheeze or whine will be heard. This, too, is a sign of a catarrhal condition, and when other signs are present is suspicious of tuberculosis.

Pleural Sounds. Not infrequently, crepitations and rubbings of pleural origin will be found. These denote either acute or chronic processes and are always suspicious. It is not at all uncommon to find crepitations at the base of the lungs when tuberculosis of the corresponding apex is present. When the right apex is the seat of tuberculous infection, it is not uncommon to find crepitations at the junction of the fourth rib with the sternum. These are most likely pleural crepitations and have their origin at the junction of the upper with the middle lobe.

Subclavian Murmur. What is known as the subclavian murmur is heard over the subclavian artery at times. It occurs during both inspiration and expiration. It denotes an inflammatory process resulting in adhesions involving the subclavian artery. This is often described as Da Costa's sign. While it is not a sign of early tuberculosis, yet it is associated with these chronic pleurisies which are usually tuberculous in their nature; hence its presence tells that tuberculosis has, at least, probably been present.

CHAPTER IV.

DIAGNOSIS OF EARLY PULMONARY TUBERCULOSIS.

While it is desirable to expend greater energies and make greater effort to discover a more perfect method of treatment for tuberculosis, yet we must not lose sight of the fact that present methods when applied early will offer health to from 65 to 90 per cent of patients. If medical men in general would expend but a fraction of the energy in learning to diagnose tuberculosis early, that a few scientists are expending in endeavoring to discover a "cure," we would be able to say that the cure for tuberculosis is already at hand.

After perusing the foregoing description of symptoms and signs which are to be found in early tuberculosis, one readily recognizes the need of carefully considering them and conceding to them their proper importance; for it is self-evident that one or even several of them may be present and yet the patient may not be suffering from tuberculosis. Nor is it enough to know that a tuberculous process is present; it is equally necessary to know whether such a process is active or quiescent.

Bacilli not to be Relied on for Diagnosis in Early Tuberculosis.

In early diagnosis here referred to, we cannot depend on finding bacilli in the sputum, because we are dealing with a condition prior to the breaking down of tissue with the elimination of bacilli.

Early diagnosis of pulmonary tuberculosis must be made independent of the microscope. A carefully taken clinical history and a conscientious, intelligent physical examination will usually determine the presence or absence of the disease.

The establishing of a diagnosis in early tuberculosis is often not an easy matter. The examiner should never be in haste to give his opinion, neither should he delay in order to allow more pronounced symptoms to develop. If there is any doubt as to the diagnosis he should not hesitate to re-examine several times until he is either satisfied of the presence or absence of the disease or of his inability to determine it. A negative diagnosis should never be made in the face of suspicious symptoms without a failure on the part of the patient to react to the tuberculin test.

If possible the patient should always be approached by an unbiased mind. Each symptom and each sign found, should be used not to establish some previously arrived-at conclusion, but for its actual worth when combined with others, in making up the picture of the condition present.

Importance of Diagnosis. When can we say with a reasonable certainty that a given patient has or has not tuberculosis, if there is no sputum to examine, or, if being present, the examination proves negative? This is one of the most important questions in medicine; for tuberculosis is the most common fatal disease and one that is likely to present itself to every practitioner of medicine, no matter what line of practice he may follow. It is essential, then, that the picture of early tuberculosis be plainly drawn and that all practitioners of medicine familiarize themselves with it. It requires more evidence to give a negative opinion than to give a positive one; for a negative opinion reassures the patient and causes him to omit caring for himself, while a doubtful or positive opinion will cause the patient, as a rule, to take steps toward improving his condition or bringing about a cure.

Unfortunately, in early tuberculosis there is no sign that is invariably present. There are many signs, however, some of which are always present; and only by carefully correllating these do we arrive at our diagnosis. Nevetheless, when we have taken a careful clinical history of an individual suspected of suffering from early tuberculosis, as a rule, we feel tolerably certain of the presence or absence of the disease. Then when we have made a careful physical examination, we should be ready to stand by our findings. Little doubt should remain. Our diagnosis should be at least as certain as that of any other internal disease. The fact that there is any doubt at all is due largely to a failure upon the part of medical men to familiarize themselves with normal chests, and to appreciate slight variations from the normal.

Candor with Patient. When a diagnosis of tuberculosis has been made the patient should be told the truth at once. The lack of candor on the part of the physician costs thousands of tuberculous patients their lives. Such deceptive expressions as "throat trouble," "bronchial trouble," "weak lungs," "stomach trouble" and "liver trouble" should never be used. They are unscientific. They all mean tuberculosis, and they should not be used to console and comfort the patient when this consolation and comfort means death. Candor on the part of the physician is the only thing that will free him from the responsibility of a death caused by tuberculosis when the disease is discovered early.

Hemoptysis. A history of hemoptysis is always suspicious and unless the patient be suffering from heart disease, cirrhosis of the liver, hemophilia, scurvy, Bright's disease, or unless he has varicose veins of the pharynx or at the root of the tongue, or has spongy gums, the probabilities are that the blood is the result of a tuberculous infection. And even if these diseases are present, we may still find tuberculosis also. It is not only safe, but facts will warrant always considering spitting of blood as due to tuberculosis unless definitely proved to be otherwise.

The expression "throat hemorrhage" has given much comfort to frightened patients, but its use has caused the death of many individuals to be rightly laid at their physician's door. Every hemoptysis in early tuberculosis should cause the patient to seize the opportunity of placing himself under intelligent treatment at a time when his chances of cure are somewhere between sixty-five and ninety-five per cent. Patients, as a rule, however, endeavor to deceive themselves as well as their physicians, so their opinions must not be relied upon.

The amount of blood raised varies. It may be only a very small amount, only a few drops, or it may be quite a copious hemorrhage.

Following a hemorrhage, not infrequently bacilli can be found in the sputum, even though they are absent at other times.

Not only should a recent hemorrhage which cannot be accounted for in any other manner be considered as tuberculous, but a history of hemoptysis in the past, even if the patient has fully regained health and remained healthy, should be regarded with the same suspicion; and, if an individual giving such a history should begin to feel tired, lose his ambition, show slight dyspeptic symptoms and with these have a slight elevation of temperature, active tuberculosis should be suspected.

General Picture of Early Tuberculosis.

The diagnosis of early tuberculosis must depend on little things, yet the picture is quite definite, as a rule.

Those suffering from early tuberculosis usually come to the physician complaining of being "run down." They usually show some of the following symptoms. They are not capable of doing as much work as previously, get tired easily, have lost their ambition, spend restless nights and are not rested in the morning, show signs of irritability, have some dyspeptic symptoms, or complain of frequent "colds." Occasionally they have slight or it may be severe night sweats. These patients are usually treated with tonics and advised to rest for a while; consequently they improve and no diagnosis is made.

They do not always cough or this would call attention to the lungs. Cough is not an important sign in early tuberculosis. It usually comes later when the disease is well established.

Neurasthenic Type.

A type quite often found in young girls, less often in young men and older individuals, is what might be called a neurasthenic type. These patients seem to lack nerve tone. They are unable to accomplish things. The least exertion exhausts them. They entertain, attend a party, visit a friend or do a little shopping and are exhausted. All work seems too hard for them; their interest in things seems to lag, and they are often considered lazy. Such patients lose weight occasionally and are subject to frequent "colds." The thermometer will often show a slight elevation of temperature. Careful examination will often reveal a tuberculous deposit in the apex of one or both lungs where such a history is given, and when this is not found tuberculosis of other organs, as the glands, should be suspected.

Tuberculosis should be remembered as an etiological factor in neurasthenia of the type mentioned above, and the lungs should be carefully examined.

Repeated "Colds." Repeated "colds" with or without some of the above symptoms, are suspicious. These "colds" are not like ordinary attacks of coryza. They are usually of the bronchial type and tend to hang on. Any "cold" (bronchial catarrh) which does not clear up within three or four weeks, calls for a careful examination of the chest.

Sudden Onset. Sometimes after an acute illness such as la grippe, measles, or typhoid fever, tuberculosis sets in with severe symptoms, even in cases where no symptoms suggestive of the trouble were present before the onset of the acute disease. In such cases, as a rule, the fever does not abate, or if it does, it is only for a few days. The patient does not regain his strength. He tires on exertion, and very often has night sweats. In many of these cases the temperature rises several degrees and a destructive process sets in which ends in the destruction of lung tissue and cavity formation. Cough is usually present at an early period, and often the expectoration is quite profuse within a very short time from the apparent onset.

Of course, we are dealing with an old process in all such instances, which has been lighted up by the acute disease.

These cases, however, must not be confused with those advanced cases which are often diagnosed and treated for la grippe and typhoid fever during the time when they are showing temperature and other severe symptoms incident to cavity formation.

Temperature. A rise of temperature is a very valuable sign in early tuberculosis. Should individuals complain of one or more of the above symptoms, they should be required to keep a two hourly chart of their temperature for several days, when a rise of from one-half to one degree, unless it can be satisfactorily explained as being due to other causes, should be looked upon as being very suspicious of tuberculosis, and should call for an examination of the chest. A persistently low temperature is likewise suspicious of the presence of tubercle.

Physical Examination. While the evidence obtained by clinical history makes it possible to suspect the presence of tuberculosis, yet we must rely most on the result of careful physical examination. As a rule, tuberculosis begins at the apex. That portion of the lung lying above the clavicle anteriorly, and the spine of the scapula posteriorly, is the part usually affected. If only one apex is involved, the diagnosis is comparatively easy, for a comparison of the two sides shows the difference in the findings; but where both sides are involved, it is sometimes puzzling.

A slightly high pitched note, with a slight tympanitic quality with perhaps a feeling of resistance to the finger used as a pleximeter is found as an early sign in percussion over an area of infection at an apex.

Auscultation shows rough breathing, perhaps markedly weaker than normal as the earliest symptom. Expiration may or may not be prolonged. Slightly harsh breathing with or without prolonged expiration is commonly found and sometimes cogwheel breathing is noted.

A few fine rales usually elicited upon coughing may or may not be present, while an occasional whine should be considered very suspicious.

If the clinical history is suspicious, and some of these slight variations from the normal are found upon physical examination, unless they can be satisfactorily explained as being due to other causes, they must be considered as pointing strongly toward tuberculosis.

Examination of Sputum. While a carefully obtained clinical history and a painstaking physical examination will, as a rule, determine the presence or absence of tuberculosis before sputum is present, yet there are exceptions to this, and whenever sputum is present, it should be carefully examined, for the detection of bacilli is the unquestioned evidence in making a diagnosis.

At times, there are lesions which cause no definite symptoms, and we can conceive of such an one being situated deep in the lung tissue without being recognizable on physical examination. Such a focus might ulcerate into a bronchus and throw off bacillus-bearing sputum. Here the finding of bacilli would be necessary to establish a diagnosis.

The presence of bacilli in the sputum always shows that lung tissue is being destroyed; consequently, the finding of bacilli is not to be considered as an early diagnosis; but, in a lesion such as I have described, we can see that it would afford perhaps the earliest opportunity of making a diagnosis.

While in my discussion, I have endeavored to urge the making of a diagnosis before the appearance of bacilli in the sputum, yet I deem it wise to give instructions for the examination of sputum in this chapter; and, in order to avoid repetition, I shall discuss that subject fully at this time.

Homogeneous Smear. It is not only important to know that bacilli are present in a given specimen, but the smear should be so made that it will afford a basis of comparison in future examinations. A smear made from a single particle of sputum only shows the presence of bacilli and their form. If the smear, however, is made from ten or twelve small particles of sputum (homogeneous smear) the element of error is largely eliminated and we have a much better basis on which to compare the number of bacilli at the various examinations. While the number of bacilli in a microscopic field gives us no evidence of a prognostic value in one or two examinations and is absolutely worthless when the smear is made from a single particle, yet where the patient is under continued observation and the sputum examination is made with the homogeneous smear by the same examiner at frequent intervals, evidence which is beyond question is offered to the phthisiotherapist who is in the habit of closely comparing his clinical and laboratory findings. This evidence is of the greatest importance if one wishes to carry out the therapy based upon the double etiology of tuberculosis as worked out by Carl Spengler (see page 177)

Staining for Bacilli.

While the staining of sputum for bacilli seems like a simple matter, yet it is one that should be done very carefully because so much weight is laid upon the result of the examination in making a diagnosis.

First the smear is important and should be made as directed above. A common fault is to make the smear too thick. It should be very thin. In fixing the smear too much heat should not be used. In order to avoid this it is well always to hold the cover-glass in the fingers. In staining with carbol fuchsin, *gentle* heat is best for both human and bovine bacilli, and absolutely indispensable for the latter. The fuchsin should never be allowed to boil, for if it does it will cause a precipitation of stain, which will make the examination difficult and make it very difficult to find splitter which are of great importance in diagnosis, see pp. 30–33. It is best to pass the cover-glass through the flame low down until a slight steam arises from the fuchsin. This is sufficient and makes a preparation free from precipitated stain.

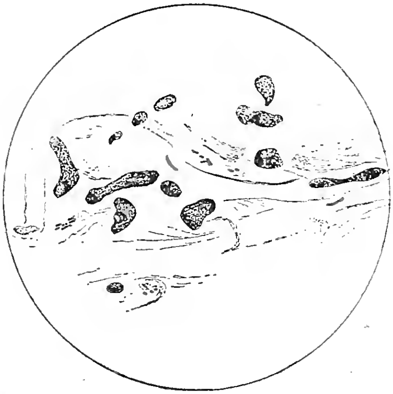
The usual method of staining is as follows:

1. Fix the smear by passing through the flame.
2. Staining with carbol fuchsin, heated slightly for a few seconds. Wash with water.
3. Decolorize with 15 per cent nitric acid. Wash.
4. Contrast stain with methylene blue. Wash.
5. Dry between paper and mount.

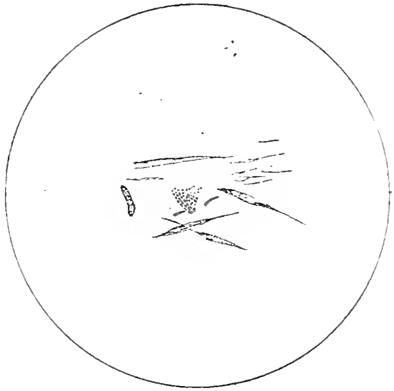
"Splitter," Spores or Sporoids.

For many years it has been taught that tubercle bacilli do not have a spore form; but like many other teachings in the scientific development of a question, this is subject to change.

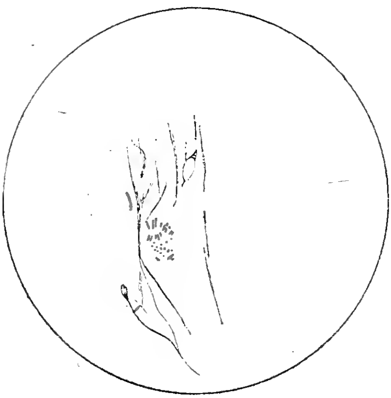
Carl Spengler (Wien Med. Woch., 1902, No. 14, und Zeitschrift f. Hygiene und Infectionskrankheiten, Bd. 49, 1905) observed certain bodies in sputum which stain the same as tubercle bacilli, and which appear as though they might be cross sections of bacilli. These have heretofore been considered to be precipitated stain, which they resemble. He described these under the name "splitter," meaning fragment. His further study has



I



2



3

4

Splitter (Spores, Sporoids,) as seen in microscopic fields. (*Spengler, Zeit f. Hygiene u. Injecktions Krankheiten*).

shown them to partake of the nature of spores. He now considers these bodies as true spores when of the bovine variety and as sporoids when of the human variety. This opinion is based on the fact that those of the bovine type are more resistant than the bacilli themselves while those of the human type are less resistant than the bacilli. Plate I shows these bodies as they appear in the sputum. They sometimes appear as single bodies, but are often found in masses.

These spore forms appear in cultures in greater or less numbers, accordingly as the culture medium is poorly or well suited to the growth of the bacilli. The poorer the culture medium the greater is the tendency to spore form production.

These "splitter" or spore forms may be inoculated on good culture media and made to produce full sized bacilli. They can be easily studied by using the smegma bacillus. By inoculating a culture medium which is rendered unsuitable, say by the addition of a small amount of bichloride of mercury, spore formation is favored. Then by the inoculation of these spore forms on a good bouillon culture medium, and examining from day to day the development of the smegma bacilli may be seen to occur in from one to four or five days. In order to make these young forms take the fuchsin stain it is necessary to alkalinize the smear before staining. For this purpose a very minute quantity of a 1 per cent solution of potassium or sodium hydrate solution should be employed.

Splitter are found most plentifully in patients with good resisting power, because their tissues offer a poor culture medium. In many cases the examiner finds evidences of pulmonary tuberculosis, on physical examination; the patient coughs and expectorates, but repeated examinations reveal no bacilli. Such cases should be examined for splitter. The writer reported several such cases before the American Climatological Association in the year 1906. Spengler has demonstrated splitter very often in the feces in cases of intestinal tuberculosis and in the blood of cases of acute miliary tuberculosis.

The discovery of splitter marks a very decided advance in diagnosis and aids us in understanding many cases of tuberculosis otherwise unintelligible.

Differential Diagnosis of Tuberculosis Caused by Bacilli of the Human and Bovine Types.

Not content at diagnosing the presence of tuberculosis, Carl Spengler has made a careful study of the various types of tubercle bacilli, and now offers us methods by which the bovine and human variety may be differentiated. In as much as his extensive studies of tuberculosis, both in the laboratory and in clinical practice, have demonstrated that the disease caused by the two varieties of bacilli varies and should be treated by different immunizing agents, I deem it necessary to give a description of his work in connection with the chapter on diagnosis.

For a long time it was thought that all tubercle bacilli belong to the same variety. Then it was shown that the human, the bovine and the fowl bacilli differed from each other somewhat. Finally Koch made the startling statement at the British Tuberculosis Congress in 1901, that human and bovine bacilli differ and that the bovine bacilli are not dangerous for the human race.

The cultural differences of bovine and human bacilli have been known for some time, and Theobald Smith has pointed out their difference in form; yet few men have undertaken to differentiate them microscopically. By carefully studying pure cultures and modifying methods of staining, Spengler has been able to differentiate the two varieties not only in pure culture but in mixed culture, also in the sputum and feces of tuberculous patients. He has further studied the two varieties and found that they differ in many particulars.

Tuberculosis, according to his studies, has a double etiology, being caused by both the human and bovine bacilli. In most cases both are present (the human predominating) and their action is antagonistic, causing a chronic course. Those cases where only one variety is found are the most virulent and most difficult to treat.

His opinion is based on a mass of observations both from the laboratory and from clinical experience. He has also founded a vaccine therapy (see page 177) upon his observations in which the therapeutic results corroborate the laboratory findings. The basis of the therapy is an accurate diagnosis as to which variety of bacilli is causing the disease; or which variety preponderates and causes the most pronounced symptoms.

A study of 112 cases of tuberculosis made by Spengler (Wiener Klin. Rundschau, No. 33, 1906) showed the following:

Seventy-eight patients, or 60.8 per cent, showed a symbiotic working of human and bovine bacilli. All were cases of a chronic nature.

Twenty-two patients, or 19.6 per cent, had exclusively human bacilli. All of these cases showed fever and offered a bad prognosis.

Six patients, or 5.3 per cent, had almost exclusively bovine bacilli. All of these patients also suffered from fever but with better prognosis than those infected with the human bacilli alone.

Twenty-two patients, or 14.3 per cent, showed only splitter but no bacilli; eight cases had a mixed infection of human tubercle bacilli and bovine splitter; seven cases had only human tubercle bacilli splitter and only one case had bovine splitter exclusively.

According to Spengler, the two varieties of bacilli differ in the following manner.

1. Culturally. They do not show the same growth under the same conditions.

2. Methods of staining. They do not behave alike under similar methods of staining. The bovine bacillus has a thicker envelope than the human bacillus, but when stained by the ordinary method (Ziehl) this envelope is injured by the acid and the heat. The envelope is a wax and has a low melting point. In order to preserve the envelope and show the bacillus in its normal size acid must be used very sparingly and the preparation must be made with little heat.

3. Sporulation. Bovine bacilli, by special methods of staining, may be seen to contain spores within them. Human bacilli do not.

4. Appearance. The envelope of the human bacillus is thin in comparison with that of the bovine and does not show the same sharp outline as does the latter.

5. Agglutination. In pure culture, they agglutinate differently. What will agglutinate one will not the other, showing that they produce different antibodies. The serum of the human being, when affected by tuberculosis, usually agglutinates both, speaking for the double etiology.

6. In their toxins. A patient infected principally with bovine bacilli, as is shown by special methods of staining, is most sensitive to the toxins from the bovine bacillus; and, one infected principally with bacilli of human origin is most sensitive to toxins from the human bacillus.

7. In their localization in the body. Human bacilli demand more oxygen than bovine, hence are found nearer to the atmosphere in the tissues. They infect the lungs principally, while tuberculosis of the intestines, kidneys, bladder and glands is more apt to be by the bovine bacilli. When the larynx is infected the deep infiltrations are most apt to be by bovine bacilli, while the superficial ulcerations are caused by the human bacilli.

Stain for Differentiating Human and Bovine Bacilli.

The following method of staining as devised by Carl Spengler (Deutschen Med. Woch., 1907, No. 9) differentiates the two varieties in the same specimen and is an improvement over his cold method of staining (Deutschen Med. Woch., 1905, No. 31). The envelope of the bovine bacillus, which is much thicker than that of the human bacillus, is preserved and stained, hence the bovine bacillus appears much larger and thicker than the human bacillus. It is an excellent method for sputum and feces. He names it Hüllenmethode (method of staining the envelope). (See Figs. 4 and 5.)

1. The smear, made as usual, should be alkalinized by a very small amount of a 1 per cent sodium or potassium hydrate solution (it is sufficient to dip the eoese into the solution and rub it over the slide thoroughly), and then dried by warming it most sparingly in order not to melt the waxy envelope of the bovine bacillus which has a low melting point.

2. Cover the preparation with Löffler's methylene blue, to give a ground color to the envelope of the bovine bacillus. (Does not color envelope

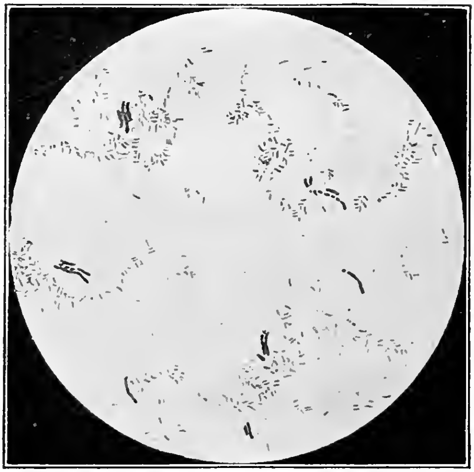


Fig. 4.—Artificial mixture of pure cultures of human and bovine bacilli stained by Spengler's "Hüllenmethode," after being first stained by acid-fuchsin (2%). The bacilli of the bovine type appear much larger, thicker and longer, than those of the human type.

Fig. 5.—Natural mixture of bacilli of human and bovine types, found in sputum. Stained by Spengler's "Hüllenmethode," after being first stained by acid-fuchsin (2%). Bacilli of human type appear small; those of bovine type, large.

of human bacillus.) Wash with water. (Bovine bacilli may be stained while alive by using potassium hydrate and methylene blue without fixing in the flame, in fact, this method is an excellent one.)

3. Stain with carbol fuchsin and warm very sparingly low down in the flame until it steams lightly. This is best accomplished by passing the slide slowly through the flame. Wash with water. Heating is to be carefully avoided in order to preserve the envelope and to avoid a precipitation of stain. The fuchsin should never be allowed to bubble.

4. Counterstaining with methylene blue to which is slowly added one or two drops of a 15 per cent solution of nitric acid. This is allowed to remain on only a few seconds when it is washed off with water and the slide is dried between folds of rice paper and warmed only slightly high above the flame.

Picric Acid Stain for Tubercle Bacilli.

In staining bovine bacilli, in order to demonstrate the envelope, a culture which has not been allowed to dry must be used, for the envelope is very easily injured by drying, and in as much as the recognition of the bovine type depends upon the staining of the envelope, intact, the importance of this is readily seen.

The human organism, in its attempt to overcome a tuberculous infection, produces certain changes in the bacilli (both human and bovine) themselves. Among other changes is an injury of the envelope so that the bacilli are no longer stained by the ordinary Ziehl method, yet they are present and capable of development upon the proper media, although their resistance is much lowered. Such bacilli may still be stained by the use of picric acid (Spengler, *ibid*). If any one doubts this let him try it by making two homogeneous smears of the same samples of sputum and then count the bacilli. Especially is the difference to be noted in cases that are nearing a cure and thus showing resistance to the bacilli. We have corroborated the work of Spengler in his staining methods in our own laboratory during the past year and can recommend them as being of the greatest value. Another test of the importance of the picric acid method may be made by taking a pure culture of either human or bovine bacilli and mixing it with ether and alcohol and shaking it so as to *partially* destroy the envelope. (Too much shaking will entirely destroy the envelope, in which case the human bacilli will not stain. The bovine may be stained even then.) A comparison of specimens stained by the Ziehl and picric acid methods will show many more bacilli in the latter.

The directions for the picric acid staining are as follows:

1. Staining with carbol fuchsin, warming the preparation sparingly as in the Hüllenmethode just described. Without washing add:

2. Picric acid-alcohol for 2–3 seconds; then add three or four drops of a

15 per cent solution of nitric acid and again picric acid-alcohol for 5–10 seconds until the sputum smear is of a light yellow color; wash with distilled water and dry. (The picric acid-alcohol solution is made by adding equal parts of a saturated watery solution of picric acid and absolute alcohol or equal parts of Esbach's reagent and absolute alcohol.)

3. Wash with 60 per cent alcohol immediately after the staining with picric acid-alcohol.

4. Wash a few seconds with 15 per cent nitric acid until the sputum smear shows only a light yellow color.

5. Wash with alcohol, 60–70 per cent.

6. Contrast stain with picric acid-alcohol until the smear is well colored, wash with distilled water, dry and mount.

Particles of Mucus Taken From Larynx for Examination.

Recently Blume (Berlin. Klin. Wochenschrift, No. 29, 1906) calls attention to the fact that the bacteriological diagnosis can be made earlier than we are wont by wiping off particles of mucus from the larynx in patients who do not expectorate and subjecting the same to microscopical examination. While we cannot admit that even such an examination can establish the diagnosis of tuberculosis as early as can be done by physical examination, nevertheless we would recommend it in doubtful cases.

Spengler's Digestion Method.

When the sputum contains very few bacilli they may be overlooked by the usual method of examination. Spengler, (Zeits. f. Hyg., 1894, Vol. XVIII, part 2) suggests the use of pancreatic digestion or peptic digestion with acid or papoid digestion. By this means, the mucus is digested and the bacilli set free and allowed to settle to the bottom of the test tube or sediment glass. The sputum must be allowed to stand in the incubator for twenty-four or forty-eight hours when this method is used.

Ilkewitsch's Method of Centrifugation.

Another method is to dilute the sputum with twenty times its volume of water, after the method of Ilkewitsch (Baumgarten's Jahresbericht, 1892, Vol. VIII, page 664). After stirring for some time, acetic acid is used to precipitate the mucin and nucleo albumen, and then it is centrifuged.

Röntgen Rays.

As yet the Röntgen rays have not been any material assistance in the diagnosis of early tuberculosis. When the area is sufficiently large to cast a shadow, it is far beyond the point where it should be diagnosed by other methods.

Tuberculin Test.

Where the clinical history and physical examination do not make us certain of our diagnosis, and where there is no sputum, or, being present, it proves negative on examination, the diagnosis may be established with a very small percentage of error by the employment of the tuberculin test.

Fears of Tuberculin.

A great many men fear to use the tuberculin test lest they do the patient harm. Can tuberculin do harm? Most assuredly, the same as strychnia, morphia, chloroform and other remedies in common use by the physician. To practice medicine presupposes a certain amount of intelligence and care, and this should be used in the application of all remedial measures.

If tuberculin is used intelligently, it can do no more harm than other potent remedies. It must be remembered that human beings are not all alike. Certain individuals show idiosyncrasies to certain remedies and unfortunately it is not possible to know this without trial; and certain coincidences happen in medicine, as elsewhere, that are sometimes interpreted as cause and effect.

The greatest fear of tuberculin is perhaps based on the idea given out by Virchow when it was first put upon trial in 1890 and 1891, that it would excite activity in latent areas and that there was danger of a general infection following its use. Some fear has been engendered by experiences more recent where such unfortunate results seemed to have occurred.

This fear of tuberculin deserves more than passing notice, for we must grant that those who oppose it and those who use it are equally honest. If tuberculin is a remedy which is endangering the lives of patients more than other remedies, it should not be employed; on the other hand, if it is of great service to the afflicted, but unjustly feared, then this prejudice should be removed.

Virchow's Opinion.

In the first place, Virchow's opinion was based upon the administration of poisonous doses of tuberculin. He did not describe the effects of therapeutic doses of tuberculin, but that of poisonous doses. The patients who were killed by tuberculin at that time were killed by poisonous doses, frequently repeated. It would be as just to condemn strychnia from the convulsion caused by it in a case of death by strychnia poisoning.

The accepted method of administering tuberculin either for the tuberculin test or for therapeutic use presupposes a knowledge of the fact that a very small dose produces no noticeable effect whatever, but simply acts as a stimulant to the body cells, causing them to form defensive bodies. A dose somewhat larger causes a slight hyperemia in tuberculous foci present, while a large dose may cause the phenomena of inflammation and, if repeated at frequent intervals, might cause retrograde changes. Knowing this, the administration is begun with small doses and serious symptoms are avoided.

Can Tuberculin Set up Activity in Latent Foci?

Can tuberculin set up activity in latent foci? Most assuredly it can, if used improperly, just as strychnia when used improperly may cause convulsions, and morphia, stupor and death. But tuberculin when used properly is shorn of its power to do harm.

Can Tuberculin Cause Acute Miliary Tuberculosis?

I can conceive of certain conditions being present so that an overstimulation from a severe tuberculin reaction might cause acute miliary tuberculosis, but such conditions are very rare and would be exceptionally rare where it is necessary to use the tuberculin test in order to establish a diagnosis.

Acute miliary tuberculosis must be caused by the escape of a great number of bacilli into the lymph or blood stream at one time. Now it is possible to find cheesy tubercles in the walls of vessels or the thoracic duct which are just ready to break down. In such a case, the overstimulation from a severe tuberculin reaction might hasten the process and cause it to break sooner than it otherwise would. Such cases must be very rare, however, when we consider how few cases of acute miliary tuberculosis following the injection of tuberculin have been mentioned in the literature.

There is an instance, oft quoted, from the practice of a noted New York consultant which occurred in the early nineties, the salient points of which as they have come to me are as follows: The patient went to this consultant for an examination of the chest, stating that it was very important that he know whether he was suffering from tuberculosis or not. After examination, the consultant was in doubt. The patient wished to have a test dose of tuberculin given, but the consultant refused. He went to another consultant, who also refused to use tuberculin. Finally, he went to a third, who administered the tuberculin test, after which the patient developed acute miliary tuberculosis and died.

To show that this might have been a coincidence, I quote a case cited by Aufrecht, which occurred in his own practice. (Pathologie und Therapie der Lungenschwindsucht, 1905.) The patient had been under observation from 1889 to 1891, and had suspicious signs at one apex, yet the diagnosis could not be established. It was decided to use the tuberculin test; but while the tuberculin was being procured, the patient was taken with acute miliary tuberculosis in which the infection extended to the meninges and the patient died in one week. The author remarks that he is very glad that he had not given the patient a dose of tuberculin, for he would then have attributed to it the cause of death. For another coincidence, where a fatal hemorrhage occurred while preparing a patient for a dose of streptolytic serum, I would refer my readers to page 145.

Thousands of tests have been made for tuberculosis with tuberculin. Thousands of patients have thus discovered that they had tuberculosis at a time when their chances of getting well were excellent. Of this number, hundreds are living today who, without it, would have waited for graver symptoms and a diagnosis made too late. If we recognize the greatest good for the greatest number, I would venture the assertion that the tuberculin test has saved scores and scores of lives for every mishap attributed to it.

We can at least offer as much excuse for its use as can be offered by the surgeon for an exploratory incision in doubtful cases of abdominal disease, even if we grant that all the dangers assigned to it are real.

In exploratory incision, we have the danger from the anesthetic, the danger from the operation and the uncertainty of being able to render aid when the condition is known; yet, this is recognized and sanctioned by practically all practitioners.

In the tuberculin test we have a supposed danger, in which much of the evidence is based upon unreliable observation, some of it upon the improper use of the remedy; but we also have a possibility of affording relief in nearly all instances and of establishing a cure in a very large majority of instances when the diagnosis shall have been made.

Reaction. The diagnostic value of tuberculin is based on what is known as a reaction. A healthy individual may receive injections of tuberculin amounting to 10 milligrammes without showing any symptoms whatever beyond the soreness at the point of injection. A person afflicted with tuberculosis, however, especially one in the early stages, will show a reaction. This reaction manifests itself both locally and generally. Either the local or general reaction is sufficient to establish a diagnosis.

The reaction occurs usually some time between eight and twenty hours after the injection, although it may occur earlier, even as early as four hours, or later, even as late as three days. These very early and very late reactions are not very common, yet it is important to know of them.

Following an injection of tuberculin, certain very definite phenomena occur. If the dose be very small, no effect is noted, If a little larger, a hyperemia, and, if still larger, a congestion occurs in and about the areas of tuberculous infection.

Local Reaction. This is what is known as the local reaction. If the areas are visible, such as are found in the larynx and occasionally in the pharynx, this hyperemia and congestion can be easily detected. In the lung it manifests itself by the same phenomena as an inflammation, although the symptoms are confined to the area of infection. Thus a comparison of the findings in the suspected areas before and after a tuberculin reaction shows an increase in all the signs during the reaction. The findings on auscultation are magnified and resemble a catarrhal condition of greater degree. Fine rales may appear where none were to be found previously or their number may increase.

In order to be able to detect a local reaction, the findings on examination should be charted carefully both before and during the reaction.

It is possible to have a local reaction without a general reaction. If there be any doubt on this point, let those who question it watch a tuberculous larynx and see how often the reaction shows there when there are no constitutional symptoms. If a man is expert with his stethoscope, he will make less and less use of the general reaction in giving the tuberculin test for suspected pulmonary tuberculosis, but rely on the local reaction instead. In this way, there can certainly be no objection to the use of the test. To be able to use the test in this manner, however, presupposes a knowledge of the careful use of the stethoscope.

General Reaction.

Besides the local reaction there is what is known as a general reaction, or systemic reaction. A few hours after the test dose is given, if the dose is small, the patient begins to feel a little nervous, or tired, and perhaps has a heavy feeling about the legs. With this, there may be a slight rise of temperature of a fraction of a degree and and an increase of the pulse-rate, or the temperature and pulse may remain undisturbed. A person who is acquainted with the use of tuberculin will detect these slight symptoms as belonging to a general tuberculin reaction, just as much as the more pronounced symptoms usually described.

If the dose is larger, this tired feeling and heaviness of the limbs becomes a true ache, which extends to the back and head and the patient feels as though he were taking la grippe. With this, the temperature usually rises one or two degrees according to the severity of the reaction, and the patient may have a cough where none was present before or, if previously present, it may be increased. Figure 1, page 10, illustrates a tuberculin reaction where the temperature went unusually high. This reaction occurred after a dose of 3 milligrammes. Two days previously the patient had been given one milligramme with no effect.

If the dose be still larger, nausea or even vomiting may take place; a chill may precede the rise of temperature, which may reach 103 or 104 degrees and all of the symptoms described above may be exaggerated.

Formerly, the only tuberculin reaction which physicians recognized consisted in a rise of temperature of at least two degrees Fahrenheit above that which the patient was running regularly, accompanied by the other general symptoms previously mentioned; today, most men conversant with the use of tuberculin require only one degree of rise and those who are most experienced in its use insist on no specific rise of temperature, but accept any symptom or group of symptoms which are unmistakably due to it, and consider a local reaction as of greater diagnostic importance than a general reaction.

The symptoms of both local and general reaction usually pass off in from a few to twenty-four or thirty-six hours.

When Should the Test Dose be Given?

In as much as the reaction usually shows itself in from eight to twenty hours after the test dose has been given, it is best to give the dose at bed-time. I am accustomed to giving it at about eight or nine o'clock, then requiring the patient to begin taking his temperature about six the next morning. Examination of the chest for the local reaction should begin about the same time and should be repeated at intervals of three or four hours until the presence or absence of such local reaction is established.

Dosage for Tuberculin Test.

With an increased knowledge of tuberculin and its physiological action, the method of giving the test has changed somewhat. Koch's old tuberculin is nearly always used for making the test, although it can be made with any of the products of the bacillus.

It is always well to begin with a very small dose. Knowing that some people are very sensitive, it is wise to begin with a dose sufficiently small as to be incapable of doing harm. Only on very, very rare occasions will a patient show any reaction at all to so small a dose as $\frac{1}{10}$ milligramme of Koch's old tuberculin. If $\frac{1}{10}$ milligramme shows no reaction, the dosage should be increased; 1, 3, 5, 7, and 10 milligrammes being used in succession, one day at least intervening between the smaller doses and one or two days intervening between the larger doses. It is rare that I have been obliged to exceed 7 milligrammes where tuberculosis was present. It has been suggested that the use of $\frac{1}{10}$ milligramme will make the patient sensitive, and facilitate the reaction, if a pause of several days is allowed to elapse before the second dose is given. In such case the reaction is obtained with a small dose, 3 milligrammes rarely being exceeded.

This gradual method is to be recommended in preference to the single dose method that prevailed formerly, which consisted in the injection of one dose of either 5 or 10 milligrammes. This method was apt to be accompanied by quite severe reactions at times. Where the gradual increase in dosage is used, a violent reaction can nearly always be avoided.

Is the Test Reliable?

Is the tuberculin test reliable as a diagnostic agent? It has been reported that other diseases will react to tuberculin, especially syphilis, and also that some cases of tuberculosis will not react. These might be valid objections if they proved true in a large percentage of cases. Regarding syphilitics, we must remember that they may also be tuberculous. The fact that a patient shows a general reaction to tuberculin is no sign that he has pulmonary tuberculosis. The disease may be in the glands, bones, or elsewhere, but, if a local reaction is detected in the lung, then the proof is positive. When we remember how prevalent tuberculosis is, as shown by post-mortem records, we may readily see that it would not be at all unlikely for syphilitics to also have tuberculosis. We might conclude that the lowered vitality caused by syphilitic infection started activity in a tuberculous lesion that was previously latent and caused it to react more readily.

That some patients who are suffering from tuberculosis will not react, is well known. Patients who do not react, however, are usually those in whom the disease is advanced. In these the system is already immunized to a greater or less extent to the toxins found in tuberculin, and a much larger dose would be required to produce a reaction than we are accustomed to use in administering the test. Failure on the part of these patients to react is no argument against the specificity of tuberculin for, if a sufficiently large dose were given to overcome the immunity which has been attained, all these patients who have tuberculous lesions would probably react. In such cases, however, a tuberculin test is rarely necessary, for the physical signs are apt to be sufficiently pronounced to establish the diagnosis, but, if necessary, we should employ larger doses than we are wont in ordinary cases. In determining dosage, it is safe to assume that those patients in whom the symptoms and signs are most vague are apt to react to much smaller doses than those in whom the symptoms are more marked, because their systems have not been immunized by a pouring out of any considerable amount of bacillary toxins from the diseased areas.

There is also a possibility, where the gradual method is employed, o each previous dose conferring an immunity which prevents the next from causing a reaction; so, while it is safer than the old method of employing one large dose, yet it will occasionally fail to show a general reaction where the other would. Here the local reaction, however, comes to the rescue and should be looked for.

According to Spengler's view of the double etiology of tuberculosis, we should not expect that small percentage of patients infected principally by bacilli of the bovine type to react to human tuberculin administered in minute doses.

How to Give Tuberculin Test.

A tuberculin test should not be given unless the patient is under the control of the physician. He should be put to rest, not necessarily to bed, but he should be kept quiet. An institution is an ideal place for administering a tuberculin test. For two days the temperature should be taken by an accurate thermometer and in a proper manner as mentioned in the discussion of temperature on page 10.

The dose should be given preferably at night, about eight or nine o'clock; then the temperature chart should be carefully kept, beginning in the early morning and continuing until the test is completed, whether it be a single dose or whether several be required. The test should be given with the same care as any other hypodermic injection.

Site of Injection.

The injection may be given in any part of the body where there are thick muscles, such as the upper arm, interscapular region, loins or muscles of the leg. I usually use the arm. The pain of injection is less, if it is given deep into the muscle and is very slight if the needle is inserted quickly.

Contra-indications.

If it is found that the temperature is above 100 degrees Fahrenheit, the test should not be given. The diagnosis should be made otherwise or we should endeavor to reduce the temperature by rest and such appropriate measures as are suggested under treatment of febrile cases.

If any acute complications are present the test should not be given until they have subsided.

What Preparation Should be Used?

A tuberculin test can be made by the employment of any of the various products of the bacilli, such as Old Tuberculin, T. R., Watery Extract, Purified Tuberculin, Bovine Tuberculin, etc. But when we speak of giving the tuberculin test, it is generally understood that we mean to employ the old tuberculin of Koch, and the dosage here given is in terms of this preparation.

It is better to employ a product made in some good laboratory. The dose used for the injection should be made up fresh at the time of the injection. If the physician makes his own dilutions, he should employ normal salt solution for the diluent. If he makes a 1 per cent solution of the original preparation then 1 cubic centimeter equals 10 milligrammes of tuberculin.

Who Shall Administer the Tuberculin Test?

Shall the tuberculin test be given by physicians indiscriminately? This is a very important question to consider. It would be best if men who intend to administer tuberculin either for diagnostic or therapeutic purposes should first learn from some man who has had experience in its administration. Certainly no man has any right to use tuberculin who does not make a careful study of it and its action. Any man, who has intelligence enough to administer other powerful remedies, should be able to give the tuberculin test, yet it must not be given carelessly or ignorantly. Tuberculin in the hands of an incompetent physician would be just as dangerous as a knife in the hands of an incompetent surgeon.

Tuberculin Test as Proof of Cure.

When patients are treated by ordinary hygienic methods, the tuberculin test is a safe and reliable proof of cure. If at the end of treatment the physician wishes to know whether or not his patient is cured, he can decide by the injection of tuberculin the same as though he were giving a tuberculin test at the beginning of treatment.

When the patient has been treated by the various products made from the bacillus, such as T. R., Bacillus Emulsion, Watery Extract and P. T. O., the tuberculin test is not a reliable proof of cure; for one of these preparations will produce an immunity on the part of the organism against all of the other bacillary products. Such an immunity will last for some time. At least six months should elapse before the test is reliable.

Tuberculin Diagnosis in Infancy and Early Childhood.

Pirquet, of Vienna, has devised a method for administering the tuberculin test to children in the earliest years of life. The method is very simple and attended with almost no pain. His method is as follows: First the skin of the arm is disinfected with ether, then two drops of the following solution

(Old Tuberculin (Koch) 1.0; 5 per cent carbolic acid solution 1.0; normal salt solution 2.0) are dropped on the skin at points about two inches apart; then with a small lancet, with cutting edge on the end and not very sharp (not unlike a small screw driver used by watchmakers) he makes pressure on the skin under the drop of lymph and turns the instrument a few times, causing a slight abrasion and at the same time inoculating the wound; the instrument is then cleaned of lymph and a third abrasion between these two is made for control.

The diagnosis depends upon a local reaction. If the child is suffering from tuberculosis, after a few hours, usually twenty-four, a small papular area of redness appears around the site of the inoculation, while the site of the control shows only the slight reaction due to the trauma. If tuberculosis is not present the site of the inoculation like that of the control shows only the traumatic congestion. The size of the papule is commensurate with the intensity of the reaction. There is no temperature reaction accompanying, consequently the test can be used in fever cases and it can be used without causing any constitutional disturbance on the part of the child.

The test is especially trustworthy in the first two or three years of life, but not so certain in children of ten and twelve years and thereafter. It is not so trustworthy in far advanced processes as in early cases for the same reason as mentioned on page 44. Pirquet has also found that patients who are very cachectic do not react so surely as do those who are not. In an experience of over seven hundred cases, many of whom have come to post-mortem, the reliability of the test has been very satisfactory.

Calmette (Presse Médicale, June 19, July 13, 1907) and Wolff-Eisner (Ber. Klin. Woch., June 3, 1907) have shown that tuberculin may be administered as a diagnostic agent by dropping it into the conjunctival sac.

Ophthalmo-tuberculin Test.

At first one drop of a one per cent solution is used. If no reaction occurs two drops may be employed after a few days have intervened. The test depends upon the fact that the body cells of a tuberculous individual are sensitized to the toxins of the tubercle bacillus, so that when the diagnostic agent comes in contact with the cells a hyperemic reaction results. When the test is positive the conjunctiva, and in some cases the adjacent mucous membrane, becomes temporarily inflamed, the degree and duration being dependent upon the severity of the reaction. When tuberculosis is absent the conjunctiva shows no reaction. No harm can result provided that weak dilutions are employed and the eye is healthy. The test offers itself as a simpler method of making a diagnosis of early tuberculosis than the subcutaneous method, but needs further confirmation.

CHAPTER V.

SYMPTOMS AND SIGNS OF ADVANCED PULMONARY TUBERCULOSIS AND ITS COMPLICATIONS.

It might be assumed that anyone who can make a diagnosis of early pulmonary tuberculosis can also make a diagnosis when the disease is advanced; yet, there are many conditions and complications present in the advanced disease that should be recognized, which produce entirely different symptoms from those of the early disease. In as much as our purpose in diagnosis is three-fold, first, to know the condition present, second, to give as accurate a prognosis as possible, and third, to apply the proper remedies, we must do more than determine that tuberculosis is present. We must endeavor to determine the extent of the disease, the effect it has had upon the lungs and general system, and then determine what remedies can be best applied to correct the pathological conditions present. Hence, the more accurate our skill in diagnosis and the more carefully we determine the exact condition present, the more valuable will be our opinion of the prognosis and treatment of a given case.

The family history in advanced pulmonary tuberculosis does not differ from that of early tuberculosis, so the reader may refer to that section for a consideration of this subject (see p. 7).

CLINICAL HISTORY IN ADVANCED PULMONARY TUBERCULOSIS.

The same general symptoms obtain as were mentioned (pp. 8–12) while considering the diagnosis of early tuberculosis, but they are apt to be more pronounced. The same tired feeling, the same inability to do customary tasks, the same loss of ambition, the failure to secure rest by a night's sleep, the same "colds" and bronchial catarrhs, the same nervousness, the same digestive disturbances with loss of more or less weight, the night sweats, the disturbances of circulation, the vaso-motor disturbances as shown in cold hands and feet or chilly sensations, are all present in greater or less degree in advanced pulmonary tuberculosis; and some of these are nearly always elicited by inquiry into the clinical history of those suffering from this disease.

Cough. Cough is usually an important symptom in advanced pulmonary tuberculosis. With the appearance of early tuberculosis and its accompanying inflammation, there begins a slight hack. As mentioned before, at first this is scarcely noticeable; then it increases. It is accompanied by expectoration, at first usually scant; later profuse.

There is nothing characteristic in the cough of tuberculosis by which it may be distinguished from other coughs.

Many patients with extensive disease cough very little, and there have been cases reported that died of tuberculosis and yet were never known to have coughed. However, these are the exceptions.

Much of the cough present in tuberculosis, as we usually find it, is unnecessary. It is due to such mistakes as wrong methods of living, overexertion and the habit of coughing, and soon disappears when patients are properly instructed and their lives carefully regulated as we find them in a properly conducted sanatorium. Catarrh of the oro- and naso-pharynx is a frequent cause of cough. Properly managed patients suffering from advanced disease will usually cough considerably in the mornings until they have expelled the secretion which has accumulated over night, then they may scarcely cough at all during the rest of the day. They usually cough again at night upon retiring. Of course, if there is some acute process present, such as a pneumonic condition or pleurisy, the cough will most likely be increased. When the disease is accompanied by extensive bronchitis, coughing is often very troublesome.

Sputum. As there is no cough characteristic of tuberculosis, so is there no characteristic sputum. At first, the sputum is mucoid in character; but, as ulceration supervenes and the catarrhal symptoms become more pronounced, it becomes muco-purulent and purulent. Sometimes it is almost pure pus. When it comes from a cavity, it is apt to come in balls (so-called nummular sputum) and if expectorated in water may sink to the bottom. Occasionally it is bloody. If it contains only flecks of blood, this is most likely due to a congestion. If the congestion be greater, it may be well mixed with blood. Sometimes the pus from a cavity is mixed with a bloody discharge which appears much like the discharge from an ulcer. This is often due to ruptured granulations. Following hemorrhages, the sputum may be blood tinged for several days.

The sputum frequently has a very bad odor, especially when it comes from cavities where it has remained for some time.

The amount of sputum varies with the accompanying catarrhal complications and the number and condition of the cavities present. When the disease is running a rapid course with the rapid destruction of tissue, the sputum is abundant and very purulent. When catarrhal conditions predominate, the sputum may be more abundant but it is less purulent. In patients suffering from diabetes the sputum is often scant, owing to the loss of fluids through the urine.

The positive recognition of tuberculous sputum depends upon the presence of tubercle bacilli. The finding of elastic fibers is also very suggestive, if all other conditions which cause destruction of lung tissue are eliminated.

In acute miliary tuberculosis, the most virulent of all types of the disease, the sputum may contain neither bacilli nor elastic fibers. There are also cases of chronic tuberculosis which have existed for years and have gone on to the death of the patient, which did not show bacilli until a short time before the end.

Sputum in tuberculosis often shows many other morphological elements. Streptococci, staphylococci, pneumococci, influenza-bacilli, diphtheria or pseudo-diphtheria bacilli and many other micro-organisms have been found. The presence of these organisms in the sputum does not necessarily mean that they are causative factors in the pathological processes present. The effect which they have upon the course of the disease will have to be determined hy future research.

Digestive Disturbances.

The digestive disturbances in advanced tuberculosis deserve most careful attention. That they should be pronounced is to be expected. Patients suffering from advanced tuberculosis are victims of a toxemia which destroys the appetite and interferes with digestion. Where the temperature is high, this is often especially severe. The constant irritation of the pneumogastric by the disease in the lung cannot help but effect the nerve supply of the stomach. Pulmonary tuberculosis must be considered as a chronic pneumonic process. It is also accompanied by catarrhal conditions of the mucous membrane of the air passages and usually in advanced conditions with more or less emphysema. The pulmonary circulation is thus severely embarrassed. The heart often shows the overstrain to which it is subjected. As a result, there is to a greater or less degree a damming back of blood in the internal organs which, among other symptoms, causes a disturbance of the digestive function. Another way in which the digestive tract suffers is through the general loss of muscular tone due to muscle waste.

In the earlier stages of the disease, we find variable appetites; sometimes depressed, sometimes entirely wanting and at other times voracious. Digestion is usually somewhat impaired, the condition increasing as the case progresses. All forms of stomach disorders are found, such as hyperchlorhydria, hypochlorhydria, atony, dilatation, displacements and the various neuroses. Tuberculosis offers a complete clinic in diseases of the digestive system, and upon the success in managing them depends, to quite a great extent, the outcome of the disease.

Circulatory System.

An examination should never be considered finished in advanced tuberculosis until the condition of the circulatory system has been carefully determined, for one of the points upon which the prognosis must be based is the condition of the heart.

In order to fully appreciate the enormous strain that is put upon the heart, we must consider, first, that chronic tuberculosis of the lungs is a chronic pneumonic process; second, that as the process advances, it destroys the blood vessels and also destroys the normal lung tissue and substitutes for it either cavities or cicatricial tissue; third, with the advance of the disease, contraction takes place in one portion of the lung while other portions enlarge, becoming emphysematous, to establish compensation; and, fourth, the advanced disease is accompanied by more or less catarrhal inflammation of the air passages.

All of these conditions tend to embarrass the right heart, thus damming back the blood in the systemic circulation as well.

The heart often learns to accommodate itself to the enormous strain that is thrown upon it because the changes come gradually, taking months and years to effect them. On the other hand, if the same amount of resistance were opposed to the heart suddenly, by an acute process, the result could be none other than disastrous.

The rapidity and efficiency of the heart's action, then, must always receive careful attention in giving a prognosis.

The pulse in a non-febrile case, which persistently remains above 90 and which does not drop after a few weeks' rest in bed must count against the patient's chances of recovery, and the more so, the weaker the impulse.

As a rule, the pulse is of low tension. This shows itself even in early tuberculosis.

The pulmonary second sound is usually accentuated when the heart is standing up well under the strain thrown upon it.

When a cavity is near the region of the heart valves, the sounds sometimes take on a metallic ring.

When the rhythm of the heart sounds change and the sounds approach each other in intensity (the so-called fetal heart) the prognosis is bad.

Nervous System.

In advanced tuberculosis, symptoms on the part of the nervous system are varied and of great interest. The toxins from the tubercle bacillus, or those from other complicating micro-organisms, or those absorbed from necrotic tissue all act deleteriously upon the nervous system.

The tuberculous patient is usually an optomist. His sanguinity is proverbial. Yet he is not always so. We meet not infrequently instances of pessimism and hopelessness.

The tuberculous patient, as a rule, lapses into a condition of dependence. He is apt to become selfish and regard his own desires and wishes as paramount to all others. He is also likely to lose some of his natural strength of will and to be easily influenced, especially if the force leads in the direction to which he is not unalterably opposed.

Many symptoms on the part of the nervous system are to be found. Such conditions as neurasthenia, hysteria, hyperesthesia, hemihyperesthesia, hyperidrosis, hemihyperidrosis, and neuritis are not uncommon. The hectic flush has long been recognized and the dilatation of the pupils (see p. 17) has more recently been studied.

Colds and Bronchial Catarrhs.

The course of tuberculosis is an uneven one. Patients feel well for a while and then ill. When they are not feeling so well, they are apt to think they have caught cold. They cough more, feel an uneasiness in the chest, may expectorate more freely, may have an elevation of temperature and, as a rule, suffer a loss of strength. These symptoms are, as a rule, coincident with a slight activity in the lung process. A frequent repetition of these so-called colds is very characteristic; and a history of repeated colds on the part of an individual or of colds which do not get well within a reasonable time should always call attention to the chest.

Hoarseness.

Hoarseness is a frequent symptom in tuberculosis. It may come on very early in the disease and it may appear every now and then during the course. It always calls for an examination of the larynx. Tuberculous patients are subjected to all non-tuberculous laryngeal affections. From frequent cough, vocal cords often show thickening. Knowing that more than fifty per cent of advanced cases of pulmonary tuberculosis show some tuberculous involvement of the larynx, tuberculous laryngitis must always be thought of.

Pain.

Many patients suffer very little, yet most of them will experience some pain during the course of the disease, and some suffer intensely.

The most common pain is the sharp, cutting pain of acute pleurisy. Few cases run the course of the disease without experiencing this. It is usually located in the lower portion of the chest but may be found in any portion. Sometimes this acute pain is followed in a few days by a pleural effusion.

The pleura is always more or less involved in advanced tuberculosis. Adhesions form which every now and then cause pain, sometimes sharp but more often dull and aching.

When an acute process near the surface is breaking down, with cavity formation, sometimes there is soreness more or less marked, sometimes quite a severe pain.

When contraction of a lung is taking place, the patients are often made quite uncomfortable by a feeling of pulling or dragging, perhaps due to stretching pleural adhesions. Sometimes they describe their feelings as seeming as though they were being squeezed in a vice.

Aside from these there is often a feeling of tightness which occurs when there is an acute congestion of the air passages.

Myalgias are often spoken of in connection with tuberculosis but their location would suggest that they might be pains of pleural origin.

The important thing to remember in connection with pains in tuberculosis is that pains of pleural origin do not necessarily have to be sharp in character, nor do they always show themselves where the tuberculous involvement in the lung is most serious.

Night Sweats. Perhaps these should be more properly called sleep sweats, since they occur not only at night but whenever the patient sleeps. They may come on early in the disease, disappear and return no more; but they more commonly return now and then during the course of the disease.

Their cause is unknown, but it is thought to be a toxic action upon the nerves. They are not confined to tuberculosis, but may be found in other weakened conditions. The sweats in early tuberculosis, as a rule, are not so severe as those found later. The most severe usually accompany an acute process when fever is present. There seem to be certain characteristics about some individuals which make them prone to night sweats.

Sometimes they are so slight that they are hardly recognized, while again they may be so severe as to completely wet the night clothes and sheets. There is a popular belief that sweats are very weakening. Is it the sweat or the condition which causes the sweat that produces the weakness?

There may be more than one sweat in a night but as a rule only one occurs. The danger from the sweats is that of the patient becoming chilled.

Temperature. Temperature is one of the most important symptoms in tuberculosis. Beginning with the earliest signs of the disease, it aids us in making a diagnosis and following throughout to the end, it is an index to the activity of the process, and of complications that may be present. There is no other symptom that tells us so much and none that requires more careful study.

If there is one thing that can be said to be characteristic of the temperature in tuberculosis, it is its instability. The heat center of the individual suffering from tuberculosis seems to be hypersensitive, so that the least irritation sends the temperature to elevations much greater than would be expected. We take advantage of this in making a diagnosis in early tuberculosis. By having the patient do a little walking or take other exercise, we often find a quick response on the part of the temperature curve. It must be remembered that exercise will raise the temperature in health, but, in tuberculosis, the rise comes with exertion that would produce no effect on a healthy individual, or, if the exertion be severe, the temperature rises much higher than it would in the case of an individual in health and, as a rule, remains high much longer.

Not only physical but mental exertion affects the temperature. It is not uncommon to see the temperature rise from one to three degrees after reading an exciting novel or an attempt at study, or following feelings of deep emotion, such as joy or grief.

The type of temperature curve depends on whether the disease is active or quiescent and upon the complications present.

The usual curve of a chronic case without complications in an inactive

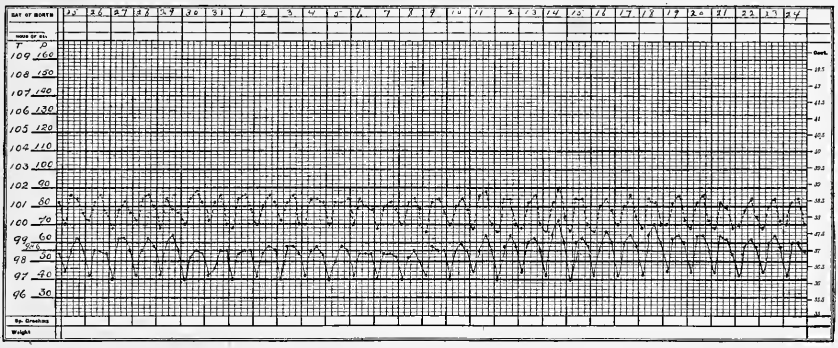


FIG. 6.—Temperature curve of inactive chronic pulmonary tuberculosis.

stage runs from subnormal, 97–98, in the morning to 99–99.5 (Fig. 6) in the afternoon. If slight activity should be present the curve would probably reach 100 or 100.5 (Fig. 7). When the hectic type is present, the oscillations of temperature become greater. The morning temperature becomes lower,

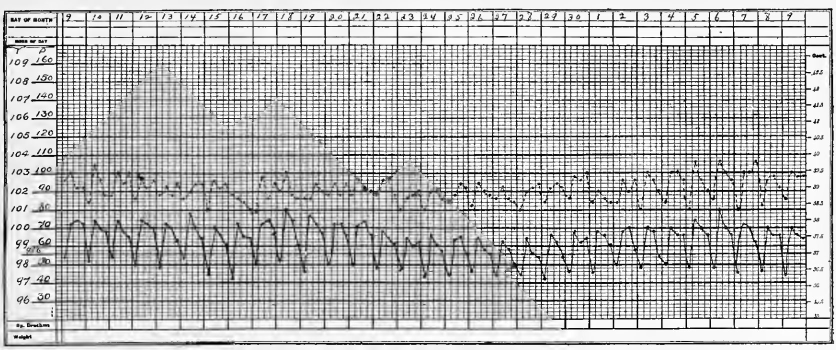


FIG. 7.—Temperature curve showing activity in chronic pulmonary tuberculosis.

going as low as 96 and even 94, and the afternoon temperature mounts higher, reaching 102–104 (Fig. 8). Sometimes there is a double rise in the twenty-four hours.

The natural temperature of tuberculosis is of the remittent type. We may safely say that uncomplicated cases will always reach normal some time in the day. It is not at all uncommon, however, to find in the course of chronic tuberculosis that the temperature appears above normal in the morning. Unless this be due to some accident, such as a sleepless night, excitement or a coughing spell, it should be looked upon with suspicion. A tem-

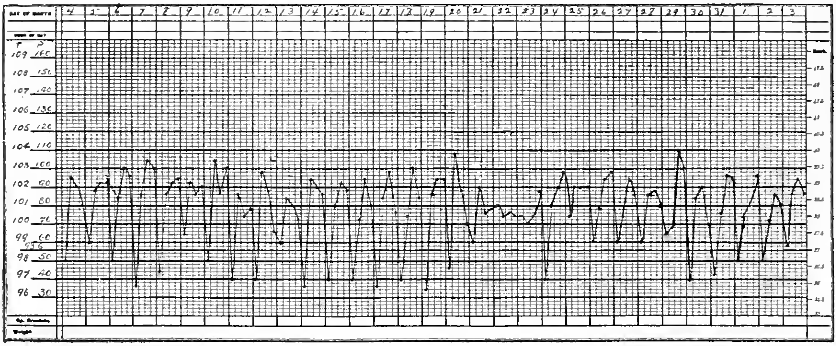


FIG. 8.—Temperature curve showing hectic type.

perature which fails to come down to normal in the morning (Figs. 9 and 10, page (54 and 55 will generally go a little higher than usual in the afternoon and suggests some complication, the most common of which are: an extension of the disease to new tissue, pneumonia, pleurisy and acute miliary tuberculosis.

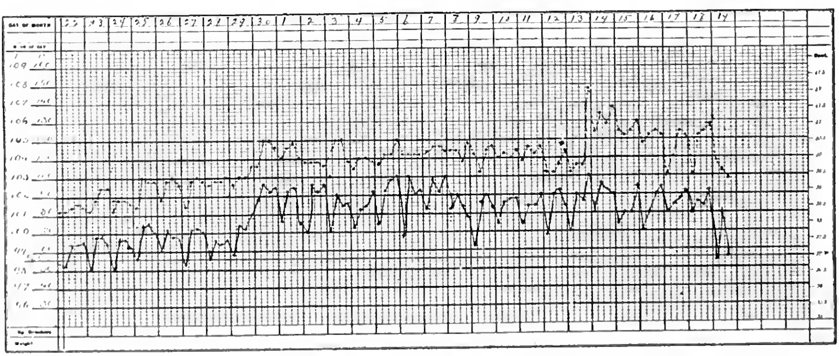


FIG. 9.—Temperature curve of a complicating tuberculouis pneumonia.

Aside from these, there are types of temperature which persistently remain below normal (Fig. 11), as from 97–98. Such cases seem to do well and, in my experience, I have been unable to account for the condition.

There is another type which remains persistently above normal and yet seems to be in fair condition (Fig. 12) and free from complications. I am accustomed to look upon this as being due to a closed focus.

The persistently subnormal temperature of the tuberculous, especially in the early morning, is not fully appreciated. Some time ago, I was called in consultation with a surgeon of no mean ability, but who had never watched

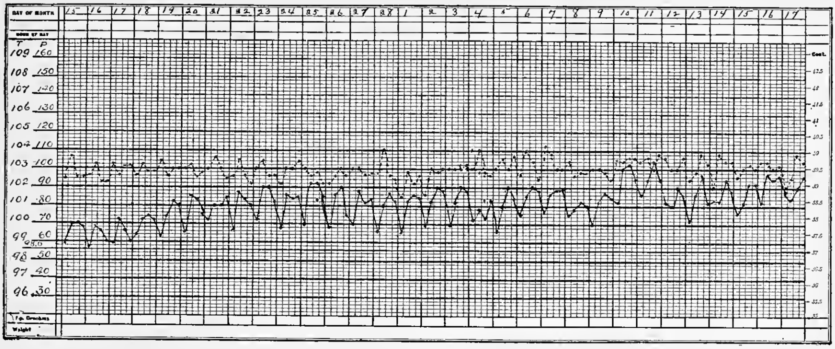


FIG. 10.—Temperature curve of acute miliary tuberculosis superimposed upon a chronic pulmonary tuberculosis.

daily temperature charts of patients suffering from tuberculosis. He informed me that on the day previous to my visit, the patient was in a condition of threatened collapse. The temperature had dropped to 96. After energetic measures, however, the patient had improved. Subnormal temperature

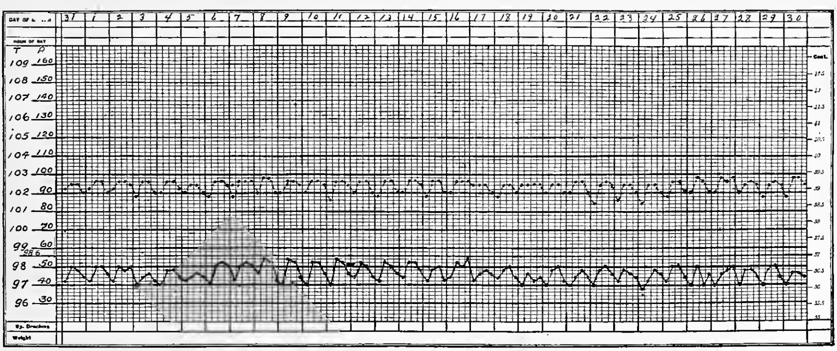


FIG. 11.—Curve showing temperature persistently below normal.

in the early morning, in tuberculosis is the rule, and is not to give the patient or physician any concern. As a rule, this departure from the normal disappears as the disease becomes arrested or cured.

My observations lead me to think that a temperature which persists in going very low in the morning points to an involvement on the part of the intestines.

The cause of the fever in tuberculosis is not known. However, I feel sure we are safe in saying that it is not due to any single agency.

That one can have a fever without the help of any other micro-organism we know from the fact that the substances elaborated by the tubercle bacillus during its growth, as well as products made from the bodies of the bacilli themselves, will produce a fever when injected into the body. This is also shown to a very small degree by the slight rise of temperature which accompanies the eruption of tubercles during an extension of the disease in the body, and even more plainly by a high fever attendant upon acute miliary tuberculosis.

That the temperature of tuberculosis is not always due to the toxins from the bacillus is suggested by the frequent presence of other fever producing

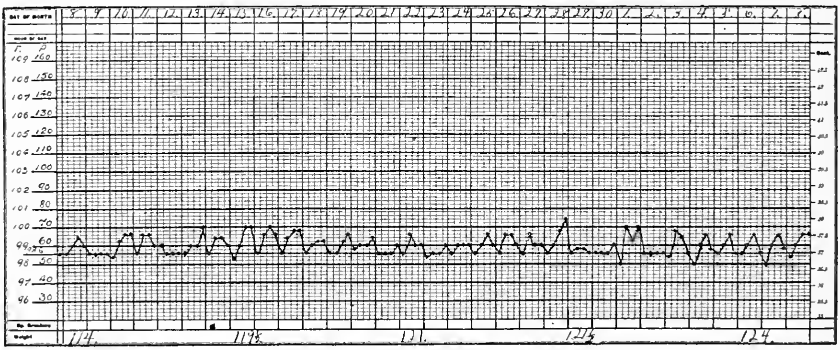


FIG. 12.—Curve showing temperature persistently above normal probably caused by a closed focus.

micro-organisms in the tissues of the lung, and also by the fact that there is a continual process of liquefaction and absorption of dead tissue going on.

The range of temperature in the twenty-four hours varies from about one degree in early tuberculosis and in chronic tuberculosis which is inactive, to from three to five degrees when the disease becomes active and even to ten degrees when it assumes the hectic type.

A temperature which persists in running high, say from 101 to 104 degrees when neither the extent of the lesion in the lung nor any complication which may be present warrants it, and which does not abate after a few weeks of proper management, indicates either a process of high virulency or a constitution of low resisting power on the part of the patient. Such conditions are unfavorable. They are often found in patients with unstable nervous systems, and in such cases the temperature must not be made the sole guide as to rest and exercise.

The temperature of tuberculosis is not infrequently mistaken for that of typhoid fever. During an exacerbation, with a pneumonic process, such as often occurs, the temperature might for a time be considered that of typhoid, but a careful examination of the chest will nearly always show the error. A mistaken diagnosis at this time, is a most unfortunate occurrence, because the restricted diet which is usually enforced reduces the patient often to a condition from which he recovers very slowly, if at all.

When a fever suggestive of typhoid occurs in an individual who has been known to have tuberculosis some time in the past, or in an individual whose general health is below par, or in one subject to a cough, tuberculosis should always be excluded before the diagnosis of typhoid is made.

It is possible for a tuberculous patient to have typhoid; yet, if such a com-

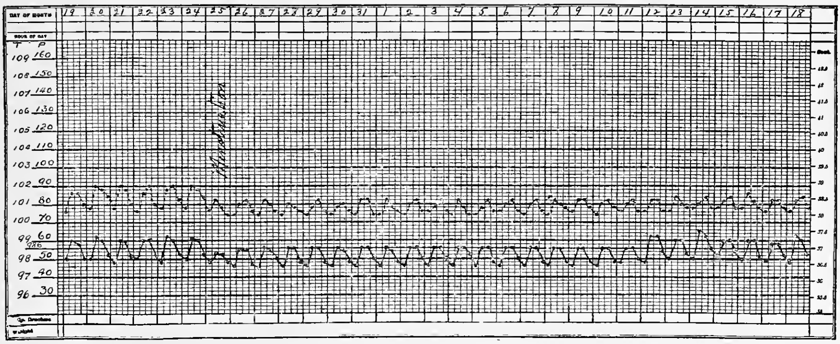


FIG. 13.—Temperature curve showing pre-menstrual rise in patient with early tuberculosis.

plication were to occur, the patient would require more careful treatment than the ordinary case.

It is not uncommon in females suffering from tuberculosis to have a rise in temperature associated with the menstrual period. It usually comes on a few days before the flow, but may not appear until it is established. In early cases (Fig. 13) this often amounts to only a fraction of a degree or a degree, but in advanced cases (Fig. 14), I have frequently seen a maximum of 103 and 104 degrees.

When the menstrual flow has been absent for some months, I have seen this rise of temperature come regularly at the expected time.

A patient's feelings are absolutely unreliable in determining whether or not fever is present. In chronic tuberculosis, it increases as a rule very gradually. Often the disease may be present for months before the temperature reaches 100 degrees. Then it may gradually mount higher and higher until even 101 and 102 degrees are reached without the patient realizing any discomfort. The thermometer is the only guide.

In order to obtain a reliable picture of the disease, the temperature must be taken systematically. The morning temperature is very important. It should be taken when the patient awakens, before the toilet of the face and mouth has been performed, and if possible, before the patient has coughed. This gives the actual temperature, modified as little as possible by outside influences. This early morning temperature is practically always subnormal.

If the patient's temperature is found to be more than two degrees above normal in the afternoon, I deem it wise to have the temperature taken every two hours of the day from early morning until 8 P.M., and should the temperature show a higher elevation after 8 P.M., I should require the 10 o'clock temperature also, unless the patient is asleep.

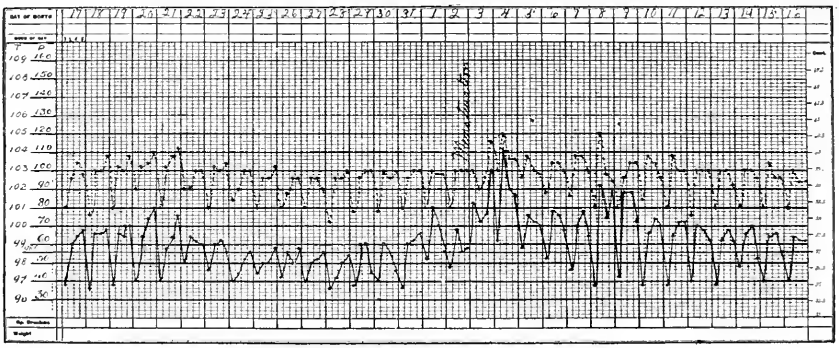


FIG. 14.—Temperature curve showing menstrual rise in patient with advanced tuberculosis.

The maximum temperature may appear any time in the day, but it occurs in my experience most often between 12 M. and 8 P.M. Unless a two hourly chart is kept it is impossible to know the maximum temperature. A chart at four hourly intervals may give a very false picture, for it is not uncommon to find a temperature between one and two degrees higher at 2 P.M., than it is at 12 M. and at 4 P.M. The same can be said of 4 P.M., when compared with 2 and 6 P.M., and also with 6 when compared with 4 and 8 P.M. Hence, the only accurate measurement of the temperature in a fever case is one taken at frequent intervals.

Cessation of Menstrual Flow.

The laity have it firmly fixed in their minds that if the menstrual flow stops, the patient is in danger of going into consumption. This is a relic of ancient teaching, which, like the theory of the hereditary cause of tuberculosis, dies hard.

This fallacy should have disappeared with the discovery of the tubercle bacillus and the increased knowledge which was brought to bear upon the clinical course of tuberculosis immediately following. When the menses cease (barring pregnancy) tuberculosis is, if that be the cause, already present, and as a rule in an advanced stage. Their cessation is usually coincident with a decline in strength on the part of the patient, sometimes gradual, sometimes sudden. It is possible for patients who are much exhausted from other causes to have the menses stop, but this is rare. The broad general rule can be relied upon that when menstruation ceases, the danger is not that the patient may go into consumption, but that the disease is so far advanced that the most intelligent treatment may fail to restore the patient to health.

This is a symptom that usually worries a woman very much. But she can be consoled, for it is a favor that nature has granted her. Nature has removed this drain upon her system until she is strong enough to resume the function again. The patient's fears can be calmed and she can be told with assurance that as soon as her strength recovers sufficiently, the function will be restored.

CHAPTER VI.

PHYSICAL EXAMINATION OF THE PATIENT IN ADVANCED PULMONARY TUBERCULOSIS.

INSPECTION.

The general rules for examination of patients as laid down when discussing early tuberculosis (see p. 13) should be followed.

Inspection of Patient.

By this simple, though insufficiently appreciated method the observing eye will often detect much important information both as regards the extent and nature of the lesion and as regards the complications that may be present. Every physical examination of a chest should begin with inspection.

Inspection comprises not only the inspection of the chest, but the careful scrutinizing of the patient as well. By this method, we observe the general build of the patient and form some opinion as to his resisting power. We note the effect that the disease has had upon him, and determine in our minds as to whether or not the patient will be able to further withstand its inroads.

Inspection gives a rough picture (although often contrary to instrumental measurements) of the condition of the blood. It shows in many instances irregularities of the pupils, as mentioned on page 17, and enlargements of the cervical or axillary glands. Vaso-motor disturbances, such as flushed cheeks, are also noticed. Some idea of the condition of the lungs and heart may be obtained by simple inspection, also.

Condition of Integument Over Chest.

First, the condition of the integument is noted. We observe whether or not edema, venous congestion, cyanosis or any other visible signs of a pathological nature are present. It is not uncommon to find extensive areas of enlarged venules over the interscapular region and also along the lower border of the chest running out toward the sides from the ensiform cartilage. This is found in the healthy also, but not so commonly.

Shape of the Chest.

There are wide differences in the shape of chests in healthy individuals, and it is important to recognize these differences, in order to avoid errors on inspection. When we speak of a normal chest, we mean a chest normal for the age and special build of the individual who possesses it. One individual will have a long chest, another a short one. In one instance a cupping above and depression below the clavicles means the presence of disease in the underlying tissue; in another chest of different shape, it is a normal condition.

And from these physiological differences there are other changes in chests which are pathological, such as the pigeon breast resulting from abnormal development; the barrel chest from emphysema; the paralytic chest of the tuberculous, and the twisted and cramped chest resulting from curvatures and diseases of the spine; also, all grades of contractions and flattening resulting from tuberculous processes and old empyemas.

Phthisical Chest.

Much has been written about the phthisical chest, the principal characteristics of which are an unusual length, with the upper ribs flattened and the union between the first rib and the sternum ankylosed, the intercostal spaces widened, and the anterior-posterior diameter shortened. The supraclavicular fossæ are cupped. The shoulders fall forward and the lower angles of the scapulæ are thrown out from the body like wings.

It was formerly supposed that those who had such chests were more prone to tuberculosis than other persons, but the truth of the matter is that individuals with such chests are, as a rule, already tuberculous. Much experience with tuberculosis has shown that there is no type of chest confined to this disease. It is not at all uncommon to find well formed chests among the tuberculous. From my experience, I have often wondered whether there would be any appreciable difference in the chests of a thousand persons suffering from tuberculosis and a thousand who were free from it.

Ankylosis of the Union of the First Rib With the Sternum.

Freund has called attention to the fact that in tuberculosis the union between the first rib and the sternum is ankylosed in a very large percentage of cases; and, has described this as being a predisposing cause of infection. In fact, this is now given as one of the necessary features which go to make up the so-called paralytic thorax. It seems, however, as has been pointed out by others, that it is more probable that this is a result of an infection rather than a predisposing cause. When an infection occurs, the motion in the part is lessened; and, in as much as the movements of the joint between the ribs and the sternum depend upon the motion of the lung within, it is but natural to suppose that the lessened motion would tend to ankylosis of this joint. And, when we recall the great number of infections of the apex we can readily see that it is possible that effect has been described as cause.

Phthisical Chest Broad or Deep.

Woods Hutchinson (Journal American Medical Association, Vol. XL, page 1196, April, 1903) disputes the long accepted theory that the tuberculous chest is a relatively wide chest and insists on the converse, that it is relatively a deep chest.

In determining whether or not a chest is flat or deep it is first necessary to form some standard. This standard must vary with different conditions. Among other conditions, age, sex, the type of breathing and altitude, must make a difference in the normal chest; and, aside from these, in the tuberculous the shape is seriously altered by hypertrophy, emphysema and contractions that occur. It is also necessary to know to what portion of the chest reference is made, whether it be the upper or the lower portion.

The value of the result will depend very much upon the accuracy of the measurements. A very slight difference in the pressure upon the instrument used for measuring makes a difference of a point or more in the index.

I have made a number of measurements of chests at two different levels; one at the junction of the ensiform appendix with the gladiolus and the other at the junction of the gladiolus with the manubrium, and have determined the index in the usual manner:

Of 20 healthy men the ensiform-gladiolus index is 75.2 and the manubrium-gladiolus index 73.1.

Of 44 tuberculous men in all stages the ensiform-gladiolus index is 75.8 and the manubrium-gladiolus index 64.5.

Of 12 tuberculous men in early stage the ensiform-gladiolus index is 73 and the manubrium-gladiolus index 64.

Of 12 healthy women the ensiform-gladiolus index is 73 and the manubrium-gladiolus index 68.

Of 43 tuberculous women in all stages the ensiform-gladiolus index is 73.7 and the manubrium-gladiolus index 67.

Of 11 tuberculous women in the early stage the ensiform-gladiolus index is 72.4 and the manubrium-gladiolus index 66.

I recognize that this number of measurements is too small to be of much value, and I would not place confidence in any conclusions drawn from them. The most striking feature of these figures is the fact that the manubrium-gladiolus is about ten points lower in the tuberculous than in the non-tuberculous men, while in the women it is only one and two points lower respectively. This difference is perhaps due to the difference in the type of breathing in the sexes. The ensiform-gladiolus index, on the other hand, shows very little variation. While these figures do not confirm Hutchinson's view, yet I am not willing to say that they are opposed to it because of the fact that the number examined is too small.

From his measurements he has established the normal anterior-posterior diameter of the chest at 70, counting the lateral as 100. In tuberculous chests he finds that the anterior-posterior diameter is relatively greater than the lateral, the index being about 80.

Movements of the Chest.

Oftentimes we are able to form quite a comprehensive picture of the pathological conditions present in a tuberculous chest by inspection.

In early tuberculosis we may note the lagging of an apex as mentioned previously. As the disease advances, this becomes more pronounced, at times, amounting to almost complete immobility.

This lagging may be so slight as to be almost unnoticeable. The excursion of the effected side may be diminished or it may be as great as that of the healthy side though more tardy in making its appearance, or it may be both tardy and diminished.

It is not difficult to detect, providing only one apex is involved, for then it may be compared with the healthy side; but when both apices are diseased, it often becomes much more difficult. Then we are obliged to compare the motion at the apices with that of the lower portions of the chest. A flattening of one upper lobe when the other is normal is almost a sure sign of tuberculosis.

We often notice the drawing in of the intercostal spaces, especially of the lower portions of the chest, showing the presence of pleural adhesions, and the bulging of the intercostal spaces when an effusion is present. Depressions are often seen over the upper anterior portion of the chest, marking the sites of areas of fibrosis or the presence of cavities. Immobility of an entire side of the thorax would suggest either pneumothorax or a large effusion. The chest which appears to be in a chronic state of inspiration suggests to us the presence of advanced lesions with resultant emphysema.

There is a marked difference between the limited motion in early tuberculosis and that of later tuberculosis accompanied by flattening of the chest. The former represents an infiltration, the latter a formation of fibroid tissue with contraction.

Cardiac Impulse.

The position of the apex beat should be noticed for it often gives important evidence. If it is displaced to the left, we might expect it to be pushed over by a right sided pleurisy, a right sided pneumothorax, or a hypertrophied right lung consequent upon contraction of the left; or to be drawn over as the lung contracts by pleuro-pericardial adhesions resulting from former left sided pleurisy.

If the impulse is displaced to the right, similar conditions but on the opposite side should be considered. I have seen the heart drawn over to the right and lifted upwards at the same time through severe contraction of the right upper lobe.

If the impulse is displaced upwards and to the left, contraction of the left lung, depending upon tuberculosis is almost certain.

I have seen the apex impulse in the left axilla with the entire heart above the nipple line as a result of a marked contraction of the left lung together with an inordinate hypertrophy of the right.

As a rule, the impulse of the apex beat in advanced tuberculosis becomes diffuse and extends over a considerable space. I have noticed, although I have not seen mention of it in the literature on this subject, that it is not uncommon to be unable to locate the apex beat either by inspection or palpation in advanced tuberculosis, where the left lung has undergone contraction. This is undoubtedly due to the apex of the heart being drawn inward away from the chest wall. For a more complete discussion of this interesting subject see Chapter VII.

Contraction of the left lung also sometimes draws the little tongue of lung tissue which lies between the heart and chest, away, in which case, the heart's impulse is directly against the thoracic wall and plainly visible in the intercostal spaces. When contraction above uncovers the upper portion of the heart and the great vessels then their impulse can be seen in the upper intercostal spaces to the left of the sternum.

Diaphragm Phenomenon.

Litten (Deutsche. Med. Woch., 1892, No. 13) has described what he chooses to call the diaphragm phenomenon. During respiration, the excursion of the diaphragm can be noted upon the chest wall, near the lower border of the lung. To be able to demonstrate this best, the patient should be stripped to the waist and placed in a recumbent position with feet toward the window. The observer should then stand between the feet of the patient and the window. As the patient begins to breathe, a shadow will be seen on the side anteriorly, at about the level of the sixth intercostal space, which moves downward. If a moderately deep breath is taken, the shadow may descend one or one and one-half intercostal spaces, while upon deep inspiration, it may descend two or three. The movement of the diaphragm is tolerably constant in health.

The explanation of the Litten phenomenon is, that as the diaphragm descends, it is vertically stripped off from the inner wall of the thorax. This enlarges the complimentary pleural angle, causing a traction to be put upon the intercostal spaces below the lung margin. This sinking in of the spaces causes the shadow.

Whatever interferes with the excursions of the diaphragm interferes with the amplitude of this wave. Hence, disease either of the lung or pleural cavity or of the abdomen will cause a diminution of it. In tuberculosis, this diminution of movement of the diaphragm was noted as a result of the use of the Röntgen ray and was considered a sign of early tuberculosis, but it was soon proved that this phenomenon does not appear until a considerable amount of tissue is involved; hence, it is of little value in early diagnosis. Not only the Röntgen ray but percussion confirms the changes that take place in the movements of the diaphragm as noted upon the surface. The phenomenon is absent in pleural effusions, pneumothorax, or when extensive pleural adhesions are found at the base of the lung.

PALPATION.

Palpation may mean much or little, according to what the examiner makes out of it. If properly practiced, however, the detection of increased and diminished fremitus is only a small part of the knowledge to be derived from its use.

Vocal Fremitus.

There is no standard of vocal fremitus by which we may judge different cases. This varies according to the thickness of the chest wall, the portion of the chest palpated and the coarseness or firmness of the voice, as well as according to the pathological conditions which are present.

Sometimes we are unable to detect vocal fremitus in normal individuals; especially is this true in women and children with high pitched voices, and in strong muscular persons.

It is well to educate some portion of the hand, such as the ulnar surface or the finger tips, and always use the same portion in detecting fremitus. This should be applied successively to different parts of the chest while the patient pronounces in a low pitched voice certain syllables or words which will throw the vocal cords into strong vibration. I have found the words "ninety-nine" to suit me best.

When the fremitus for the given individual has been determined then we can look for variations.

In tubercular infiltrations, we find the fremitus increased, providing the bronchus leading to the area is patent. In thickened pleura it may be either increased or decreased, the difference perhaps depending upon its consistency. In pleural effusion, pneumothorax and infiltrations where the bronchus is occluded by mucus, fremitus is decreased.

Friction Fremitus.

When the pleural surfaces are roughened, sometimes a fremitus may be felt as the surfaces move over each other. The passage of air through mucus which has collected in large quantities may often be detected by the palpating hand.

Detection of Changes in Lung by Palpation.

In normal breathing air passes through the bronchi and bronchioles and enters the alveoli unimpeded. This conveys a certain feeling to the palpating fingers. When infiltrations and other pathological conditions are present, they interfere with the natural ingress of air and the practiced examiner may detect this in the different sensation which is conveyed to the palpating hand. It is difficult to give an intelligent description of this change, but the feeling conveyed to the hand seems to be that of resistance. The soft, smooth, breezy movement in health, which is conveyed to the hand, seems to become harsher. While such refinements in examination are not of general practical value, yet, they are of value to those who will take the pains to master them and at times they come in good play.

Lagging. While we may detect lagging of portions of the chest by inspection, yet it is much easier to detect it by palpation. It gives very important information to place the hands systematically over the surface of the chest, noting the freedom or restriction of movement of the underlying portion.

Palpatory Percussion. While palpatory percussion is not as important as a diagnostic measure in advanced tuberculosis as in earlier cases, owing to the fact that the physical signs are so much more pronounced, that they can be detected with little difficulty by other methods, yet, the degree of resistance to the finger used as a pleximeter is of great value, when considered in connection with the findings on auscultation, in determining the condition of the underlying tissues.

PERCUSSION.

What Can be Elicited by Percussion? There are several methods of percussion which are of value in examining the chest. While fairly exact results may be obtained by the methods in common use, yet a familiarity with other methods aids the examiner in confirming his findings.

When we discuss percussion, we usually speak of the percussion note, so we have definitely fixed the idea of sound with percussion. Not only do we think of the sound but of the pitch and quality of the sound, and our efforts at percussion have been directed toward determining the pitch and quality of the sounds elicited by the stroke.

This gives us but a faint idea of what can be determined by percussion, if various methods are used. By percussion we can elicit the pitch and quality of the tone; we can determine the resistance as transmitted to the finger used as a pleximeter or to the tips of the fingers in mediate percussion; we can also feel the difference between infiltrated and normal tissue or between different degrees of infiltration, or between solid and hollow viscera, as by means of Ebstein's touch percussion, and we can outline organs, infiltrations, effusions and even lobes of the lung by auscultatory percussion.

Auenbrugger's Method. Auenbrugger was the discoverer of percussion. He described his method in "Inventum Novum" in 1761. It was that of immediate percussion and consisted of striking the chest with the pulp of the fingers of the extended hand. While this method has been largely discarded, yet it is not without value. The examiner can seat himself before a patient and by stroking the chest a few times, after Auenbrugger's method, gain quite a bit of useful information regarding the condition of the underlying organs. The objection to this method is the same as that to immediate percussion in general. Where the tissues are soft and flabby, as they sometimes are, and as they often are over the female breast, the results are not very satisfactory.

Auenbrugger's method is recommended by its simplicity. Its value depends upon a combination of sound and touch.

Ebstein's Touch Percussion.

Ebstein ("Ueber die Bestimmung der Herzresistenz beim Menschen," Berlin. K. Woch., 1894, Nos. 26–27 die Tast-percussion, Stuttgart, 1901) has described a method of percussion which depends for its value entirely upon the sensation conducted through the fingers of the hand used as a plexor. Sound is totally disregarded in its use. He first employed it in determining the heart boundaries; but, later experience showed its sphere of usefulness to be a broader one. His method can be used either as the mediate or immediate.

While percussion is usually carried on by a stroke from the wrist, the arm being held firm, Ebstein's percussion requires that the hand and wrist be held rigid and that the blow be delivered from the elbow. This method is of great assistance in outlining the boundaries of the various organs and is especially to be recommended in mapping out the heart.

The stroke should be firm yet not so strong as to cause pain.

Auscultatory Percussion and Auscultatory Stroking.

Reference is often made in text books, to the use of auscultatory percussion. It is especially employed in mapping out the boundaries of the various viscera. By placing the stethoscope on the organ to be outlined and then beginning to percuss at a distance beyond its border and gradually coming nearer to it, the sound grows more distinct when the border is reached. The explanation of this phenomenon is based upon the principle that sound is conducted better through a single medium than through several media of different density.

A method which I much prefer to this is what might be called auscultatory stroking. The stethoscope is placed over the organ to be outlined at some distance from the boundary to be mapped out. Then instead of percussing as in the previous method, I draw the end of the finger gently across the skin, first at some distance beyond the border, then, by coming nearer and nearer, the border will be easily detected by the decided increase in the conduction of the sound when it is reached. This method of examination is so delicate that the outline of the lobes of the normal lung can easily be made out, owing to the fact that so slight a change in density of tissue as the sulcus dividing the lobes interferes with the transmission of sound. I do not think the value of this method is sufficiently appreciated or it would be more generally used. Not only can it be used in outlining organs, but also in outlining a pneumothorax or pleural effusion and differentiating the latter from liver or lung dullness. Cavities and infiltrations can also be differentiated from the surrounding tissue and the boundaries of the stomach from the intestines. I always make use of this in determining the edge of a lung when, through compensatory emphysema, it has extended beyond the median line.

It is very important to remember that the stethoscope should not be placed too near the boundary to be outlined, because the nearer the stroke to the stethoscope the louder the sound; consequently, the difference will be noted much easier, if the stethoscope is at least two or three inches away. When the given boundary has been found, it can be proved by placing the stethoscope over the other organ from which we are endeavoring to make a differentiation and stroking from the other side. For example, if we are outlining the upper boundary of the heart, we place the stethoscope near the lower boundary, then begin to stroke over the lung tissue at a little distance from the heart, and approach closer and closer until the boundary has been determined, which will be indicated by an increase in the sound due to better transmission. We then place the stethoscope upon the lung and stroke over the heart, approaching the lung in the same manner as before, until the border is reached. The border as determined by the two methods should coincide.

FIG. 15.—Illustrating the method of delivering the stroke in the author's elastic tube percussion.

Elastic Tube Percussion.

While examining a patient one day, I accidentally struck him over an infiltrated area with the rubber ear tubes of my stethoscope. My ear instantly caught the dull sound, and I struck the healthy side for comparison and found that the difference was very marked. I at once began to develop the idea and have found it very valuable. The following description was published in part in the Journal of the American Medical Association, March 23, 1907.)

Instead of using a percussion hammer or finger with which to percuss the chest, in this method we use a piece of rubber tubing of a convenient length, say four or five inches long, and deliver the stroke directly upon the surface of the chest (Fig. 15), allowing the tubing to remain in contact with the surface after delivering the blow.

It makes quite a difference in the sound elicited whether a soft elastic tube or one with rigid walls is used. The former gives more or less of a dead sound while the latter emits a tone.

I have found both qualities of tubing useful and have found that different sized tubes produce sufficient differences in the character of the tone to make one more advantageous in one place, another in another.

The tubes which I have found most useful are a soft flexible tube with lumen of one-eighth inch (Fig. 16) and a piece of ordinary tubing such as is used on douche bags, with firm walls, not too thick, and a lumen of three-sixteenths inch.

The great difficulty with ordinary methods of percussion is that we rarely elicit the simple tone which should be produced by the tissues underlying,

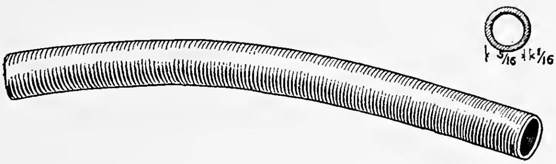


Fig. 16.—Showing size of soft elastic tube used by the author in elastic tube percussion.

but we obtain this tone largely modified by the tone emitted by the vibrations of the bony thorax. It being impossible to differentiate these, there is a certain false resonance to most of the tones obtained on ordinary percussion and especially is this true if the percussion stroke is not very light.

With the use of the tubes, especially those of soft flexible rubber, there is no noticeable thoracic resonance. The density of the underlying tissue can be readily determined by the sound and also to some extent by the sensation of resistance which is transmitted through the tube to the hand. When the tubes with firm walls are used, there is a tone transmitted to the tube which changes with the density of the underlying part.

This is a most valuable method of outlining the heart. The relative and absolute dullness are easily differentiated. Different degrees of infiltration and density in the chest are also easily detected, making it very valuable in examining tuberculous chests.

One great advantage is that the stroke may be made across the ribs just as well as parallel to them, because it does not cause an appreciable vibration of the chest wall.

Like all forms of percussion it is most valuable where the least tissue interposes between the skin and the part percussed, and least satisfactory over the fleshy parts.

Perhaps a smaller, more definite area can be examined by the old method where the finger or other pleximeter is used; and, yet, when we consider the fact that we can use this method across the ribs as well as parallel to them and percuss the parts immediately under a rib or under the sternum without causing an appreciable vibration of the bony thorax, it is questionable whether the supposed advantage is not more apparent than real.

I have been using this method now for more than a year. I have checked it with ordinary percussion, auscultatory percussion, auscultatory strokings and Ebstein's touch percussion and find it very accurate; in fact, I can often elicit differences by this method that I have passed by unnoticed by other methods.

While the old argument in favor of finger percussion, that you always have your fingers with you, still holds good, yet I believe that this method is one of great precision and that it will pay one who appreciates exact methods to investigate it. Like all other methods of percussion it requires time and experience to become master of it.

Further experience with this percussion shows it to be of great value in diagnosing cavities. The power of differentiation with it is so delicate that cavities can be outlined where one fails to get the usual signs, such as pot félé and those described by Wintrich and Gehrhardt.

The Ordinary Method of Percussion.

The ordinary method of percussion depends upon the fact that blows delivered over tissues of different densities set up vibrations which differ from each other and which may be differentiated by the ear. The value of ordinary percussion depends entirely upon the differentiation of sound and upon the ability of the examiner to make the differentiation.

Ordinary percussion is carried out by means of two instruments, one to receive the blow, the pleximeter, and another to deliver it, the plexor. For the former, the finger is the best, for it has intelligence and can feel while the blow is being delivered, although pieces of bone, glass, ivory and rubber are often used. These latter emit a sound of their own with which the examiner must become familiar before he can appreciate the meaning of the tones elicited.

For the plexor, the middle finger of the right hand is best, although hammers made of metal handle and frame with rubber over the striking surface are excellent The handle should have a fair amount of spring to it. The style that I prefer is shown in Figure 2, B (p. 14). If a pleximeter other than the finger is used, it is important to have one that will fit down into the supraclavicular notch and into the intercostal spaces. The one represented by Figure 2, C (p. 14) is made of hard rubber and meets these requirements admirably.

Outline Lung Boundary.

It is very important in examining chests in advanced tuberculosis to outline the borders of the lungs. The apices should be carefully percussed in order to discover the amount of contraction present if there be any. While the height to which the apices of the lungs extend varies even in health, yet we should assume that an apex is contracted unless its highest border is one inch above the clavicle.

Posteriorly, the highest border should be on a level with the spine of the seventh cervical vertebra. It should also be determined whether the lower borders of the lungs are free and movable or bound down by adhesions. The amount of hypertrophy and contraction present in the two lungs should be known. The size and position of the heart with reference to the chest wall and the lungs should also be determined. These, together with the presence of fluid or air in the pleuræ may all be made out by the various methods of percussion here described.

Mobility of Lower Lung Boundaries.

The lower borders of the lungs are normally capable of making wide excursions. In the parasternal line this equals 2 c.m., in the nipple line 4 c.m., in the axillary line 9 c.m., and near the spinal column 3 c.m. This mobility is decreased by emphysema, consolidation of lung tissue, firm pleural adhesions, acute pleural pain, effusion and pneumothorax When the difference in the lung border between forced inspiration and forced expiration by percussion falls much short of the figures here given, barring disease below the diaphragm, one or more of the above conditions are present.

Differentiation of Intercostal Neuralgia and Pleural Pains.

Many of the pains of acute pleurisy are mistaken for intercostal neuralgia. Recognizing the fact that a very large percent of these pleurisies are tubercular in origin, it is very important that their true nature be diagnosed.

When the pleura is acutely inflamed, nature checks the movement and consequently the excursion of the lung is lessened, usually very markedly. In intercostal neuralgia, the limitation of motion is very slight in comparison. We can, by percussion, determine the width of the excursion of the inferior border of the lung upon normal breathing and forced breathing. In cases where the pleura is not already bound down by firm adhesions, if there should be any marked diminution of motion, it would point to pleurisy, while if the motion be only slightly restricted, it would more probably be intercostal neuralgia.

Heart Outline.

It is very important to know the position of the heart in chronic tuberculosis. From its position alone valuable inferences may sometimes be drawn as to the nature and extent of the disease and when both apices are involved, even as to the priority of the involvement. Percussion gives the most trustworthy evidence regarding the heart. By it we can outline its boundaries with precision. I have found Ebstein's touch percussion, the author's elastic tube percussion and auscultatory stroking the most valuable methods for mapping out the heart boundaries. The heart is often bound down by adhesions and it is sometimes drawn away from the chest wall. Emphysematous lung tissue also often interposes between the heart and chest wall. Percussion under such circumstances may be facilitated by having the patient bend far forward during examination.

Various Percussion Notes.

In advanced tuberculosis we find every variety of percussion note. The examiner must have certain standards of notes fixed in his mind. He should not only be able to say a certain note is resonant, but should recognize the degree of resonance, for the departures from the normal are usually only differences of degree. He should also be able to detect a hyperresonant note, for this is very common, owing to that portion of the lung tissue which is not infiltrated taking upon itself increased function resulting in a dilatation of the air vesicles. If this dilatation becomes more extensive, then the note becomes tympanitic. A tympanitic note may be recognized by its having a musical character while non-tympanitic notes are only noises, as can be seen by comparing the tone elicited by percussing the stomach or larynx with the non-tympanitic note of the normal lung or the dull note of marked infiltrations.

Percussion Note in Acute Miliary Tuberculosis.

In acute miliary tuberculosis, the physical signs are not in keeping with the severity of the disease. The percussion sounds may be normal, slightly dull or hyperresonant. The dullness is rarely marked, and if present is more apt to be caused by a previous tuberculous process in the chest. Hyperresonance and sometimes tympany is common. This is due to the relaxation of the lung tissue.

Acute Pneumonic Phthisis.

The percussion note in acute pneumonic phthisis resembles that of pneumonia.

Chronic Tuberculosis.

If the tubercles are few and scattered there may be no change recognizable upon percussion.

There is usually, however, some degree of impairment present varying from a slight muffling to a marked dullness. Dullness may be due to infiltration, a pneumonic process, fibroid thickening, a dense wall about a cavity, a cavity filled with secretion, a thickened pleura or pleural effusion. Hyperresonance and tympany may be present as a result of relaxation of lung tissue due to scattered tuberculous foci, emphysema, pneumothorax, or the presence of an air containing cavity or bronchiectatic dilatation. In a senile or emphysematous lung there may be a widespread tuberculous infiltration present and yet the findings on percussion be almost nil. In these cases, however, we must depend for a diagnosis more on percussion than on auscultation, because the auscultatory findings are even more unsatisfactory than those of percussion.

Percussion Over Cavities.

The percussion note is normal over small cavities or over larger ones covered by healthy lung tissue. When filled with secretion the note is dull. Sometimes dullness is due to a very thick fibrous wall. If the cavity is superficial, large and filled with air, the tone may be hyperresonant or tympanitic. Cavities may be found very readily by elastic tube percussion, the difference in the note over the cavities and over the thickened walls or lung tissue being very marked. The cracked pot sound is elicited when the cavity is superficial and fairly large, provided it contains air and communicates with a bronchus. If the cavity is fairly large, superficial, the walls thin and the sides smooth, a metallic resonance may be obtained.

Wintrich noted that if the mouth is kept open and the tongue flat on the floor of the mouth during percussion, the pitch of a tympanitic or metallic note over a cavity is raised; while if the mouth is closed, the pitch is lowered. The patient should breathe naturally during the test and the comparison should be made during the same phase of respiration; for Friedreich has shown that the pitch of these same tympanitic and metallic tones is raised by inspiration and lowered by expiration. Since inspiration raises the pitch of the note in normal lungs, this phenomenon cannot be taken as pathognomonic of a cavity.

AUSCULTATION.

No matter how much information we may derive by careful inspection, palpation and percussion, we could have no exactness in the results of our chest examinations, if it were not for auscultation. It is the supreme judge that tests and interprets the findings of the lower courts.

Auscultation is practiced for the purpose of determining the character of the respiratory sounds, the presence of adventitious sounds and the manner in which the breath sounds are transmitted to the chest wall.

Weakened Respiratory Murmur.

The normal breath sound is a smooth, breezy murmur, caused by an unimpeded passage of air through the air channels, which are surrounded by elastic tissue, and the ultimate expansion of the air vesicles. The intensity of the murmur in health or disease depends upon the thickness of the chest walls, the amount of lung tissue, the method of breathing, obstructions in the upper air passages, or pathological conditions in the chest.

Patients who have well developed muscles, or large cushions of fat are sometimes very hard to auscultate. In strong muscular men the examinations of the posterior-superior portion of the chest is very difficult. The examination of that portion of the lung under large breasts is often very unsatisfactory. This can be overcome to some extent by having the patient lift the breasts while examining the lower portion of the chest.

Sounds vary with the method of breathing. Patients who practice abdominal breathing give a much fainter respiratory murmur in the upper portion of the chest than those who expand these portions of the chest more.

Stenosis of the upper air passages, especially of the nose, will make the respiratory murmur very indistinct. When the breath sounds are difficult to hear, it is well to have the patient breathe through the mouth, when, if the lessening of the murmur is due to nasal stenosis, the sounds will be heard more distinctly.

The pressure of large bronchial glands may so constrict a bronchus as to cause a weakening of the respiratory murmur in the region supplied by it. If the lung tissue be unaffected, the murmur will be normal, except as to intensity.

Thickened pleura is very often the cause of diminished murmur at the bases of the lungs; occasionally at the apices also. Effusion and pneumothorax also cause weakening of the note.

Infiltrated areas where the lumen of the bronchi is partially or wholly closed, also areas supplied by a single bronchus which becomes blocked up by mucus, show diminished or absent breath sounds.

Increased Respiratory Murmur.

An increased respiratory murmur may be naturally due to thin chest walls with poorly developed musculature and absence of adipose tissue. The intensity of the note is increased whenever the function is increased. In case of dense infiltration of a portion of a lung, or the displacement of the normal tissue by fibroid tissue and cavities, or the compression of lung tissue by the filling up of the pleural cavity by fluid or air, extra work is thrown upon the remaining portion of the pulmonary tissue and the performance of this extra function causes an increase in the intensity of the murmur.

Prolonged Expiration.

Prolonged expiration is often found in early tuberculosis, and is rarely absent when the disease has extended. It shows that the normal elastic tissue of the lung has been interfered with, causing a diminution of its contractile power. Thus, in early infiltrations, contraction is slower than normal, causing the note to be prolonged. We must accept as a reason for the sound being somewhat more intense, the principle that owing to the infiltration interfering with the normal elasticity of the bronchi, they become somewhat rigid and offer resistance to the free flow of air; also to that other principle that sound is conducted through patent bronchi surrounded by dense tissue much better than when surrounded by air-containing tissue.

When large patent bronchi, bronchiectasis or cavities are present and these are interlaced with dense scar tissue, the ideal conditions, if the above explanation is correct, are present for a very pronounced prolongation of expiration, for the elastic tissue of the part is largely destroyed and the large air conducting chambers surrounded by dense tissue are present to conduct the sound. Such is true. There is no condition present in the chest which shows expiration so prolonged, so loud and so harsh.

Oftentimes prolonged expiration is present over all that portion of the lung or lungs which is not infiltrated. Sometimes this is confined to a single lung and even to a single lobe or part of a lobe. It often shows the presence of emphysema, although sometimes when accompanied by sharpening of the inspiratory sounds, it may mean only a temporary compensatory condition.

Normal Bronchial Breathing. Bronchial breathing shows a reverse of the vesicular. Expiration is longer and more intense than inspiration, and both phases are more or less harsh. This is found normally in the region of the trachea, in the interscapular region posteriorly and anteriorly along the borders of the upper portion of the sternum. This physiological bronchial breathing is simply a conduction of the murmur produced in the larynx and trachea, to the chest wall in the regions mentioned. The sound may be imitated by fixing the mouth to say "ha" and then forcibly inspiring and expiring.

Pathological Bronchial Breathing. Bronchial breathing found in portions of the lung other than those mentioned in the preceding paragraph must be considered pathological. This type of breathing varies greatly in pitch and in intensity. Its presence means either lung tissue free from air as found in infiltrations and fibroid tissue, a dilated bronchus, or a cavity communicating freely with a bronchus. The expiration at times assumes somewhat of a blowing character and is mistaken for the sign of a cavity. In fact, it is often very difficult to say whether the blowing character of the expiration means a cavity or dense scar tissue.

Amphoric Breathing. When the bronchial breathing assumes a definite amphoric type, such as might be imitated by blowing over a jar or whispering the syllable "ha," there is no mistaking its meaning. It is almost a positive sign of a cavity. This expiratory note is soft and of low pitch. It has been estimated that a cavity must be about the size of a hen's egg in order to produce amphoric breathing. I have found a well marked type of amphoric breathing in the first interspace at the right edge of the sternum, where we normally find physiological bronchial breathing, in a lung apparently free from disease.

Mixed Breathing. Aside from the definite types of breathing here enumerated, there are mixed types. Sometimes inspiration is distinctly vesicular and expiration bronchial in quality. Sometimes inspiration partakes of both vesicular and bronchial qualities, while expiration is bronchial. This is usually spoken of as bronchovesicular. It is found on scattered small infiltrations, also over normal tissue near an area of infiltration. It means that sound is being conducted to the ear from air containing and infiltrated areas at the same time.

Rough Breathing. Rough breathing as mentioned previously is perhaps the earliest sign of tuberculosis to be found on auscultation. It is often found later in the disease also, and is presumably caused in the same manner. There is also a distinct roughness associated at times with emphysema and sometimes with changes in the pleura.

I have often seen changes in the pleura cause such a roughness coincident with the inspiratory note that it might well be characterized as a grating.

Adventitious Sounds. There are sounds which accompany the respiratory murmur in diseases of the lungs which demand careful consideration. These may be produced either within the lung or in the pleural cavity. Oftentimes, in chronic tuberculosis, it is very difficult to be sure of their origin. Sometimes in the vicinity of a cavity there is a creaking which resembles rales.

Rales. Rales are produced by the motion of air, secretion or other fluids or solid material in the air passages. They may be either moist or dry, yet this division means very little, for the so-called dry rales are produced by moisture. The presence of rales in the lungs means the presence of a catarrhal condition.

Effect of Cough on Rales. Oftentimes these rales are not heard on ordinary respiration, but may be produced by deep breathing or coughing. No examination of the chest should be considered complete until the patient has been required to cough during auscultation. Not uncommonly do I find patients with extensively scattered lesions who have been repeatedly assured that their lungs were sound simply because percussion had not shown dullness and ordinary auscultation had shown no rales. Had the patient been required to cough during auscultation, the rales could have been detected very easily.

At times, rales disappear after coughing, which fact is sometimes taken advantage of to distinguish rales within the lungs from those of pleural origin.

Size of Rales. Rales are divided into fine, medium and large. The fine ones are supposed to be produced in the finer air passages, the medium in the medium bronchi, and the large ones in the large bronchi. That the size of the air passage in which the rales are produced is not the only factor to be considered is suggested by the fact that we also have fine, medium and large rales in cavities. It seems to me that the amount and character of secretion present is a very important factor. Thus fine rales may take their origin from either the fine air passages or from a scant amount of thin mucus in a larger tube or cavity; likewise medium rales might originate in bronchi of medium size or in larger ones, or cavities in which a small amount of mucus, not too tenacious in character, is present.

Constancy of Rales. In tuberculosis, it is surprising to see how constant rales are. By making repeated examinations of the chest and recording the relative number and character of rales found in the various parts of the chest, it will be found that a comparison of the various charts will show the presence of rales of the same character day after day and even month after month, until the pathological condition within the chest changes. Thus, in early tuberculosis, we find fine rales; a little later, may be a week or many weeks or months, if the disease is extending and going on to consolidation and cavity formation, medium rales will appear in the same area; and, as softening occurs, these will give way to large rales. Moist rales persistently remaining over one area, especially over the apices, nearly always mean tuberculosis. In tuberculosis, large bubbling rales persisting in an area away from a large bronchus, as the apex or the base of the lungs, nearly always mean cavities.

Metallic Rales. Sometimes in cavities, the rales assume a distinct metallic sound, and at times they simulate falling drops of water.

Dry Rales. The name dry rale is a misnomer because it is dependent upon moisture for its existence the same as the moist rale. Aside from the moist rales already mentioned, we find in tuberculosis many sounds which are difficult to classify, most of which belong to the class usually described as dry rales. Sometimes these are clicks or squeaks, sometimes they resemble the croak of a frog, the rattle of musketry, the purr of a cat, the whine of a puppy or the low note of a bass viol. The higher toned ones originate in the smaller passages and the lower ones in the larger passages. They depend for their origin upon a small amount of very thick, tenacious mucus.

I have come to look upon a click, squeak or croak which remains localized over a given area for some time as being very suspicious of destruction of tissue and cavity formation.

In tuberculosis, several of these different kinds of rales may be present over the same area at the same time.

Rales and Sounds of Pleural Origin. One of the most difficult procedures in the examination of cases of advanced tuberculosis is to distinguish between sounds of intrapulmonary and intrapleural origin. If the only sound produced in the pleura were that of the pleural rub, we should have little difficulty, but we have sounds like crepitations, like bubbling rales and coarse gratings of pleural origin which are at times almost impossible to differentiate from those of respiratory origin.

Rules as laid down in text books for differentiating these sounds leave us in doubt in many cases. Pleural sounds and rales of intrapulmonary origin are identical as far as their quality is concerned, so the differentiation must depend on other features. Text books say that pleural sounds are more superficial, and give the sensation of being nearer the ear, that they are more apt to be heard on both inspiration and expiration, and that they are not affected so much by cough as are rales produced in the lung which often appear as a shower after an effort at coughing. Sometimes pleural crepitations may be felt on palpation.

It would seem that with these rules, the recognition of pleural sounds would be quite easy, but when we remember that the differentiation of the nearness of the sound is a matter of very slight degree if the rales have their origin in lung tissue adjacent to the pleura; and that the determining of the nearness might not be accomplished except by a practiced examiner; that crepitations, while usually heard only on inspiration, may also be heard on expiration; that these pleural sounds are sometimes influenced by cough; and that pleural crepitations are not always felt on palpation, we can see that our positive evidence is practically nothing, and we are left to rely largely upon our experience in differentiating these sounds.

Where the respiratory note is normal and there is no change upon percussion, if at the same time the patient gives a history of attacks of pleurisy over the area, then the differentiation is not difficult. But where we have an area of old pleural adhesions and the underlying lung tissue the seat of tuberculous disease, then it is often difficult, sometimes impossible, to differentiate. If the patient, however, is watched for months and the disease goes on to arrestment or cure, then the differentiation will be finally made out. Text books tell us that pleural friction is increased by pressure. This is true of light pressure, but, in my experience, firm pressure decreases and at times obliterates the sound. This also holds good in the pleural sounds which resemble crepitation and medium rales. By firm pressure we can usually decrease their number and at times totally obliterate them. I find this a very important aid in differentiation; and, when taken with the relative nearness of the sounds and the effect produced upon them by coughing, and the character of the underlying tissue, we can usually make a diagnosis. Sometimes we have both pleural and intrapulmonary sounds present which make the differentiation more difficult.

Voice Transmission.

If words are spoken or whispered by the patient while we listen to the chest over the areas of infiltration the sounds are heard more distinctly than over air-containing tissue, following the same law as bronchial breathing and vocal fremitus. It is well to use the same syllables all the time so as to become more familiar with them. For the spoken voice, I prefer "ninety-nine" spoken firmly, and for the whisper I prefer "one, two, three" long drawn out. Where large superficial cavities are present, the whisper is transmitted to the ear with such clearness that the syllables may often be distinctly understood. Over dense scar tissue, the same phenomenon occurs, so that a transmission of the whispered words cannot be taken for a sure sign of cavity. In cavities, however, as a rule, the sound is low and soft, while in fibroid tissue it is more harsh.

CHAPTER VII.

DISPLACEMENT OF THE THORACIC VISCERA IN ADVANCED PULMONARY TUBERCULOSIS.

Displacement of the thoracic viscera is found to some degree in all individuals who are suffering from chronic advanced pulmonary tuberculosis. Considering the frequency and importance of this condition, it is strange that it has not received more attention from clinicians and pathologists.

Normal Changes in Position of Organs of Respiration.

In order to understand clearly the pathological changes in position of the viscera, it is necessary to know the natural changes.

If we recall the changes which take place during the developmental and declining years of life we note that from birth to old age there is a continual change taking place by which the organs of respiration are gradually assuming a lower position.

The larynx which is high at birth gradually becomes lower and lower as years progress.

The upper aperture of the thorax changes very markedly. At birth, the anterior-posterior and the lateral diameters are nearly equal, and the junction of the first rib with the sternum is on about the same horizontal plane as the first dorsal vertebra; as the child grows older the anterior portion of the thorax gradually lowers and the anterior-posterior diameter shortens, so that by the time adult life has been attained a horizontal line drawn through the junction of the first rib with the sternum to the spinal column would, instead of striking the body of the first dorsal vertebra, strike the body of the third. The diaphragm, also, which is highly arched at birth gradually descends as adult life and old age approach. See Fig. 17, a and b.

Inspiratory Thorax.

Thus the chest at birth is round and the anterior and posterior borders of its superior aperture lie in about the same horizontal plane. This condition is that of inspiration, hence the child's chest is said to be physiologically in the phase of inspiration. This same type of chest is again found in emphysema but in this instance the chest is pathologically in a state of inspiration.

Expiratory Thorax.

During early childhood the chest remains much as it is at birth, but as puberty approaches the changes become marked, and the chest flattens. As old age approaches this becomes most marked and produces what is known as the physiological expiratory thorax.

The expiratory thorax is found pathologically in what is known as the paralytic thorax, one which is characterized by the fact that the superior aperture is on a marked inclined plane passing from behind forward and downward, giving the appearance of a marked anterior-posterior flattening

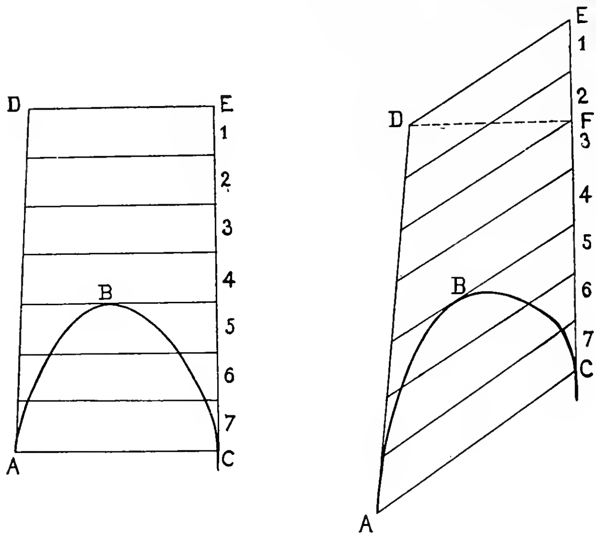


Fig. 17. (a.) Fig. 17. (b.)

Fig. 17. (a.) Schematic representation of the thorax of a child, showing the horizontal position of the ribs. D E, the superior aperture, A B C, the diaphragm.

Fig. 17. (b.) Schematic representation of the thorax of an adult, showing the manner in which the anterior portion of the thorax together with the intrathoracic viscera descends as adult life is reached. The superior aperture, D E, instead of being horizontal assumes an incline plane; and, a horizontal line drawn from the first rib to the vertebral column, D F, strikes the latter on a level with the upper portion of the third dorsal vertebra.

of the superior portion of the thorax, by the chest being long and the lower intercostal spaces being wide, and by an early ossification of the first rib.

Normal Changes in Position of Heart. Not only do the organs of respiration change their position physiologically in the various stages of life but the heart does also. At birth we find the apex about the fourth interspace. In adult life we describe the apex as being in the fifth interspace and the lower border of the heart being on a level with the lower border of the sixth rib at its junction with the sternum. In old age the heart gradually sinks lower until we can feel its pulsation at the lower end of the sternum, the apex being in the sixth interspace or even lower.

Position of Heart Depends on Pericardium. In order to understand the displacements which take place on the part of the heart, either physiologically or pathologically, we must recall a few points relative to the pericardium, for every change in position upon the part of the heart is dependent upon the nature of, or displacement of the pericardium.

The heart is completely enveloped by the pericardium. The pericardium has four firm attachments: first, to the diaphragm; second, to the sternum; third and fourth, to the right and left pleuræ respectively.

There can not be a movement of the diaphragm without a movement of the pericardium, nor can there be an increase or diminution in the size of either lung, no matter how slight, without its affecting the pericardium.

Aside from these firm attachments the pericardium is attached to the great vessels at the base of the heart, enveloping the aorta to the junction with the innominate artery.

Size of Pericardium Affects Position of Heart.

Not only the attachments of the pericardium, but the size of the pericardium also affects the position of the heart, because if the pericardium is small there is little chance for change of position while if it is large the heart has more latitude in its movements.

This is a very important point to remember not only in dealing with displaced hearts in tuberculosis, but in dealing with all forms of displacement of this organ.

We are taught in text books that the normal apex beat is felt in the fifth interspace on the left side about three and one-half inches to the left of the median line and one inch to the right of the nipple. Aside from the change in position which occurs at different ages this statement is misleading. In quite a percentage of individuals with normal hearts, the apex beat can not be felt at all, because the apex is not against the chest wall. In some of these it can be felt by having the person bend forward. When the pericardium is large the apex may be in what is described as the normal position when the individual stands or sits erect, but if he lies on the side it may shift even several centimeters. This should be remembered in estimating enlargements and displacements, as accurate diagnosis of either can not be made by the position of the apex alone. The movability of the apex in different positions of the patient is of great value in differentiation between physiological and pathological displacement.

Movability of Heart Depends Upon Condition of Aorta.

The heart may have a large pericardium and yet be only slightly movable, for its movability depends to some extent upon the condition of the aorta. In advanced age when the aorta hardens or whenever atheroma occurs the movability is diminished, because the aorta does not lend itself so readily to the movements.

Normal Outline of the Lungs.

That the displacements may be more thoroughly appreciated it is well to recall the normal boundaries of the organs as usually described for an adult.

The apices of the normal lungs extend from one to one and one-half inches above the clavicle.

The anterior border of the right lung passes forward and downward and approaches the median line at a point on a level with the junction of the second rib and the sternum. It then continues downward in the median line to a point on a level with the sixth costo-sternal articulation when it passes outward and backward, crossing the eighth rib in the mid-axillary line, until it joins the posterior border on a level with the tenth dorsal vertebra.

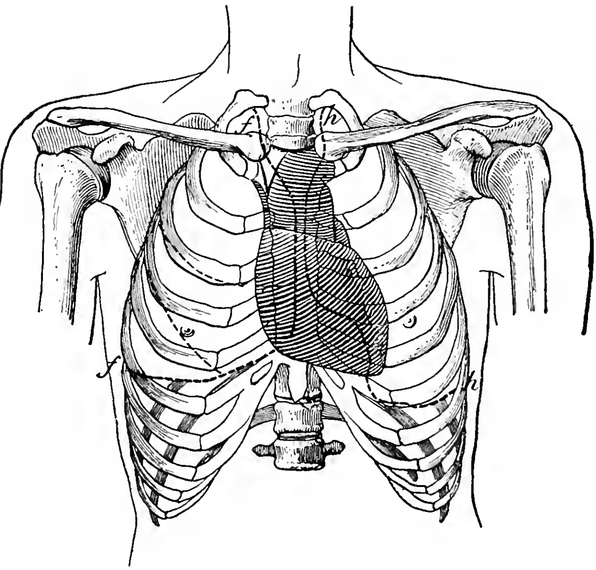


FIG. 18.—The thorax, showing the outlines of the intrathoracic organs as usually found in a healthy adult.

The anterior border of the left lung begins at the apex, passes downward and forward meeting the median line at a point on a level with the junction of the second rib and the sternum, the same as the right lung. It then follows the median line until it reaches the junction of the fourth rib and the sternum when it curves obliquely downward and outward until it reaches the sixth costal cartilage near its point of articulation with its rib, after which it passes around to the spinal column in the same manner as the right lung except on a little lower level (see Fig. 18).

Posteriorly the borders run downward from the apex in a gentle curve with the convexity upward and inward meeting the vertical line of the posterior border at the level of the space between the second and third dorsal spines.

Normal Outline of the Heart.

The outline of the heart as described by various authors differs somewhat. It also differs in different individuals as mentioned above. The following seems to me to be about the correct outline for the majority of adult individuals during the prime of life.

The superior boundary of the heart lies on a level with the upper border of the third costal cartilage, and extends from the articulation of the third left costal cartilage with its rib to a point on the superior border of the third costal cartilage about one inch to the right of the sternal margin. The right border of the heart extends from the upper border of the third right costal cartilage downward in a slight curve with its convexity outwards to a point in the fifth interspace about one inch to the right of the sternum. The inferior border crosses the sternum at the level of the upper margin of the sixth left costal cartilage at its junction with the sternum, terminating at the apex in the fifth interspace at a distance of about three and one-half inches to the left of the median line and about one inch to the right of the nipple. The left border starts at the apex, runs upwards and inwards to a point about two inches to the left of the left sternal border near the junction of the third left rib with its cartilage. (See Fig. 18.)

Importance of Recognizing Change in Outline.

The importance of recognizing the changes in outline which mark the displacement of the thoracic viscera is self-evident. From the standpoint of both prognosis, and being able to satisfactorily understand symptoms and apply the proper remedial measures, it is indispensable. The recognition of a marked contraction in one lung and a marked enlargement of the other, together with the displacement which takes place in the heart under these conditions, has an important bearing upon our methods of treating the case and especially upon the amount of exercise, the diet, and the degree of altitude which we would prescribe for such a patient. This is especially important in elderly individuals with hardened arteries, for the displacement twists the hardened arch of the aorta. The character of this displacement may also afford valuable evidence bearing upon the priority of involvement where both lungs are involved, as I shall explain later.

Cause of Displacement.

Displacements of the thoracic viscera are either acute or chronic. Acute displacements are due to pleurisy with effusion or pneumothorax, while those of a chronic nature are due to changes within the lung or within the lung and pleura combined. The former are produced quickly while the latter develop slowly. The cause is of a mechanical nature. It is due to a combination of contraction and enlargement, of pulling and pushing.

Displacement of the Lung.

The most common cause of chronic displacement of the lungs is pulmonary tuberculosis. There are a few cases which are the result of empyema, and some due to a condition which is described as simple fibrosis. In this connection the enlargement of the lung with the extension of its boundaries, due to emphysema, must also be mentioned.

We most often meet displacements on the part of the lungs in the form of contraction at the apices. Tuberculosis usually involves the apex of the lung. Soon after an infiltration occurs, certain changes take place. Either healing or the destruction of tissue ensues. Both of these processes are accompanied by contraction of the part affected. Sometimes a compensatory emphysema on the part of the lung tissue adjacent to the diseased areas occurs which fills in the space previously occupied by the tissue which is the seat of the contraction. Perhaps some emphysema always occurs, but in some instances it is so marked that very little, if any, change can be noted on inspection of the chest; in other instances the supra- and infraclavicular spaces are drawn in and the ribs appear sunken. When an infiltration of any extent has existed in an apex for any length of time, we find upon careful examination that the apex has contracted and is drawn down. Very often it is forced down by an inflammatory condition causing more or less thickening of the pleura which covers the apex.

If this contracting infiltration is small the only appreciable change that we note may be retraction of the apex. It is well to bear in mind, however, that tuberculous infiltrations which involve lung tissue near the surface are commonly accompanied by pleuritic adhesions of greater or less extent; consequently the apex is bound more or less firmly to the bony thorax, and the rest of the lung or lungs being free, contraction in this part is almost certain to make traction upon the remaining portions of the thoracic viscera, consequently displacing them to some extent. If that portion of the lung which is the seat of contraction extends as low as the second rib, and the contraction is marked, we must expect to find evidence of this contraction shown on the lower anterior borders of the lung, and also upon the heart.

The amount of the displacement will depend upon a number of factors. It is more marked where the disease has been confined to one lung, and most marked where the principal involvement has remained for a long time at the upper portion of the lung and caused a high degree of contraction to take place there before the disease manifested itself in other portions and before the lower parts became bound down with pleural adhesions. In such cases the opposite lung usually takes upon itself a high degree of compensatory emphysema and follows up the contractions, even pushing far beyond the median line in its endeavor to carry on the work of the destroyed tissue and to fill the space vacated by the retraction, as shown in Figs. 19, 20, 21. In case represented by Fig. 19 the patient had been ill for five or six years, the left lung being first involved, the right lung later. The left lung was the seat of a severe infiltration, which had resulted in the formation of both extensive cavities and much fibrosis. The right lung enlarged enormously, and extended more than an inch beyond the left sternal border. The heart was displaced to the left a distance of about two inches and upward more than one inch. This condition had made its appearance so gradually that it had not afforded the inconvenience that might be expected from such a change.

Figures 20 and 21 also illustrate high degrees of displacement. The continuous line illustrates the boundary of the heart and the broken lines those of the lungs. The circles are placed over the normal sites of the pulmonary

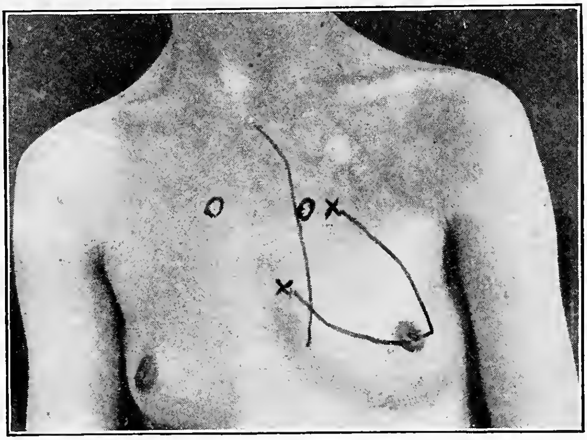


FIG. 19.—Showing displacement of thoracic viscera consequent upon a high degree of contraction on the part of the left lung. The right lung is the seat of compensatory emphysema and pushes beyond the median line to the left of the sternum as indicated by the dark line. The heart is pushed upward and to the left. The normal location of the aortic and pulmonary sounds is indicated by circles, the points of greatest intensity by crosses.

and aortic valves, while the crosses indicate the points where the sound of these valves is heard with greatest intensity.

Figure 20 illustrates a case with disease of about two years' standing. Both lungs were involved, the right but slightly. The patient has been under observation nearly one year, during which time a high degree of contraction of the left lung with a compensatory emphysema and enlargement of the right has taken place. Owing to the fact that the base of the left lung has been the seat of pleurisy which has resulted in adhesions binding the apex of the heart down, it is prevented from being drawn up to the extent that would be expected under the circumstances; consequently, the base of the heart has been pushed over quite far. One strange thing in this case is the fact that the upper left edge of the heart seemed to be separated from the chest wall by an intervening portion of the left lung. This is nearly always true of the lung which takes upon itself the enlargement, but it is not to be expected on the part of the retracted lung. This patient has been very seriously inconvenienced during the time when these changes have taken place, principally on account of a tendency to repeated hemorrhage, so she has not attempted to move around. If she had, she would have doubtless suffered much inconvenience on account of the heart.

The patient illustrated in Fig. 21 has been ill two years, a portion of which time she has spent in the mountains endeavoring to regain health and another portion attending to her ordinary duties. The right lung is now the seat of recent slight invasion. In spite of the high degree of displacement, this

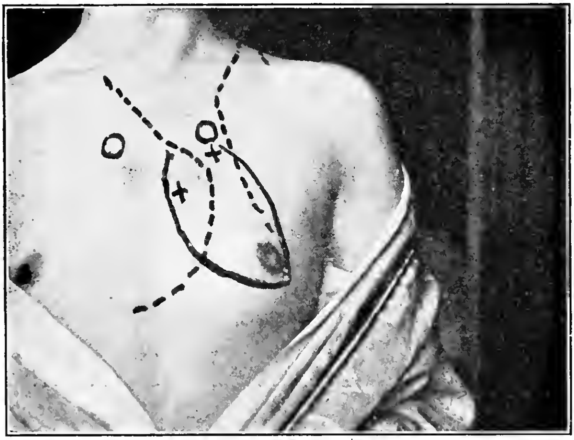


Fig. 20.—Showing displacement of thoracic viscera in advanced tuberculosis. Left lung seat of marked contraction. Right lung seat of compensatory emphysema. Heart displaced to left. Apex being bound down by pleural adhesions is prevented from being displaced far upward. Continuous lines represent the heart, broken lines boundaries of lungs. Circles represent the normal points of greatest intensity of the aortic and pulmonary valves; crosses represent the present points of greatest intensity.

patient has never experienced any dyspnea or inconvenience, and was very much surprised when she was apprised of her condition. In this case the force of the enlarged right lung has been spent in an upward direction pushing and lifting the heart far to the left. The liver dullness is also one inch above its normal, coming up to the dotted line in the picture.

Where both lungs are the seat of tuberculous infiltration, it is impossible to have so high a degree of enlargement as when the lung is sound, nevertheless, we do find this condition with both lungs involved. Careful inquiry and examination, however, will usually prove that the enlarged lung became diseased after the compensatory emphysema had taken place; or, at least, that, if an involvement was present prior to this time, it was not extensive.

At times we get a high degree of displacement where both lungs are involved, for example, if the upper portion of the lung is the seat of widespread destruction of tissue resulting in the formation of large cavities. Here nature makes an effort at repair, and attempts to carry on the function of respiration, and to fill in the space made vacant by the contracting lung by enlarging the remaining portion of the lungs. If this occurs on the left side or at the base near the sternum on the right, the heart is drawn and pushed into the space left by the wasted lung. The space at the lower part of the thorax when vacated by the retracted lungs, is occupied by the abdominal viscera which are displaced upward. The diaphragm is pushed upward. The liver dullness, and the tympany of the stomach are both found higher than when the

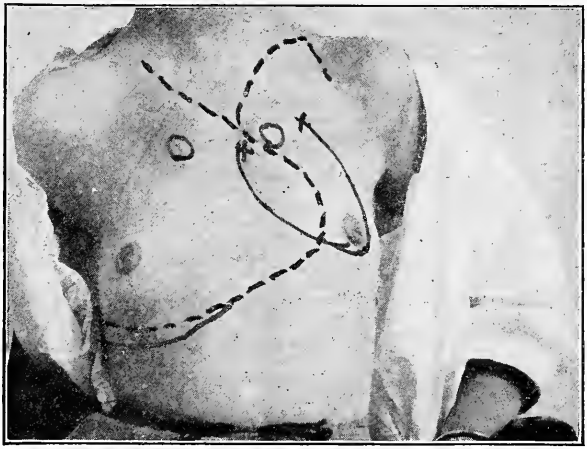


FIG. 21.—Displacement of thoracic viscera in advanced pulmonary tuberculosis, where left lung is markedly contracted and right the seat of compensatory emphysema. Continuous lines represent heart and normal liver dullness; broken lines, boundaries of lungs. Circles at normal points of greatest intensity of aortic and pulmonary valves, crosses at present points of greatest intensity.

lungs are normal. When the left upper lobe anteriorly is the seat of destructive change and contraction, the heart and great vessels are often uncovered. This condition gives a very diffuse impulse over the heart at each contraction. Where the large vessels are uncovered the pulsation is marked at the second interspace on the left of the sternum.

Effect of Displacement of the Lungs.

When an infiltration occurs in a lung, if healing takes place, it must do so by the formation of scar tissue. If ulceration occurs with cavity formation, and healing takes place, it still does so by the formation of scar tissue around the cavity. Scar tissue has a tendency to contract, and if contraction occurs before healing has been accomplished it reduces the size of the cavities and aids in their healing. The scar formation and contraction that occurs, while conservative, yet reduces the functionating area of the lung. To meet this deficiency a part or all of the remaining portion of the lung or lungs becomes the seat of a compensatory emphysema and takes upon itself the work which had previously been accomplished by the part affected. With this extra burden thrown upon the remaining portion of the lung, all goes well providing too much lung tissue has not been destroyed. It is truly marvelous to see what little inconvenience sometimes follows even a high degree of destruction of tissue. If the amount of destruction is too great, the remaining portion of the lung or lungs in enlarging and endeavoring to take upon itself the extra function may become seriously incapacitated. The air vesicles dilate to their utmost and instead of being able to perform an increased function, may be disabled. Thus a conservative process has become destructive. While the function of respiration may be carried on with little inconvenience even with a high degree of contraction and compensatory emphysema present, yet, if the proper balance is exceeded, the respiratory function will be interfered with, the aëration of the blood will be imperfectly accomplished and dyspnea will result.

The effect of such conditions upon the heart must also be considered. In these cases the heart is displaced, it is laboring under unnatural conditions, it is bound down by adhesions, and it is compelled to force the blood through the pulmonary system against enormous odds, because many vessels have been destroyed with the loss of tissue that has occurred, and the lumen of many have been obliterated where not actually destroyed. The new scar tissue is but poorly supplied with vessels and the tissue that becomes emphysematous offers a great hindrance to the free flow of blood through the lung. Consequently the heart is greatly embarrassed and must be carefully considered in treating these patients.

Displacements of the Heart. It is the exception to find the heart in its normal position in advanced chronic tuberculosis. Contractions here and there with compensatory emphysema of other parts, pleuritic effusion and adhesions draw and push the heart away from its original location. In some cases the change is very slight and will not be recognized without a very careful examination. Displacements are the most marked where one lung only is involved, or where, if both are involved, one is involved before the other, and this previously involved lung becomes the seat of a high degree of contraction and the other becomes the seat of compensatory emphysema. Under such circumstances we may find the apex of the heart to the left of the nipple line, and occasionally the entire organ so drawn up and toward the left that it lies entirely above the nipple, the apex being beyond the axillary line. Such a high degree of displacement can only occur when the patient possesses a large pericardium or when the diaphragm is pushed high up, or when both of these conditions are present. The accompanying cuts (Figs. 19, 20 and 21) represent a high degree of displacement due to contractions of the left lung followed by a compensatory emphysema on the part of the right. When the contraction is on the right side, the entire heart may be drawn or pushed over beyond the median line with the apex two inches to the right of the sternum.

In the majority of cases, however, there is a much less degree of displacement. The heart may be drawn over to the right or to the left for a half inch or an inch. Not an uncommon displacement of the apex is upward and outward.

Sometimes one lung is seriously involved and a marked degree of contraction is present and yet the heart shows but slight, if any, displacement. In this case the absence of displacement is doubtless due to the heart being held in place by pleural adhesions. Where both apices are simultaneously and about equally involved, marked contraction may occur without producing much displacement of the heart, either to one side or the other, due doubtless to the opposing force of the contracting lungs counteracting each other. In such case the entire organ is lifted or pushed up as the diaphragm ascends.

One can often form an opinion of the priority of involvement when both lungs are affected by simply observing the displacement of the heart. If with a double involvement the heart should be drawn up and over to the right, I should suspect the right side to have been involved first; or, at least, to have contracted first. If, on the other hand, the displacement should be up and toward the left, I should suspect the left side to have been first involved. As exceptions to this rule we occasionally find a more rapid destruction and more rapid contraction to take place on the side which is involved later, or on one side when both are involved at the same time. In such a case the heart might be displaced toward the side which is the seat of the greater destruction and contraction.

Detection of Apex Beat Difficult.

Although I have never seen reference to the fact in medical literature, yet I have found that the apex of the heart is often very difficult to locate in patients suffering from advanced pulmonary tuberculosis. In many cases its beat can not be seen on inspection nor its impulse felt on palpation. By having the patient bend far forwards its impulse may be felt sometimes where it is not palpable with the patient in a sitting posture; but even this method sometimes fails and we are obliged to locate the apex by percussion and auscultation. The reason for this is very plain. It is due to the apex being drawn or pushed away from the chest wall as a result of contractions and hypertrophies of the lung tissue or to contraction resulting from pleural adhesions. Such movements, of course, depend on the size of the pericardium. If the pericardium is small, the apex can not get far away from the chest wall, while, if it is large, more movement is permitted.

When the heart is displaced to an extreme degree, especially to the right, it is sometimes very difficult to locate the apex. It must not be taken that that part which causes the stroke against the chest wall is the apex, for in the dislocation which occurs the relative position of the parts of the organ are so changed that the impulse on the chest wall is more probably due to the side of the ventricle than to the apex; in fact, in these cases the heart is pushed *in toto* toward the right; it is not pushed around as has sometimes been supposed, with the great vessels acting as a hinge and the entire organ reversed. Such is impossible except under anomalous conditions. It is almost impossible also to locate the valves, for their relative position is changed and we can no longer depend entirely upon the distinctness of the sound for our location.

Effect of Changed Position Upon the Heart and Lungs.

Throwing the heart out of its normal relationship in the thorax, putting it on a strain by traction and pressure, and drawing and twisting the great vessels at the base of the heart, which are often hardened in patients beyond middle life, can not help but throw extra burden upon this organ, which, as I have shown elsewhere, is already bearing the brunt of the fight against the disease. In spite of the extra burden thrown upon the heart, it bears up under the strain most wonderfully. As a rule, such changes come gradually, and are not attended with great inconvenience; in fact, the heart may be the subject of a high degree of displacement without any unusual inconvenience beyond what would be expected to accompany the tuberculosis. When this change comes quickly, however, and where the organ is put on an unusual strain, it sometimes encounters difficulty in adjusting itself to the new condition. In a few such cases in which I watched the displacement occur from month to month, the patients suffered from tachycardia, palpitation and a feeling of faintness until the heart became adjusted to its new position. These symptoms gradually improved, however, and after a short time disappeared.

During this time rest is essential. The heart should be spared all extra work until it becomes accustomed to its new position.

The effect of compensatory emphysema on the part of the unaffected lung is favorable to the patient. It insures that the function of the lung will be carried on in spite of the loss of tissue. However, if it occurs to too great a degree, it defeats its own purpose. As long as compensation occurs in these high degrees of compensatory emphysema all is well. The respiratory function is carried on and little inconvenience is experienced on the part of the patient. The most serious thing that can happen in these cases is for the emphysematous lung to become also the seat of a tuberculous involvement, or at least to become seriously involved. As long as it is free from tuberculosis, providing the changes in lung tissue are not too great, the function of respiration may be carried on; but, if it becomes involved, then we must expect serious trouble. Another serious condition results when the acini of the lung which is the seat of compensatory emphysema become dilated to such a degree (become truly emphysematous) that they are no longer able to perform the functions of respiration.

Management of Patients Who Have Displacement. Patients who have such conditions should be apprised of them and their lives should be so regulated that there is the smallest call made upon the heart and lungs that is consistent with a moderately active life. They should never again attempt to live strenuous lives, but by care they may lead lives of usefulness. Extra effort should be made to keep the emphysematous lung free from tuberculous infection or to cure it as quickly as possible if it is already present.

Such persons should not live at a high altitude, nor should they undergo severe physical exertion. I believe also that it is very important that these patients should not gain too much weight or gain it too rapidly, for this throws extra burden upon the organs of respiration and circulation.

Aids in Detecting Displacement. It requires some skill at physical examination in order to be able to outline the boundaries of these displaced organs, yet it is not so difficult but that any one who is accustomed to examine chests can master it with a little close application to detail.

The ordinary methods of percussion and auscultation may be sufficient to outline the displaced boundaries of these organs, but if any one wishes to become expert at it he may obtain much help from familiarizing himself with other methods such as I have described in Chapter VI. For the heart I would especially recommend auscultatory stroking and percussion, the author's elastic tube percussion, and Ebstein's percussion. For outlining the boundaries of the lungs, auscultatory percussion and stroking and elastic tube percussion are of the greatest value. The findings on percussion should be proved by the stethoscope, beginning over an area known to belong to the lobe in question and then following it out, listening at every point until the border has been reached. When the stethoscope is placed beyond the border and over the other lung the change in the character of the note is usually easily recognized. This can be appreciated because one lung is hypertrophied, the other contracted, and these two conditions produce different respiratory notes. The fluoroscope may be used to great advantage in these cases in studying them in connection with ordinary methods of examination.

CHAPTER VIII.

PROGNOSIS IN TUBERCULOSIS.

The prognosis in a given case of tuberculosis, depends, first, upon the nature and extent of the disease; secondly, the directing intelligence by which the disease is managed; and thirdly, the character and determination of the patient.

Nature of the Infection.

There is great difference in the virulence of different bacilli. Some are so virulent that an infection with relatively few germs will produce a grave disease. Such infections are rapid in their course and destructive in their nature. Other infections are of bacilli of such a low grade of virulence that the organism overcomes them entirely, a cure resulting; or, failing this, holds the disease in check perhaps for years, allowing it to manifest itself only when the person infected has been reduced in vitality by some such cause as excesses, overwork, bad methods of living or some exhausting illness.

It is not at all improbable that toxins make their way out of these apparently quiescent foci and exert a deleterious influence on the tissues with which they come in contact, especially upon those lying in close proximity to the foci; which makes them more prone to become the seat cf infection.

Extent of the Disease Important.

The extent of the disease is a very important factor in prognosis. All things else being equal, the smaller the area involved the better are the chances of the patient for improvement or cure. This can readily be seen when we bear in mind the pathology of the disease. Of course the severity of the process, the amount of tissue destroyed, and the complications present must all be considered.

Tuberculosis has a tendency to spread from the original focus in the lung to other tissues of the body either adjacent or remote. The routes of infection in these cases are the lymph channels, the air passages and the blood stream. This advance of the disease is opposed by the natural defenses of the body. The principal protective agencies, so far as we know, are found in the body fluids. So our picture is that of a more or less constant outbreak of bacilli from the areas of infection with a simultaneous defensive movement upon the part of the natural protective elements in the blood stream.

Here the same law comes into play that governs infection in general, viz.: if the bacilli are present in great numbers, or if the numbers are less but the virulency great, or if the patient's resisting power is low, then infection will occur. It is very plain then to see that, given an infection of a certain degree of virulence, the prognosis depends much upon the extent of the disease; for, the larger the area of involvement, the greater the opportunity for the escape of bacilli into other tissues. And it must be remembered that in this conflict which ensues there are losses on both sides. While many of the bacilli may be destroyed and the spread of the disease be prevented, at least for a time, yet this advantage is gained at the expense of a considerable loss on the part of the patient; for the content of his blood serum in defensive bodies gradually diminishes, the antibodies being used up in the conflict with the bacilli. That this actually occurs has been shown by the estimation of the opsonic index of the blood after Wright's method. Thus the advantage is given over to the invading bacilli, and gradually new foci of the disease are started. With each new focus the opportunity for the escape of bacilli increases, and so the vicious circle continues.

Why Incipient Tuberculosis is most Curable.

With this explanation we can easily see why incipient tuberculosis can be cured so readily and why advanced tuberculosis is so difficult to overcome. Of course in advanced tuberculosis another element enters in. The results of the disease, such as destruction of tissue, the formation of new tissue, the havoc wrought by other bacteria, together with diseases of other organs, must be considered. Nevertheless the explanation which I have given above demonstrates with mathematical clearness the advantage of early diagnosis over late diagnosis from the standpoint of prognosis.

Responsibility of Cure in Tuberculosis Upon Family Physician.

The prognosis in tuberculosis then depends upon the earliness of diagnosis and the intelligence with which the case is handled. Since the family physician is the one to whom these patients, suffering from symptoms of early tuberculosis, are most likely to go, we can truly say that the prognosis in tuberculosis depends upon the ability of the family physician to recognize the symptoms of early tuberculosis. He may not have had the teaching or the practical experience which will enable him to make a thorough physical examination by which he may detect the delicate changes found in early tuberculosis, but there is no excuse for his not bearing in mind those early symptoms of this disease, such as, a feeling of languor, an altered nervous condition, capricious appetite, slight loss of weight, night sweats, slight elevation of temperature, hemoptysis, and pleurisy; and if unable to make the diagnosis alone, for the sake of his patient, he must call some competent consultant. The burden of early diagnosis is upon the family physician. He cannot throw it off. He must shoulder it, and upon the seriousness with which he accepts this charge depends the progress that will be made in mastering this disease.

The members of the medical profession must arouse themselves. They can no longer be true to their calling and ignore the great advances which have been made in recent years in dealing with this disease. It is time to throw off pessimism, for it has no place. It is time to discard indifference because it takes away from the patient his chance of cure. Recognizing the important advances which have been made in the knowledge of tuberculosis during the last few years, which have removed it from the rank of hopeless diseases and placed it in the forerank of curable chronic diseases, and have demonstrated that from sixty to ninety per cent of those suffering from incipient tuberculosis may be cured when treated intelligently, the members of the profession must assume a hopeful attitude and undertake the cure of this disease with the same earnestness that they show in dealing with other curable maladies.

Not only is the responsibility of diagnosis upon the family physician, but that of cure as well. The great majority of cases of tuberculosis will be treated by the family physician. Perhaps in few diseases does the result of treatment depend more upon the medical man than in tuberculosis. Tuberculosis is a chronic disease which heals slowly, and, yet, during a great portion of the time the patient does not feel ill. The physician must have the patient's absolute confidence and implicit obedience. He must be optimistic, forceful, desirous of making the patient happy and contented, but yet knowing when and how to say "No." He must keep the patient interested until the cure, arrestment or other result is obtained. If he wavers, shows discouragement or lack of confidence in the final outcome of the treatment, the effect on the patient is often very marked. An intelligent, cheerful, optimistic, conscientious physician who understands tuberculosis and the tuberculous patient is a great factor in the prognosis of this disease.

Patient's Responsibility in Diagnosis.

Patients do not always seek advice at the beginning of the disease. They have not yet learned the importance of early signs. Here again the family physician should exercise his rights. As the guardian of the health of the members of the families in which he is employed, there should be such a relation of confidence between the family physician and his families that he would be expected to call attention to any indisposition that he might note. He should watch with especial care those children who have been exposed to dangers of infection through intimate association with a tuberculous patient in previous years. He should train them to seek advice at the earliest manifestation of suspicious symptoms no matter how slight they may be.

Since it has been demonstrated that an early diagnosis in this disease is very important and that the initiative must be taken by the patient (except when it is taken by the family physician as suggested above), it seems to me that the prognosis in this disease could be greatly improved by familiarizing all school children with the early symptoms of tuberculosis and by emphasizing the fact that intelligent aid given at the outbreak of these early symptoms means a curing of the disease in a large proportion of instances.

Patient's Responsibility in Cure.

While the prognosis varies with the earliness of the diagnosis, and the responsibility rests with the afflicted to seek advice when the early symptoms show themselves, yet a greater responsibility rests upon him in the cure of the disease when it has once been discovered. I always emphasize the point with my patients that whether or not they shall get well depends largely upon their own individual effort. I have seen conscientious patients with the desire of their lives so bent upon cure that every act counted for recovery. I have seen this determination snatch them from what seemed to be certain and early death. On the other hand, I have seen indifference and willful disobedience turn an apparent recovery to a hopeless end.

An obedient, intelligent patient will often make an unfavorable prognosis favorable, while an indifferent, willful patient will often throw away bright chances.

Prognosis in Advanced Cases.

While it is the early case that offers the best prognosis, yet those farther advanced are not beyond hope. In many moderately advanced cases and in some far advanced, we see all symptoms disappear and the patient again assume life's duties. In many cases when this apparent cure can not be attained, an arrestment of activity can be secured. This result, while not as fortunate as an apparent cure, is not incompatible with a long and useful life. In fact, many such will go on to a final healing. I have known many patients who, while unable to secure an apparent cure of their tuberculosis, still having an old cavity which continued to secrete a small amount of bacillus-bearing sputum, were yet able to lead a moderately active life with no other inconvenience than that of clearing out their cavity each morning. To be sure, this is not as desirable as an apparent cure, yet it is often as favorable a result as can be obtained, and one that offers much hope to those suffering from advanced tuberculosis.

Heart in Prognosis.

Among the most important symptoms to bear in mind in giving a prognosis in a given case of tuberculosis are those upon the part of the heart. A good heart is a very valuable asset to an individual suffering from tuberculosis. Tuberculosis is an inflammatory condition involving the lung tissue. Through its action as mentioned previously, new tissue forms, normal tissue is destroyed, blood vessels are obliterated, catarrhal thickening of the mucous membrane of the air passages results, the area of pulmonary circulation is considerably lessened, hence the heart is embarrassed. We must also add to this mechanical embarrassment the fact that the heart is unfavorably influenced by the toxins which are liberated in the system, and also that the myocardium partakes more or less of the general muscular wasting of the system, and further that owing to contractions which take place, the heart is pulled and twisted out of place and bound down by adhesions and consequently compelled to labor under great difficulties.

If the heart withstands the effects of the toxins, and adjusts itself to the obstruction in the lung and to these other influences, this will add very much to the prognosis. If, on the other hand, the heart weakens, the pulse becoming rapid and soft, the prognosis is less favorable if not positively unfavorable.

A pulse which is much higher than would be expected with the temperature range, and does not respond to rest in bed with appropriate care, in a few weeks' time, must be considered of unfavorable prognostic import.

Digestive System. The condition of the digestive system is very important. Fortunately many of the symptoms of which tuberculous patients complain on the part of their digestive systems disappear when they are placed under favorable conditions. However, where there is present organic disease of the alimentary canal, or where there are functional disorders which fail to respond to treatment, the prognosis is bad. I have seen patients do well in spite of grave disturbances on the part of the digestive system, yet, as a rule, progress is unsatisfactory without good digestion.

Loss of Weight. The amount of weight lost must be considered in connection with the cause of such loss. If a patient has lost weight because of an acute exacerbation of the process in the lung which yields to proper management in a reasonable time, it is not serious. If this loss has been associated with improper methods of living, it will often be recovered readily upon a correction of them. If it be due to serious stomach or bowel trouble which does not soon yield to treatment, the prognosis is bad. If it be due to chronic toxemia associated with cachexia, it is very unfavorable for it is but rarely that such a patient can put on weight. A failure to put on weight in spite of full diet is also unfavorable. It is not at all uncommon, however, to find patients who have made enormous losses, even to one-fourth of their body weight, steadily regain when they have been placed under proper treatment.

Temperature. We can place no reliance on temperature except as it suggests to us the presence of certain conditions. However, a temperature which does not yield to intelligent treatment within a few months is of bad significance, for it usually indicates a serious involvement or a lack of resistance. High temperatures will often yield to treatment in a very short time.

Individual Resistance. Individual resistance is always an uncertain factor. It raises some from the brink of the grave to useful citizenship; and it dooms others who seem to have every opportunity for regaining health, to quick and certain death.

Some patients with slight involvement present very severe symptoms of toxemia, and respond poorly to treatment. On the other hand, others with extensive disease remain in good physical condition, and respond readily to proper management.

An individual who has had the disease for a number of years shows more resistance and offers a better prognosis than one who has had his breakdown recently. In these cases fibrosis predominates over ulceration, although cavities are always present. The exception to this statement is when secondary changes, such as extensive fibrosis and emphysema, or serious complications on the part of other organs have arisen as a result of the prolonged illness.

There is one class of cases which rarely responds favorably to treatment. It consists of those patients who have daily rises of temperature, showing intermissions, but rarely remaining normal for the entire twenty-four hours, and in whom the heat controlling function seems unusually sensitive, showing a variation in temperature of from one to several degrees upon the least provocation. The pulse is usually rapid and digestion variable. Cachexia does not develop quickly although it comes before the end. In my experience the majority of these cases have been of the nervous type. In several such I have seen the condition in the lung clear up, and the area of involvement become markedly less, yet the temperature remain in its unstable condition.

Former Environment. The previous environment of a patient has an effect on the prognosis. A patient who has developed tuberculosis in spite of hygienic living, in spite of good food and being surrounded by the comforts of life, shows a lowered resistance to the disease, and even the greatest change that we can make in his life, such as is offered by sanatorium treatment, is often not sufficient to overcome the disease. Again, patients, whose occupations keep them in the open air, who, nevertheless, have developed the disease in spite of this, are, as a rule, unfavorable patients for treatment, and must have more than open air to produce a favorable result. A patient from the slums, on the contrary, who has been sleeping in overcrowded, poorly-lighted and badly-ventilated rooms, who has lived on scanty amounts of unwholesome food and who has been accustomed to many irregularities and vices, is completely transformed when placed under treatment for tuberculosis according to the modern methods of cure, especially so when he is placed in a sanatorium. He is in a new world. His resisting power is awakened and he shows a marked advantage over his well-to-do brother.

This fact is very encouraging to those who are striving for the establishment of state and municipal sanatoria for the treatment of the poor. They know that their energy directed to the poor will bring the greatest returns in curing and checking the spread of the disease.

Financial Condition. There is a class financially below the well-to-do who are accustomed to comfortable homes, but with whom life is still a struggle. They do not wish to be objects of charity yet they are unable to meet the requirements necessary to wage a successful fight against a long drawn out disease. These patients respond well to treatment. They would be happy and contented, but they have the ever-present burden of insufficient funds staring them in the face. This lessens their chance of recovery. The greatest hope that we can offer this class is to discover the disease in that stage when the cure can be accomplished most quickly.

Temperament. Temperament has much to do with prognosis. A bright, cheerful, contented patient, who is willing and anxious to do all he can to get well, increases his chances materially, while one who is despondent, pessimistic, determined to find fault with everything, and everybody, lessens his chances of cure.

A patient who is passive, and who does not exert himself, does not offer as good a prognosis as one who has spirit and determination.

Age. Children seem to respond well to treatment for tuberculosis. Young adults from the age of fourteen to twenty seem to show a lowered resistance. The prognosis in the case of a girl at twenty according to my experience is as good as that of a boy at twenty-three. The girl seems to be more mature. The greatest resisting power to the disease seems to be from twenty-five to forty-five, and I have found patients of these ages yield best results from treatment. My experience with elderly individuals has been that, though they develop the disease more slowly than younger persons, yet, except in rare instances, they do not seem to gain sufficient immunity to overcome it.

Complications. The effect of complications on prognosis must always be considered. Any severe disease has a tendency to lower vitality and aid tuberculosis in its advance. The extension of the disease to other organs also affects the prognosis. Tuberculosis of the larynx has long been considered as almost a hopeless complication, but recent methods of treatment, together with early diagnosis, show it will yield. I am in the habit of looking upon tuberculosis of the larynx when diagnosed early as a serious but by no means fatal complication.

Tuberculosis of the intestinal tract is considered of grave prognosis, yet we know from post-mortem evidence that it also heals. Mild infection of the intestines should not necessarily condemn a man. I believe that if a fair trial were given many of these cases, we might change the prognosis. Here, the same as elsewhere, an early diagnosis should be made.

Hemoptysis. The occurrence of hemorrhage is looked upon very differently by different observers. In the great majority of instances no appreciable harm follows slight spitting of blood. This occurs in the course of the disease in a very large percentage of cases. It is always an indication for placing the patient in bed and ordering absolute rest; and, if heeded, a more severe hemoptysis may be avoided.

Severe hemorrhages sometimes produce pneumonia. They are sometimes followed by an extension of the disease. I have repeatedly seen miliary tuberculosis follow them and end the patient's life. Sometimes the shock following a hemoptysis is such as to destroy the patient even although the loss of blood is insignificant. I have seen several such deaths; one occurring the third day after a hemorrhage amounting to about three or four ounces, in a patient who had been progressing very favorably.

In a small percentage of cases hemoptysis proves fatal instantly. This occurs in advanced cases and is due to the erosion of a large vessel or the rupture of an aneurism.

I have seen some relief follow hemorrhage in a few cases. In one instance, particularly, I remember a severe inflammatory condition accompanied by a most aggravating cough which had persisted for five or six weeks, ended by the spitting up of a few ounces of blood. Nevertheless, I can never look upon it with unconcern.

Pregnancy. Pregnancy is a very disastrous complication in tuberculosis, especially where the disease is in an active state. While the mother may do well during the period that she is carrying the child, yet in a large percentage of cases the disease starts up with renewed vigor after delivery. In many cases it takes away all chances of arrestment or cure.

Number of Bacilli and Prognosis. There is a widespread belief among the laity, which is shared to a great extent by physicians, that the number of bacilli found in a field of the microscope has some prognostic significance. Often we have patients tell us with great glee that only a few bacilli were found in their sputum. This fact alone is of no consequence. It can be interpreted only by taking into consideration the nature and extent of the tuberculous involvement in the lung. It must be remembered that we are not sure where the specimen examined comes from. If it comes from a small ulcerating surface in a bronchus and is mixed with other mucus it may have only a few bacilli, while if it comes from within a large cavity it may contain many.

If it were possible to find some way of determining the virulency of bacilli, it would be of much value in prognosis. Following out Sewall's suggestion that short, thick bacilli are found in virulent cases and long beaded bacilli in those of a more chronic, hence less virulent nature, I have made observations and my experience tends to confirm his statement, although we often find both kinds of bacilli in the same case.

How Long Treatment Necessary.

One of the most unsatisfactory points connected with the treatment of tuberculosis is the length of time necessary to produce the desired result. It is a great triumph to be able to cure this disease at all, so we must not be disheartened, but endeavor, through earlier diagnosis and improved methods, to shorten the term of treatment. An incipient case may be apparently cured in from three to six months although there are very few who should be treated so short a time as three months. There are a few who will require even more time than six months. More advanced cases secure arrestment or apparent cure in from six months to one or two years, the average time being from eight months to a year. Oftentimes physicians, in referring cases to sanatoria, become too optimistic and tell the patient that two or three months will cure them. This causes severe disappointment on the part of the patient when he learns that the time required will be longer.

CHAPTER IX.

PROPHYLAXIS.

The most practical point in prophylaxis, is to cure as many patients as possible before the disease reaches the open stage.

One of our first aims in the treatment of tuberculosis is to have the patient so conduct himself that he will minimize the danger of reinfecting himself. If he does this, he will also minimize the danger of infecting others.

It must be borne in mind that the patient suffering from tuberculosis in the ulcerative stage is carrying tubercle bacilli with him in his air passages below the larynx all the time and in the mouth and pharynx a great deal of the time. During sleep, at least, and at other times, through accident, if not purposely, he is sure to swallow them. How extensive this reinfection is and what part it plays in the course of the disease, we do not know; however, it is but natural to suppose that it is a factor of some importance, and one that should receive careful consideration at the physician's hands.

This question of reinfection lays before the supporters of the direct inhalation theory a very serious question which must be answered. If a few bacilli inhaled into the air passages (according to their theory) will cause infection, what saves men, whose air passages constantly receive numbers of bacilli from ulcerations in their walls, from certain death; and how is it that so many of these recover? The supporters of the ingestion theory must also tell us why the bacilli which these patients swallow do not constantly reinfect them and carry them on to rapid death. This question is another evidence that all is not yet known about infection.

While we must admit that these dangers are always present in cases of advanced tuberculosis, yet, it is our duty to minimize the opportunity of reinfection as much as possible. Fortunately, the precautions which we must ask the patient to take in order to protect himself are the same as are necessary to protect others. If a tuberculous patient conscientiously follows out the rules of hygienic living that appertain to his case, which are so painstakingly laid down in books and pamphlets dealing with the prevention of tuberculosis, he stands in no danger of transmitting the disease to others.

Dust Infection.

There are several theories which attempt to account for the manner in which bacilli are carried from the sick to the well. The theory of dust infection held unquestioned sway for a number of years. Cornet supported this theory with a great mass of evidence, and showed to the satisfaction of the scientific world that tuberculosis is spread by the bacilli which come from discharges from tuberculous ulcers. The principal source of bacilli is the sputum from the ulcerations in tuberculous lungs; this becomes dry and then passes into the atmosphere as dust to be taken into the body with the inspired air.

Droplet Infection.

Fluegge noted that there was a fine spray of sputum thrown out by the patient during coughing, sneezing and talking; and, by placing culture plates before the patient he was able to prove that these little droplets contain bacilli; and, after some observations, he announced this as "one of the most common ways in which tuberculosis is transmitted." Cornet, in the second edition of his book, examines the droplet theory and gives some very important experiments bearing upon the theory. Plates were set before patients who were coughing, at a distance of from one-half to one meter from the mouth. Laschtschenko found these to contain bacilli 4 times in experiments with 21 patients, Heyman 14 times in 35 patients, Moeller in half of 30 patients but only after an exposure of five or six hours, Goldie in 60 per cent of his experiments after twenty-four hours' exposure. B. Fränkel had a number of patients wear masks for twenty-four hours, and upon 219 of these masks he found within thirty-two days 2600 tubercle bacilli. It has been reckoned that one patient, suffering from advanced tuberculosis, will by expectorating once an hour, expectorate 7,200,000,000 bacilli a day. After considering these facts, we must admit that the greatest source of danger lies in the expectorated sputum and that the great fear of impalpable sputum which has been engendered in some minds has no secure grounds for its foundation.

Infection Through Ingestion.

For many years the direct inhalation theory has been questioned and men have suspected the alimentary tract as being the portal of entry. Behring has more recently advanced the theory that infection takes place in nearly all instances in childhood during the milk using age, and that the cause is bovine bacilli ingested with the milk. While we must all admit that there is some danger from this source, yet we cannot believe that even a large proportion of cases are infected in this manner.

That infection frequently takes place through bacilli which have been swallowed, we believe to be fairly well established; but we believe that the source of bacilli is usually some person and not an animal suffering from tuberculosis. The tonsils have also been established as portals of infection, and are believed by some careful students of the subject to be the chief ports of entry of the tubercle bacillus.

Bacilli do not Multiply Outside the Body.

While it is very desirable to know the exact manner in which bacilli pass from one individual to another in causing infection, as yet we cannot be positive. There are certain things, however, which we do know that aid us in establishing an intelligent prophylaxis. The most important of these is that tubercle bacilli do not multiply outside of the body. When once expectorated, they may retain their vitality for many months, but they will not increase in number. The bacilli which cause infection in an individual are the very same bacilli which have been expectorated by some one who was suffering from tuberculosis. If, then, the discharges from tuberculous ulcers, especially those from the lungs, could be destroyed, the spread of the disease would cease.

Personal Prophylaxis. Patients should be told that the danger of infection lies in the discharge from tuberculous ulcers and that if this is properly collected and destroyed, danger of communicating the disease to others is removed. In tuberculosis of the pulmonary and laryngeal form, the danger lies in the expectoration. The breath is not dangerous.

The patient should not swallow the sputum lest it cause tuberculosis of the bowel; and now that it is generally acknowledged that the alimentary tract is a very important avenue of infection, we must recognize the possibility of even reinfecting the lungs through the bacilli that have been swallowed.

The patient should be absolutely cleanly about his habits. No man who expectorates bacilli should wear a mustache or beard and no woman should wear a veil. The reason is obvious to all.

Patients should avoid soiling the hands with sputum and should wash the hands and rinse the mouth frequently, especially before meals. They should never expectorate in a handkerchief which they use in wiping the mouth, nose or face, nor should they allow their clothing or bedding to become soiled with sputum.

The important point in the care of sputum is to prevent it from drying, until it has been destroyed. Patients should therefore expectorate in paper spit cups which can be burned or in cuspidors containing either plain water or some germicide such as carbolic acid, or bichloride of mercury combined with tartaric acid, to render the sputum more soluble, or common lye; and, the contents should be emptied in the sewer once or twice a day and the cuspidor cleansed with boiling water.

When the patient is away from his room, it is quite a problem to know what is the best course to pursue in order not to make it embarrassing for him and yet not to allow him to relax his care for the sputum. The pocket flask does not grow in favor in this country, although it is used quite generally on the continent. It seems to me that the least objectionable and the most inconspicuous method consists in the use of small bits of cloth, large enough to receive one expectoration, or pieces of tissue paper or Japanese napkins. These should be carried in one coat pocket or one compartment of a small shopping bag. In the other pocket or compartment should be fitted a rubber lining. As the cloths or papers are soiled, they should be placed in the rubber pocket and kept there until the patient reaches home, when they should be burned. The rubber lining should be removed, cleansed and disinfected.

Effect of Sunlight Upon Bacilli.

The surest enemy of the tubercle bacillus is light. Sunlight, according to Koch, will destroy bacilli in from a few minutes to a few hours, according to the thickness of the mucus in which they are found. Diffuse light will also destroy them, although it requires longer. Cornet and others have examined the dust of the streets and found that it is free from danger of infection. There is practically no danger of infection taking place in the open air.

Tuberculosis a House Disease.

It is probable that nearly all cases of tuberculosis, resulting from dust infection, have been contracted within the house (meaning house in the broad sense of inclosure). Ordinarily for infection to take place, there must first be a careless patient to scatter bacilli, and then there must be an association with him in quarters under conditions which favor the preservation of the life of bacilli, or a dwelling in such quarters after the departure of the patient. It has been shown that rooms frequented by patients occasionally are not infected, but rooms occupied constantly by careless patients are dangerous.

Lighting and Ventilation of Homes and the Tubercle Bacillus.

Experiments show that the floor is the part of the room which is the seat of greatest infection, and that nearly all infection in rooms is confined within two and one-half feet of the floor.

Coates ("An Investigation into the Presence of Infective Material in Dwellings Occupied by Consumptive Persons." British Congress on Tuberculosis, Vol. II, page 88) collected dust from houses and inoculated guinea pigs with it to determine its infectiousness. Three groups of homes were investigated.

1. Dirty houses occupied by consumptives who were lax in caring for their sputum, spitting either in their handkerchiefs or upon the floor.

2. Houses in a clean condition occupied by consumptives who were not sufficiently careful in disposing of their sputum.

3. Very dirty houses in which consumptives had not lived for years.

Of 21 houses in group 1, 14 or 66.6 per cent were found to be infected. Of the 14 infected homes lighting and ventilation were bad in eight, fair in one and good in five, while of the seven negative homes, lighting and ventilation were good in six and fair in one.

Of 10 homes in group 2, the dust was infectious in 5, or 50 per cent. Of the five infected houses, lighting and ventilation were bad in two, fair in two and good in one, while of the negative houses all were well lighted and ventilated.

Of 10 houses of group 3, not a single inoculation proved positive, no matter how much dirt and dust was found on the floors, thus showing that the more or less constant presence of the careless consumptive is essential in causing infection.

The great lesson of these experiments (and these results agree with those of Cornet) is that common cleanliness, such as is carried out by good housekeepers, is not sufficient to prevent the accumulation of infectious dust in rooms occupied by careless tuberculous patients, but good lighting and ventilation, even without cleanliness, will destroy most of the bacilli, and with cleanliness will even take away nearly all danger even in rooms occupied by careless consumptives. These experiments must not be taken to justify filth or any carelessness on the part of patients; but their proper interpretation shows what factors lighting and ventilation are in the destruction of bacilli, and emphasizes more than any arguments that can be deducted, the importance of keeping tuberculous patients in sunny, well ventilated rooms.

Danger in Ordinary Method of Sweeping and Dusting Houses.

The ordinary methods of sweeping and dusting houses can not be condemned too severely. Instead of these being methods of cleaning houses they are methods of scattering dust. As long as the dust lies on the floor it affords the least possible danger of scattering infection; but when it is stirred up by the broom and then allowed to settle on the furniture, after which it is stirred up again by a dry cloth or feather duster, it fills the air and is breathed into the upper air passages, carrying with it whatever infectious material it contains. If an infected room is swept and dusted in this manner the person who does the work is exposed to unnecessary danger.

Floors which are not covered with carpets may be cleansed by first sprinkling them with sawdust, and those which are carpeted by using wet pieces of paper or tea leaves. As these are brushed along they gather up most of the dust from the floor. After sweeping, the dust should not be removed from the furniture by any method which scatters dust in the air, but should be wiped off with a cloth, which should be carefully cleansed at once or burned. What is even better than this is the sanitary vacuum cleaner, by the use of which the dust is drawn up from the floor and carried by suction to a receiver in another portion of the building where it is destroyed. Apparatus of this kind should be put into all public buildings and it is not at all impractical for private houses. Such apparatus may be installed for a few hundred dollars.

Burden of Prophylaxis Not Entirely Upon the Afflicted.

While those afflicted with tuberculosis must exercise every necessary precaution to prevent further infection, yet the burden of the prevention of tuberculosis is not entirely upon them. Tuberculosis is a disease of society. Wrong methods of living foster it. It is most common among the underfed, overworked and overcrowded. It also follows excesses of all kinds (especially alcoholism and sexual indulgence) which lower vitality and make infection easy; or, if the disease be already present, but quiescent, through these excesses conditions are brought about which render it more liable to an outbreak. An outbreak often follows diseases such as measles and la grippe. Therefore, it is urgent upon the well to take precautions to maintain their resisting power at par so that they may withstand disease, if it occurs. Model tenements are needed in all cities. Stringent factory and workshop laws, looking to proper lighting and ventilating, should be passed. Construction of office buildings needs supervision to rule out poorly lighted and badly ventilated rooms. School rooms in which our children spend so much of their time should be models, demonstrating the proper supply of light and air. Last but not least, our homes should be constructed so that all rooms would be thoroughly flooded with light and so that pure air would constantly circulate into every corner.

Prophylaxis in Childhood.

Doubtless childhood is the time when infection occurs in a great many individuals (see Appendix, Chap. II, page 307), even though they never show advanced symptoms, or, if they do, only after many years. The child lives in an environment which is most pregnant with danger for this disease. All people pet and caress children and give them toys and sweetmeats; or, if they do not give them to them, they handle those which the children possess. Children live near the floor in the environment which is most apt to be infected. They play on the floor; they constantly put their hands from the floor into their mouths. If there are bacilli on the floor, little children are likely to become infected.

Children, therefore, should never live in the same room with careless consumptives, nor should they be under the care of persons suffering from tuberculosis, and especially should they be kept from eating food which has been prepared or handled by persons suffering from this disease. Too great precaution can not be taken.

Children should receive greater care than is wont while they are growing up. They should be assisted by their parents in the formation of good habits. They should be taught the simple rules of hygiene. Especially should they be taught the necessity of having light and fresh air in their rooms at all times and the value of proper bathing in maintaining a healthy organism.

Prophylaxis for those Predisposed to Tuberculosis.

There is a certain large number of children and youths whom we are accustomed to say are predisposed to tuberculosis. These individuals need more than ordinary care. Many of them, as I mentioned in another chapter, are already infected and are suffering from tuberculous toxemia. I believe the time will soon come when such cases will be treated for tuberculosis; for I have no doubt that science will soon force us to such action.

Those who are not infected, but who are delicate and unable to take their part in the world's work, should be taught the value of a natural, open-air life, with rest and tonic measures. Careful guidance of such children for a period of a few months or a few years at the proper time, will make them less prone to infection and prevent many of them from falling victims to tuberculosis.

Modern Methods of Prophylaxis and Cure.

The problem of the prevention of tuberculosis must be attacked from two standpoints, that of the afflicted and that of the well. The afflicted must be cared for and the well must be guarded from infection.

The problems connected with the prevention and cure of tuberculosis have received much attention in recent years, and it has been found that the measures necessary for preventing the spread of the disease are simple and humane. The tuberculous individual is not to be looked upon as a criminal, he is not to be treated as a leper, but as an unfortunate human being who is suffering from a communicable, preventable and curable disease. He is not necessarily dangerous to the well.

If he is careful and conscientious in the destruction of his expectoration, and lives a hygienic life, he is a perfectly safe companion; nevertheless, it is inadvisable for him to associate intimately with children. As evidence of this security may be cited the fact that infection almost never occurs in sanatoria, where the proper precautions are taken.

Although Brompton Hospital, London, has treated more than fifteen thousand cases of tuberculosis during the past twenty years, yet neither a nurse, a physician nor an attendant has become infected. The same record has been made in Falkenstein and Goerbersdorf, Germany, and in the Adirondack Cottage Sanatorium and Winyah in the United States. Here we have an intimate association of patients and attendants for months and years with no infection occurring. We can safely say, then, that tuberculosis is only communicable when the proper care is not used.

Education.

The first and most necessary measure for the prevention of tuberculosis is education. There are so many erroneous ideas about this disease that a thorough knowledge of it is necessary in order to combat them. Some people foolishly refuse to accept the fact that tuberculosis is a communicable disease and still cling to the old theory of heredity. Others have caught the idea of its communicability and fear it as much as they would smallpox, scarlet fever or diphtheria. Both attitudes are wrong, but they will be maintained until something is offered in their stead. The idea of heredity must be abolished. Tuberculosis is almost never inherited by the child from the parent. There are perhaps less than two dozen authentic cases on record where children were born with tuberculosis. True, some children are born with less resisting power than others; some have constitutions more frail than others; some have respiratory organs more prone to disease; but the disease itself, the infection, takes place after birth. The bacilli are grafted on to these weakened constitutions after they are born. A child born of a tuberculous mother or father is not necessarily doomed to die of consumption. In fact, most of them do not. These children, however, run great chances of becoming infected if they are allowed to play in the rooms occupied by a person suffering from tuberculosis or to play with the individual who is afflicted, unless he be intelligent and conscientious in the care of his sputum. It must be remembered that the resisting power of the child is not as great as that of the adult, so greater precautions should be taken with children. These cases of supposed heredity are instances where the child was perhaps born with a weakened constitution, and reared under unfavorable circumstances. The child, perhaps, became infected by association with the diseased parent, for it must be remembered that very few of the total number of persons afflicted with tuberculosis are taking the proper precautions to prevent the spread of the disease. It is not necessary for the disease to manifest itself at once when infection takes place. It is probable that tubercle bacilli are often taken into the system in childhood, yet cause few or no noticeable symptoms until later in life, when the resisting powers of the individual are lowered. Then the disease starts up with full force. Not heredity but infection is the cause of tuberculosis.

There is one thing particularly favorable about the manner in which tuberculosis is conveyed from one person to another, and that is, that the infectious elements are all found in the discharges from tuberculous ulcers and that practically the only discharge that we need to consider, in order to prevent the spread of consumption, is that which comes from the lungs, and which is thrown off as expectoration. If this is destroyed, a thing not difficult to do, there can be no spread of the disease. By proper education, this should be attained. The breath is not dangerous, neither is there any danger whatever from close contact. So there are absolutely no grounds, except lack of understanding, upon which this inordinate fear of tuberculosis, possessed by some people, can stand. This fear causes many foolish things to be done. It works undue and unnecessary hardship upon those who are afflicted with tuberculosis. It causes them to be feared, and provokes unwise and unjust legislation against them. Neither cruelty nor inhumanity have any place in dealing with the question of the prevention of tuberculosis. It can and will be prevented by the people understanding the true nature of the disease. This can come only through education. The interest and co-operation of the people must be secured through pamphlets, the press and public lectures.

Health Board Control.

Tuberculosis should be under health board control. It should not be treated the same as other communicable diseases, but every individual suffering from pulmonary tuberculosis should be reported to the health department, that the department may know where each focus of the disease is. The physician reporting the case should either instruct the patient and those about him how to prevent the spread of infection, or should request the health department to do so. In this way there would be nothing on the part of the health department that might be considered as meddling with private patients and yet each person afflicted would be instructed how to prevent scattering infection. In case of removal or death, the apartments occupied by the patient should always be thoroughly cleaned and disinfected before being again occupied. This disinfection should be done under the direction of a competent representative of the board of health. The matter of putting a pound sulphur candle in a room occupied by a tuberculous patient is of no value whatever from the standpoint of destroying germs. An excellent method of disinfecting houses is by the use of formalin and permanganate of potash, 16 ounces of the former and 6½ ounces of the latter for every 1000 cubic feet of space. The room should be closed. The receptacle to receive the disinfectant should be large and the ingredients should be put in one at a time, for when they unite they cause a marked effervescence. By their chemical union formaldehyde gas is set free.

Health Board control in tuberculosis is not for the purpose of placarding the house or establishing quarantine, as in diphtheria and scarlet fever. Such measures are not at all necessary; it is simply for the purpose of knowing where all cases are located, that they may be instructed, and of knowing when the premises have been vacated, that they may be cleaned and disinfected.

Dispensaries. One of the most practical agencies in combating tuberculosis is the dispensary, such as we have in America, England and France, or what is even more practical, the Fürsorgestelle of Berlin. These institutions are presided over by men who are experts not only in the diagnosis and treatment of tuberculosis but also in its prevention. Each dispensary is provided with competent helpers, usually nurses, who assist the physician and see that his orders are carried out. They visit the homes, and adapt them as well as is possible to the carrying out of the modern methods of treatment. They also instruct the patient and his friends and show them what measures must be taken in order to prevent the spread of infection. By visiting these homes occasionally, they are able to keep up an interest on the part of both patients and friends. They can also correct any mistakes that are being made and report any flagrant disregard of instructions to the head physician. These dispensaries furnish sanitary cuspidors, disinfectants, and, some of them, eggs and milk, besides what medicines are needed; and the Fürsorgestellen in Berlin go so far as to furnish beds, bedding, and even rooms for the patients. They endeavor to do just what is best for each patient to help him recover and to prevent him from infecting his friends. The dispensary is a great help to the Health Board in that it is carrying out the very work that the Board desires. There are usually found listed in the dispensary the names of those individuals who are occupying the worst rooms, in the poorest lodging houses, or who are huddled together with their families in contracted unhygienic quarters. Since the disease is most common among the poorer classes, its prevention here means much toward stamping out the disease.

Classes in Tuberculosis. A very important and practical method of educating tuberculous patients is by the class method. A number of patients are gathered together and then instructed *en masse*. This very practical method has been successfully carried out in many places. One advantage of it is that time can be saved. The physician or nurse can instruct a dozen as quickly as he can one. In teaching these simple truths one essential is repetition and where a number can be instructed together it affords time for this.

Sanatoria. Another important factor in preventing the spread of tuberculosis is the public sanatorium. These institutions work for the prevention of the disease in many ways. In the first place, they remove patients from their homes where they may, through ignorance or carelessness, scatter infection. Secondly, they cure a large per cent of the cases treated in them (for they usually confine their efforts to early cases), and thus render them incapable of further spreading the disease. Thirdly, they return these cured patients to their homes to continue the support of those dependent upon them, and in this way not only save them from becoming public charges but also through rendering them better able to support their families, save some of them from breaking down with tuberculosis. Fourthly, all patients who return from a sanatorium carry with them the new ideas of tuberculosis and the measures necessary to prevent its spread. They also know how to live in order to prevent and overcome it. Great as are the other features of the sanatorium, perhaps its greatest good comes through the fact that it educates those treated in it as missionaries who return to their former homes and teach their friends how to live in order to prevent and cure tuberculosis.

Hospitals. Not only are dispensaries and sanatoria needed, but hospitals as well. Unfortunately, many cases of tuberculosis escape detection until they are so far advanced that they cannot recover. The greatest danger of infection comes when the patient is in the late stage of the disease. At this time he is, as a rule, expectorating more than at any other time. Owing to weakness, many are not as careful as they should be. They soil their clothing, bedding and whatever comes in contact with them. Especially is this true among those who are ignorant. If such individuals live in crowded quarters, where they must have their friends and the members of their families associated with them, they are apt to infect them. For such cases there should be hospital accommodations, a place where they may be taken, in order that their last days may be made free from suffering and that they may not infect others.

Sanatoria and Hospitals not Dangerous to their Surroundings.

Since it has become known that tuberculosis is communicable, some people have become imbued with such a fear of the disease that they are afraid to enter a place frequented by those suffering from the disease. They would hesitate to visit a dispensary, a hospital or sanatorium for tuberculosis lest they should become infected. These same people often live with tuberculous individuals, who think they have only "throat trouble" or "bronchial trouble;" they will occupy a room in a hotel or lodging house which has previously been occupied by a consumptive and which has never been fumigated; they will drink from a public cup which has just been used by a consumptive; yet, they would not even visit one of these institutions frequented by tuberculous patients, who know they have the disease and who are careful to destroy their sputum. The most dangerous consumptive is the one who either does not know that he has the disease or who tries to deceive himself and make himself believe that he does not have it. He is dangerous because he will not take precautions. On the other hand the one who knows that he has the disease, and takes the proper precautions, is a perfectly safe companion with whom to associate.

Some municipalities, even health resorts, which are frequented by hundreds of consumptives annually, fear to see these beneficent institutions established in their midst. This is due to a faulty understanding of the disease. Such institutions should be welcomed because they cannot possibly be a menace, but on the other hand, they will educate the tuberculous patients who are treated there so that they will cease to be a danger. How much better it is to have the poor consumptives who live in a community attend a dispensary and receive instruction rather than to ignorantly infect the lodging houses and homes occupied by them. How much better is it to have the curable cases in a sanatorium where they may have a chance to get well and where, in any event, they will be instructed in the manner of right living and the measures necessary for the prevention of the spread of infection. How much better is it to have the advanced cases in hospitals where they will receive proper attention and where they will not give the disease to others rather than to have them occupying and infecting their illy adapted and often overcrowded quarters. Such institutions are neither a menace to a community nor to those who live in them. On the other hand, they are blessings to a community; for, they remove from homes, lodging houses and hotels those who are diseased, and thus take away the danger of spreading tuberculosis in the community.

That such institutions are not dangerous to the communities in which they are situated is well shown by the death rate from tuberculosis in these communities. Instead of being dangers they are educators. Knopf quotes the statistics from Goerbersdorf and Falkenstein, small villages in Germany where sanatoria have existed for years. These sanatoria are visited yearly by several hundred tuberculous patients. Nevertheless, even though the population has increased, the proportion of deaths has decreased.

Deaths From Consumption in Goerbersdorf.

1790–1799	14	1850–1859	6
1800–1809	5	First Sanatorium established 1859.	
1810–1819	9	1860–1869	4
1820–1829	9	1870–1879	5
1830–1839	8	1880–1889	5
1840–1849	6		

Deaths From Consumption in Falkenstein per 100 Population.

Before Establishment of the Sanatorium.		After Establishment of the Sanatorium.	
1856–1858	17.2	1877–1879	17.
1859–1861	7.7	1880–1882	14.6
1862–1864	22.6	1883–1885	6.
1865–1867	14.	1886–1888	5.
1868–1870	16.7	1889–1891	13.9
1871–1873	21.	1892–1894	15.1
1874–1876	33.3		

Prussia has many institutions for the care of tuberculosis and her deaths from tuberculosis are decreasing. In Prussia today 20,000 less people die annually of tuberculosis than twenty years ago.

A Lesson From Davos.

Perhaps no village offers so good a proof of the fact that sanatoria are not dangerous to a community as the little village of Davos, Switzerland. This little town of about 4,000 inhabitants is visited annually by 20,000 people, a great portion of whom are afflicted with tuberculosis. This town has eight sanatoria affording accommodations for about one thousand patients, and numerous hotels and boarding houses which afford accommodations for 3,000 more. These rooms are also mostly occupied by tuberculous patients. In spite of this, the mortality from tuberculosis among the natives is not on the increase. This mortality is exceedingly low, being only 9.7 per thousand population as compared with 22.5 per thousand in Germany. The fact that there are so many sanatoria here where patients are educated in the care of their sputum, together with another fact that the hotels and boarding houses all co-operate in this same good work, and that careful destruction of sputum and disinfection of all rooms after being occupied by patients is practiced, makes the danger of becoming infected with tuberculosis in Davos almost nil, in spite of the fact that there is perhaps never a time when there are not more people in the village who have tuberculosis than there are permanent inhabitants.

Such institutions should be welcomed then because:

1. They are dealing with the tuberculous problem scientifically.

2. They are treating the tuberculous patient humanely and offering him his best chance of recovery.

3. They are protecting the well from becoming infected.

CHAPTER X.

THE PRINCIPLES UNDERLYING THE TREATMENT OF TUBERCULOSIS.

Curability of Tuberculosis.

Perhaps there is no other serious disease so curable as tuberculosis, if treated early; and few more fatal if allowed to extend. It is within truth to say that sixty-five people out of every hundred have tuberculous foci in some organ or organs of the body, some time during their lives, and yet only about twelve or fifteen out of every hundred die because of their tuberculosis. This means that tuberculosis proves fatal in scarcely 20 per cent of the instances in which infection has occurred.

If we seek the cause of the cure in these cases, we find that most of the cures occurred in patients where the lesions were small; and, if we could know more of the history of the infection, we would doubtless find that where the healing occurred there was a great disparity between the vitality or numbers of the infecting micro-organisms and the resisting power of the patient. A person with a low resisting power might become infected with bacilli of low virility or with small numbers of micro-organisms while a person with normal resisting power might overcome the same infection, and a person with great resisting power might overcome many bacilli even of a virulent strain.

When an infection occurs with bacilli of a low virulence there is a tendency to healing; in fact, this rule is so general that Störk (Transactions of Congress on Tuberculosis, Vienna, 1907) has been able to produce a cirrhosis in animal experimentation in nearly every instance, by the injection of bacilli whose virulence had been lowered. On the other hand, where the virulence is great necrosis is the rule. It was formerly taught that the necrosis of the tubercle was due largely to the fact that the tubercle was poorly supplied with blood-vessels, but the best authorities to-day are of the opinion that the necrosis is due to the action of the tubercle toxins, and that the cutting off of the blood-vessels is a mere incident, with little if any primary effect upon the tubercle.

The natural tendency of an infection with few bacilli or with bacilli of low virulence is toward healing. Such an infection stimulates the cells to the formation of new tissue and tends to healing by the production of fibrosis.

Such infections may prove fatal, however, if the resisting power of the patient is low.

The natural tendency of infection with large numbers of bacilli or with highly virulent bacilli, on the other hand, is toward necrosis. Such an infection sets free large quantities of toxins or toxins of such potency as to cause a rapid necrosis of the surrounding cells.

Such infections may be overcome if the resisting power of the patient be great enough.

These facts may be summed up by the statement that where the bacilli are the chief factors, as in the experiments of Störk mentioned above, the tendency is conservative and where the toxins are the chief factors the tendency is destructive. As further proof of this statement might be cited the fact that dead bacilli (being less toxic) show more of a tendency to the formation of connective tissue and less tendency to cheesy degeneration than live bacilli.

Nature of Cure in Tuberculosis.

The cure of tuberculosis consists in establishing upon the part of the infected organism an immunity to the tubercle bacillus and its toxins. No matter what methods of treatment are employed, if a cure results, it is due to this cause and to this alone.

In this respect tuberculosis differs in no wise from other diseases of bacterial origin. The cure of all bacterial diseases depends upon the favorable action of the machinery of immunization. If a cure results, immunity is present, and the cure is due to the immunity, although it may be very transitory as is noted after pneumonia, or somewhat more lasting as is seen following diphtheria, or it may be quite permanent as we find it after smallpox. A cure, no matter how transitory, in diseases of bacterial origin is synonomous with immunity.

In order to have a comprehensive understanding of the treatment of tuberculosis it is necessary to bear this in mind. When we know neither the nature of the disease nor the manner of its cure our therapeutic efforts must be empirical, but where both are known, therapy can be made a scientific procedure.

How Immunity is Produced.

There are many intricate problems connected with the establishment of immunity. Some of them are understood while others are still unsolved.

It is impossible to comprehend the treatment of any infectious disease without understanding the phenomena associated with the establishment of immunity; therefore, in order to make plain the direction that our efforts should take in the treatment of tuberculosis we shall find it profitable to inquire somewhat into the phenomena which occur when an infection takes place.

The common idea of immunity, that of protection from disease, either natural or acquired, is not the conception that we wish to emphasize. The term as used in modern scientific medicine has a broader meaning. It means that state or condition resulting from an effort upon the part of the organism to protect itself from some foreign substance by the formation within itself of specific protective bodies. Such an immunity may be partial or complete; it may be transitory or it may be permanent.

The production of immunity is a chemical process, and is due to a reaction upon the part of the inoculated organism in response to the stimulation of some foreign element. In infectious diseases this stimulation is furnished by the specific micro-organisms which produces the disease.

When specific micro-organisms gain entrance to the body tissues a struggle for mastery at once ensues. Some of the bacteria are destroyed by the antibodies which are normally found in the tissues; and these bacteria which have been destroyed stimulate the body cells to the formation of more antibodies. Thus the machinery of immunization is set in motion. Whether the bacteria or the organism will conquer depends upon the number or virulence of the bacteria on the one hand and upon the response of the body cells to the stimulation on the other. The antibodies which are produced as a result of this cell stimulation are of several different kinds. Antitoxins, lysins, agglutinins, precipitins, coagulins and opsonins have been studied so far, and there may be others that are as yet undiscovered.

It is very important to know that these specific antibodies can be produced not only by the inoculation of living virulent bacteria but by bacteria which have been killed. The only essential is that the chemical element in the bacteria which calls forth the elaboration of the antibodies remains intact. Experiments carried out with dead staphylococci, typhoid bacilli, vibrio of cholera and products made from tubercle bacilli show that they stimulate the organism to the formation of the very same immunizing elements as are produced by the living micro-organisms. Thus we may by vaccination with dead bacteria or bacterial products set the physiological machinery of immunization into activity and immunize our patient.

Antibodies Specific.

Another fundamental principle in immunity is that the antibodies resulting from an infection or from a vaccination are specific for the micro-organism which set the machinery of immunization in motion and caused their elaboration. Thus typhoid bacilli cause typhoid antibodies; staphylococci, staphylococcus antibodies, and tubercle bacilli or tubercle vaccine cause antibodies for the tubercle bacillus.

Normal Health Offers Resistance to Disease.

While I do not know whether or not any experiments have been made to determine by actual measurement the relative resisting power of individuals in normal health and those with lowered vitality, yet, it stands to reason that a man in normal health should be less prone to infection than when in ill health. It also seems but common sense that a man whose nutrition is good, should offer more resistance to a disease than one whose nutrition is low.

With this brief discussion of nature's method of curing infectious diseases, we can now intelligently approach the subject of the treatment of tuberculosis. We can understand nature's method and we can estimate the part played by each of the various measures which we employ.

Immunity the Ultimate Aim of Treatment in Tuberculosis.

We can see that the ultimate aim of scientific therapy in tuberculosis is the establishment of immunity, whether it be indirectly, by improving the general condition of the patient and making him more resistant as is done by placing him in the open air, furnishing him with nutritious food and training him in the proper way of living, or directly by artificially increasing the antibodies of the blood by the inoculation of tubercle vaccines. We can not understand the cure of tuberculosis in any other light than this. If a cure results, it is because the organism, naturally supplied by sufficient antibodies or stimulated by the toxin of the tubercle bacillus, has arisen to its own defense and produced sufficient antibodies to overcome the infection.

Classification of Remedial Measures.

We would classify the various measures employed in combating tuberculosis under six heads:

1. Those which aid in bringing about immunity by endeavoring to restore the natural resisting power of the patient to a point as nearly normal as is consistent with the condition present. Among such measures we must class fresh air, hygienic measures, proper diet, hydrotherapy, favorable climate and suitable tonics.

2. Those which aid in bringing about immunity by artificially stimulating the body cells to the production of more specific protective substances. In this class falls vaccination or treatment by the injection of the specific products of the bacillus, such as tuberculin, extracts of the tubercle bacillus and bacillus emulsion.

3. Those which aid in establishing immunity by supplying to the organism specific protective substances which are produced by vaccinating some animal such as the horse or cow. Under this head come the various antitoxic sera.

4. Those measures which cause an increased flow of blood or lymph to the seat of infection, thus bringing a greater amount of specific antibodies into contact with the bacilli and causing their destruction. Bier's hyperemia, Finsen light, poulticing and the local congestive action of tuberculin are measures whose actions are explained in this manner.

5. Remedies and measures which relieve symptoms.

6. Measures which relieve any secondary infections that may be present.

Hygienic Treatment not All.

Thus it can be seen that there is nothing specific in such measures as fresh air, good food, the regulation of rest and exercise, hygiene, hydrotherapy and tonics, yet they have their purpose in the treatment of tuberculosis. By these measures we sharpen the appetite, improve digestion and assimilation, strengthen the heart, improve the quality of the blood, and tone up the nervous system; in a word, we bring the patient to a point where he is as nearly a normal man as is possible, while the disease from which he is suffering affects him.

How much this falls short as measured by the opsonic power of the blood, has been determined by Lawson and Stewart (Lancet, Dec. 9, 1905) in twenty-four patients who were treated by ordinary open-air methods in a sanatorium in Scotland. These patients had been treated for a period varying from one month to two years at the time of this investigation. If we take the normal healthy individual's opsonic index as 1. and compare the indices of these patients with it, we find that after this period of open air sanatorium treatment, the indices of twenty out of the twenty-four patients was below .8, the average being .75. This means that ordinary hygienic dietetic open-air treatment as carried out under the most favorable circumstances was able to bring the body fluids of these patients to a condition where they were able to prepare only three-fourths as many tubercle bacilli for destruction as the body fluids of a normal individual.

This table is so instructive that I reproduce it:

The Opsonic Indices of Twenty-five Cases of Pulmonary Tuberculosis after Varying Terms of Treatment (without Tuberculin Inoculations).

Initial.	Duration of Disease.		Duration of Treatment.				Opsonic Index.
			Climatic.		Sanatorium.		
	Years.	Months.	Years.	Months.	Years.	Months.	
M.	2	6	1	..	1	..	1.1
K.	1	2	..	..	1	2	1.0
L.	..	5	..	..	..	5	0.9
H.	..	5	..	..	..	2	0.9
McC.	4	3	..	..	1	7	0.9
M.	1	..	..	..	..	2	0.8
L.	4	6	4	..	..	..	0.8
McD.	3	10	2	4	1	4	0.8
F.	2	..	..	..	2	3	0.8
W.	1	5	..	2	..	10	0.8
G.	4	..	..	..	..	2	0.8
T.	..	2	..	..	..	2	0.7
P.	4	3	..	..	..	1	0.7
McA.	4	1	2	6	1	1	0.7
M.	7	..	1	..	1	2	0.7
H.	8	..	6	..	..	6	0.7
A.	1	2	..	..	..	9	0.7
B.	1	9	..	..	..	10	0.7
B.	2	..	..	3	1	4	0.7
M.	1	..	..	..	..	4	0.7
K.	..	4	..	..	..	4	0.7
W.	3	..	..	..	1	4	0.5
A.	3	6	..	..	2	2	0.5
S.	1	5	..	1	1	..	0.5
G.	2	4	..	..	1	10	0.5

Tubercle Vaccines Specific.

We can also see from the discussion which has preceded that the products made from the tubercle bacillus do have a specific action; and, when injected artificially, raise the content of protective bodies in the blood. This being true, we might hope by proper dosage of these products to aid greatly the organism in its attempt to overcome the infection.

That this is not only theory but that it works out in practice is proven by these same cases mentioned above. After six weeks treatment by the inoculation of tuberculin, the power of the body fluids of these patients to prepare tubercle bacilli for destruction by the phagocytes was raised from three-fourths of that of a normal individual to 1.19 or 19 per cent more than a normal individual. Thus by the injections of tuberculin the body fluids of these patients were enabled to prepare 58.6 per cent more bacilli for destruction than they were under open air methods alone. This is shown in the following table:

Comparison of the Opsonic Indices of the Bloods of Twenty-three Patients, Taken After a Term of Sanatorium Treatment only, with Those Taken After a Short Term of Sanatorium Plus Tuberculin (T. R.) Inoculation Treatment.

Initial.	O. I. Before Inoculation.	Doses Given Within a Period of Six Weeks.	O. I. After Inoculation.
S.	0.5	4 of 1/500	1.5
P.	0.7	4 of 1/500	1.3
McA.	0.7	4 of 1/500	1.1
McD.	0.8	4 of 1/500	1.0
W.	0.5	5 of 1/500	1.1
A.*	0.5	1 of 1/500, 1 of 1/1000	0.8
M.	0.7	3 of 1/500	1.3
B.	0.7	3 of 1/1000	1.2
F.	0.8	3, 1/500, 1, 1/50, 1, 1/500	1.3
A.	0.7	3 of 1/500	1.2
L.	0.9	3 of 1/1000	1.2
W.	0.8	1 of 1/1000	1.1
K.	1.0	1 of 1/1000	1.1
H.	0.9	3 of 1/1000	1.4
B.	0.7	4 of 1/500	1.3
M.	0.7	1, 1/1000, 1, 1/2000, 1, 1/1000	1.5
G.	0.5	4 of 1/500, 1 of 1/400	1.1
H.	0.7	2 of 1/1000	1.0
G.	0.8	3 of 1/1000	1.0
K.	0.7	4 of 1/1000	1.3
McC.	0.9	3 of 1/1000	1.4
T.	0.8	2 of 1/500	1.2
M.	0.8	3 of 1/500	1.4

*Spinal complication. Index eventually rose above 1.0.

Rational Treatment. The treatment of tuberculosis is not a simple matter. It is one which requires great skill and resourcefulness on the part of the physician. Best results can be obtained only by careful individualization. The phthisiotherapist should be wedded to no idols. His only desire should be results, and these obtained in the shortest time with the least inconvenience to the patient. He should be conversant with all measures of value and know how to employ them with skill and intelligence. He should not be a thoughtless follower of any method, be it fresh air, diet, hydrotherapy, drugs, climate or tuberculin; but, he should be an intelligent conscientious physician who knows the value and limitations of these various measures and who so combines and employs them that his patient is given the benefit of all. Nothing short of this can be considered a rational treatment of tuberculosis.

Method of Treatment Very Important. After all has been said about the treatment of tuberculosis, it is the method of applying the various measures, the technique that counts most. It is not fresh air, but fresh air applied under the proper conditions; not hydrotherapy, but hydrotherapy suited to the patient and the disease; not tubercle vaccines, but tubercle vaccines administered at the proper time and in the proper dosage; not hyperemia but hyperemia most carefully administered after a certain definite technique; not the sanatorium, but the carefully regulated sanatorium where all measures are combined under the most favorable circumstances to cure tuberculosis. As the surgeon emphasizes technique, so must we emphasize exactness of method and attention to details in the carrying out of the various measures which are of value in combating tuberculosis. In our judgment of measures we must bear in mind that the originator may be a little enthusiastic; but we must also remember that he has, as a rule, by careful trial arrived at a method, developed a technique which often means much and not infrequently means everything for the success or failure of the measure.

We not infrequently hear men say that they can not secure the favorable results that are reported by other observers by the use of open air. Usually a careful inquiry shows that the case was beyond cure or the measure applied in a faulty manner. Tuberculin was almost lost to those suffering from tuberculosis simply by faulty technique in its administration. How many men have thought that they were using hydrotherapy as suggested by Winternitz and Baruch, or hyperemia, as suggested by Bier, only to find, when they saw these methods applied properly, that they were only using water in the one case and congestion in the other!

It is natural for a scientific man to have confidence in his own ability to do the work of other men and to judge the results, but he should not condemn a measure simply because he does not succeed with it. He must be sure that he uses the measure correctly, that his technique is exact, before judging.

No matter what remedial measure is being used, even though it seem as simple and harmless as "open air," the effect of the remedy upon the individual and upon the disease treated should be carefully studied, and then applied intelligently. Even the correct application of remedies may not cure the disease but it can not do harm and will have a tendency to aid; while a faulty application can not help doing harm and may do sufficient harm to prejudice the recovery of the patient or even to cause his death.

CHAPTER XI.

THE OPEN-AIR TREATMENT OF TUBERCULOSIS.

The open-air treatment of tuberculosis marks one of the greatest advances in modern therapeutics. While it is simple and sensible, yet, when enunciated, it was revolutionary. Even today it is not fully appreciated and only imperfectly carried out by many of our foremost physicians. Patients suffering from tuberculosis have frequent attacks of bronchial catarrh. They ascribe it to "catching cold;" and, if left to their own inclinations, they are prone to shun the fresh air, avoid all possibilities of contact with draughts, shut themselves up in close superheated rooms and clothe themselves in impermeable chest protectors and a superabundance of the warmest clothing that can be found.

Fresh Air First Recommended by Bodington, 1840.

With this as the universally recognized method of dealing with this disease, it took a brave man to first advocate putting these patients into the open air. George Bodington, of Warwickshire, England, in 1840, made the startling statement that: "Cold is never too intense for a consumptive patient; the apartment should be kept well aired, so that it should resemble the pure air of the outside, pure air being used in the treatment as much as possible." Of course such doctrine was not readily received. He was maligned and considered to be an insane crank by both his confreres and the laity. So bitter was the persecution upon the part of the medical profession that patients were afraid to stay in his institution, in spite of the fact that he was helping them while his confreres were allowing their patients to go on to certain death.

While the doctrine of the open-air cure of tuberculosis was enunciated more than sixty years ago, and while it has been advocated by tuberculosis specialists for the past quarter of a century, yet its full significance is not yet understood by our profession.

Fresh Air not Specific.

The fresh air cure has its limitations. Fresh air is not a specific for tuberculosis, but it will work marvelous changes in patients who are taken from the common walks of life with their unhygienic methods of living, and allowed to remain in it day after day and night after night. Its effect is least marked upon those who have been living outdoor lives and have developed tuberculosis in spite of it.

What is the Effect of Open Air?

Before entering upon a discussion of the methods of applying the open-air treatment it is pertinent to stop and ask: What is the effect of open air upon the tuberculous process or upon the individual afflicted with tuberculosis?

While we recognize that the breathing of impure air such as is found in imperfectly ventilated rooms is injurious and apt to produce diseases of the respiratory tract, we note this in healthy individuals as well as in those infected with tuberculosis. It seems that the greatest detriment in breathing such air is not the effect upon the lungs, but the effect upon the general constitution; and, the effect is not so much upon the tuberculous process as upon the tuberculous individual. The breathing of infected air might produce a secondary infection in the lung but, except indirectly, even this would not be an effect upon the tuberculous process. As the principal effect of breathing vitiated air is the general lowering of vitality of the tuberculous individual so the principle effect of the open-air cure is the impression which is made by it upon the physiological processes of the organism whereby a better state of nutrition is produced. When fresh air has done its best, the resisting power of the patient as measured by the specific opsonins present, is still low as is shown by table quoted from Lawson and Stewart (see page 118).

How Outside and Inside Air Differ.

We hear so much about the open air that it might be well to inquire wherein the outside air differs so much from inside air. By hearing the expression "open air" so frequently used, we are apt to think that the only place suitable for treating tuberculosis is out of doors. This is not necessarily true. The essential element in the open-air cure of tuberculosis is a constantly changed air so that the patient is not required or permitted to rebreathe the same air. This object can be attained in properly ventilated buildings as well as in out of door shacks and tents. In order to meet this demand best, rooms should be placed in a single row with open corridor behind (see plan of Pottenger Sanatorium, page 218). In homes, corner rooms with windows on two sides can be utilized. Unless there be a good cross ventilation, the air of rooms will not approach the outside air in purity.

It was believed formerly that the value of the open-air treatment depended upon the fact that patients so treated were supplied with a greater volume of oxgyen, and, that they escaped the poisonous effects of carbonic acid as found in rooms which are imperfectly ventilated. Some recent experiments have been made, however, which seem to show that these factors are not so significant as was formerly believed and that the benefits of open-air treatment depend in a great measure upon other factors.

Air which is kept in motion is purer than air which stagnates, and I believe that this is the greatest objection to the ordinary home, and, I am sorry to say, even to rooms in some sanatoria. They are so constructed that ventilation is imperfectly carried on, and the air does not change with sufficient rapidity to furnish the patient with a constant supply of fresh air.

It has been shown that the air taken from ordinary rooms contains more bacteria than that from the open. This is not surprising when we consider the imperfect unscientific manner in which ventilation is cared for in the construction of our modern buildings, but I cannot see why there should be any appreciable difference in the air of a room thoroughly ventilated by cross ventilation and that taken from the outside. I have had the opportunity of testing the comparative results of the open air such as is found in bungalows (see plan, page 219), and in thoroughly ventilated rooms, on several hundred patients suffering from tuberculosis in all stages, and I can see no difference in results. From the standpoint of air, I do not believe that the one has any advantage over the other. It goes without saying, however, that there is an advantage in open shacks and bungalows over improperly ventilated rooms.

Open Air Hardens Patient.

By placing patients in the open air we accustom them to the various climatic changes. When properly carried out, the open or fresh air treatment of tuberculosis requires that patients be kept in fresh air all the time. They are taught to endure cold. In the rigorous climates of the north they are wrapped up in warm blankets and furs and kept in the open, or in rooms with little fire. In the warmer southern climates, patients can sit or recline in comfort on the coldest days with the protection of a steamer rug.

The effect of this open air is to harden the patient. He soon reaches the state where the weather changes affect him very little.

Effect on Nervous System.

The effect of the open-air life upon the nervous system is very pronounced. Nervous excitation is quieted. Neurasthenic conditions improve. Sleep is induced, often in patients who are usually very poor sleepers.

Open Air Improves Digestion and Assimilation.

Perhaps the most important effect of keeping the tuberculous patient in fresh air is that upon nutrition. Fresh air is a wonderful tonic; and, when we take patients from their poorly ventilated homes and place them in the fresh air, the first improvement noticed is usually upon the appetite. Digestion and assimilation are at once improved, and the patients begin to gain in weight. A temporary improvement is sometimes noted even in patients who are very ill and far beyond hope of any material improvement.

It is very important to remember that this action which is so noticeable in tuberculosis is not specific, nor is it peculiar to this disease. The same effect is noted upon individuals suffering from other diseases and also upon normal individuals. We should extend our use of fresh air to other diseases and we can recommend it as being the best prophylactic measure known.

Lessens Danger of New and Secondary Infection.

As mentioned above, open air does not contain as many bacteria as the air of closed rooms. Patients leading the fresh air life enjoy a peculiar immunity from infections of all kinds. They are not as prone to suffer from coryza or la grippe as others are. Infections, as a rule, are transmitted in houses where ventilation is poor and where conditions favorable to the life of bacteria and to the lowering of the vitality of the inmates exist. It is not necessary to keep rooms frequented by patients who are living the fresh air life at a very high degree of temperature. Such patients will sit in rooms at a temperature of 60 degrees and feel confortable. They are thus spared the sudden chilling which comes from going from overheated rooms to the outside air as is constantly experienced by people living in modern houses. By refraining from occupying closed rooms they are less liable to meet infectious bacteria; and, by the effect of the fresh air upon them, they are rendered more resistant to infection.

We can see that open air has two distinct advantages over improperly ventilated rooms, in the treatment of tuberculosis. In the first place, it improves the patient's nutrition, increases his resisting power and provides his body fluids with more antibodies for destroying bacteria. Thus he is better fortified against the escape of bacilli from old foci to new areas and also better able to ward off attempts on the part of other micro-organisms to gain entrance and complicate the process. The second effect, which is a very important one, consists in furnishing the patient with fresh air which contains very few bacteria instead of air from poorly ventilated rooms which contains numerous bacteria.

Open Air Lessens Temperature.

Just how fresh air lowers temperature has been frequently discussed without any definite answer being reached; but, that patients suffering from temperature seem to lose it more quickly when subjected to the open-air treatment than when treated in closed apartments has long been observed. It seems to me that the action of fresh air in these cases is twofold. In the first place, there is less danger of renewed infection from without, because the patient is breathing air which is laden with fewer bacteria; and secondly, if the patient is not so low that he cannot respond, the effect of the open air improves his nutrition, and thus enables the machinery of immunity to become more active in combating the infection which causes the rise in temperature.

Is there Danger at Beginning of Treatment?

It is such a change from the ordinary methods of living to the open air method that we are often confronted with questions relative to the danger of taking patients, who are reduced in vitality by such a debilitating disease as tuberculosis, from their closely constructed houses where they have avoided all "draughts," and placing them in the midst of freely circulating air. Personally I have never seen harm come from it, although I usually make the change at once on the beginning of treatment. In some cases I have exposed the patient somewhat gradually taking three or four days to reach the full ventilation. In elderly patients the exposure should be made more gradually than in young adults. As elsewhere in medicine we must exercise judgment, and common sense in the employment of pure air, and much more care should be exercised where climatic conditions are rigorous than where they are mild.

One thing to avoid in establishing the outdoor life is the use of too much bed clothing. There is an exaggerated fear on the part of some, especially certain individuals suffering from neurasthenia, that they will suffer from the cold. No more cover should be used than is necessary for warmth. The physician must be the judge, and he must exercise tact in dealing with those who desire to use too much cover. In cold weather there is no objection to having the bed warmed by a hot water bottle (but I believe it is better to remove it as soon as the bed is warmed) and if it is very cold even a covering for the head is not to be denied. Patients should always, if possible, have their feet warm before retiring. This, with a warm bed, takes away the danger of chill and does away with the desire for so much cover.

Even the most delicate patient can be taken from a stuffy, close room and put into a well-ventilated room, or outside, in open bungalows or shacks, without the least danger providing the proper judgment is used in making the change. The beneficial effect is usually so prompt that if the patient sleeps in the open a few nights he becomes wedded to it and has no desire to return to his former quarters.

Clothing for the Tuberculous.

The matter of clothing is very important to the tuberculous. A good general rule is to wear the least clothing that can be worn with comfort. There is a tendency to dress too warmly. An excess of clothing enveloping the patient has a bad influence upon the skin, keeps it in a condition of lowered tone, and at the same time prevents proper elimination. Consequently the patient finds it difficult to harden himself; for, while he is subjecting himself to conditions which require a healthy, active skin, he is interfering with its nutrition and function by his clothing.

The underclothing is an important factor. I have long discarded the use of wool and replaced it with linen. Linen is an absorbent of moisture but does not retain it, consequently the action of the skin is aided and the patient is not so liable to chill after perspiring as when garments of other material are used.

The usual habit of ordering tuberculous patients to wear heavy woolen undergarments during the hot summer is not only unscientific, but harmful and barbarous. Why subject these patients to such discomfort? There can be no reason except because somebody said so. The best underclothing for summer, likewise for winter, is one that keeps the patient comfortable. The garment which causes perspiration and maceration of the skin is, if anything, more harmful than the one which is too light. The care of the feet is likewise important. The skin should be kept healthy by frequent bathing, and changing of stockings and shoes. Perspiration with its resultant maceration should also be avoided here as far as is possible.

Wet Weather no Contra-indication.

Neither damp weather, fog nor cold are contraindications for beginning or following out the open-air treatment. It can be begun at any time. I have frequently received patients at the sanatorium during a several days' rain who had never spent a night in a properly ventilated room. I have placed them at once in an open bungalow or open room and have as yet seen no harm come from it.

There is no reason why windows and tent curtains should be closed during rain or fog unless, in the case of rain, it is necessary to keep the patient from exposure to wet. The damp air is the best air that we have at these times and it is not harmful. The dampest air we can find is to be preferred to that found in a close, stuffy room.

How Derive most Benefit from Open Air.

The most benefit will be derived from the open-air life by keeping it up persistently, not only at night, but during the day as well. There is a popular idea that the open-air life is synonymous with exercise. Nothing can be further from the truth. In fact, patients suffering from this disease who are trying to regain health, can profitably spend much of their time quietly reclining. Each case must be treated as an individual and the instructions should be specific and be based upon a thorough knowledge of the conditions present.

Wrong and Insufficient Instructions Cause Many Deaths.

The best effect of open air can be obtained only by using it discreetly. While in itself harmless, doubtless more lives have been wrecked while trying to follow this mode of treatment than any other. Open air is not a cure for tuberculosis; it is only a measure for the production of a certain end. If used properly, it is one of the greatest aids to nutrition that can be employed; if used improperly, it will defeat its own purpose.

An individual suffering from tuberculosis should not be told that open air will cure him, but that proper living in the open air will be one of his greatest aids toward health. Many an individual has eaten good food and remained in the open air all the time, and yet killed himself. The oft-repeated advice of well-meaning eastern physicians to their patients, "Go West, live in the open air or rough it, and keep away from physicians," is responsible for the deaths of hundreds of patients annually. Not open air, but the proper use of open air, is one of the chief aids in the cure of tuberculosis.

It is the physician's duty to go into the minutest detail when prescribing any mode of treatment. This is just as necessary when open air is the remedy as when it is strychnia or morphia.

Open-air Treatment at Home.

While there is no place so unsatisfactory to treat tuberculous patients as in their own homes, yet we must realize that it is there where we must treat most of them. It is but a small percentage of the total number of pulmonary invalids that will be treated in institutions, tents or bungalows built expressly for the purpose; so, it is necessary for us to adapt the homes as best we can to meet the needs of the patient.

The most difficult thing to attain in the homes is a thorough co-operation on the part of those who are well. They are not accustomed to, nor are they willing as a rule to have their rooms well ventilated. Neither are they willing to submit to the cold air that we advise for the invalid, consequently the patient must occupy a room by himself.

Often a very satisfactory shelter can be made by screening in a porch. Sometimes an extra shelter can be built on the outside of a room, large enough for a bed and other actual furniture required. A bungalow (see Figures 37 and 38, pages 219 and 220) can be constructed in a yard adjacent to the house at a small cost. If none of these are practical it is best to have a room with windows on two sides, preferably a southeast or southwest room, and then, by placing the bed between the windows, a fairly good change of air can be obtained. When there is only one window in the room occupied by a patient, and the door is so arranged that it does not insure a constant supply of fresh air, I have the bed drawn near to the window and advise the patient to sleep with his face as near to the open window as possible. In this way he is breathing air as nearly like that of the outside as can be had in a room.

CHAPTER XII.

DIET IN TUBERCULOSIS WITH HINTS FOR THE MANAGEMENT OF THE MORE COMMON GASTRO-INTESTINAL COMPLICATIONS.

Present System of Diet Unsatisfactory. The subject of diet in tuberculosis is very poorly understood. It is a subject upon which we have very few accurate clinical observations based upou scientific facts. The crimes that have been committed in the name of feeding tuberculous patients have been legion. We hear of the stern medical director of a sanatorium who sits at the head of the table and does not allow the patients to leave until they have eaten all the food served to them; also, of patients being compelled to empty a quart pitcher of milk, besides eating other food, and turning the pitcher upside down before leaving the table. We hear boasts of patients' eating three meals, drinking from four to six quarts of milk and taking as much as two dozen raw eggs a day. The time will come and is near at hand when such unscientific, unpardonable offenses against common sense will no longer be tolerated. The rational treatment of tuberculosis does not depart far from common sense, while the treatment, as often employed, seems to depart as far as possible from it.

If we were to discover a scientific dietary for people in health, I do not think it would be far from that required in treating tuberculosis. Our aim in the treatment of tuberculosis is to secure a maximum of resisting power, and, to this end, we must endeavor to secure a maximum of nutrition. This requires a carefully balanced dietary, supplying sufficient quantities of each class of food stuffs to maintain nutrition without waste and without overburdening the organs of elimination.

Overfeeding. For a number of years it was thought that a gain in weight was the most important thing to be accomplished in the treatment of a tuberculous patient, and most extraordinary measures were resorted to in order to accomplish this end. It was found that forced feeding would put on weight rapidly; consequently, without thinking of the injurious results of such a course, patients were ordered to consume enormous amounts of food. I have heard the advice often given, to eat all the solid food possible and then swallow one or two raw eggs and drink a glass of milk. Such advice is absurd and cannot be followed for any length of time without doing injury to the patient.

Some patients can stand overfeeding better than others. We must remember that our tuberculous patients are taken from the general ranks of humanity and that they may have other diseases besides tuberculosis. Such diseases must always be considered in our treatment of tuberculosis. It would not be wise to attempt forced feeding in the case of a patient with diseased kidneys. Nor would we expect to accomplish any good by it where there was serious disease on the part of the gastro-intestinal tract. A weak heart is also a contraindication. A patient who is of normal weight for his height and age should eat only moderate quantities of food. I do not believe that it is advisable to force the feeding of a patient who has much fibrosis in the lung. These patients, as a rule, put on weight very slowly and I believe it is nature's way of protecting them. Moderate eating of substantial food is best for them.

Even though, for any reason, it should be thought advisable to increase the diet of a patient beyond what would usually be considered normal, such a dietary should not be persisted in indefinitely. It is always best to have the patient on a normal diet before he is dismissed from the physician's care.

Evil Effects of Overfeeding.

The evil effects of forced feeding are most pronounced on the part of the gastro-intestinal tract. The stomach often manifests rebellion against it in the form of nausea, and, if this warning is not heeded, chronic indigestion either with or without dilatation may ensue. The intestines show their disapproval of it by disturbances in their functions. The patient may have an undue amount of gas formation causing a feeling of fullness and discomfort, or he may suffer from obstinate constipation, or he may have two or three loose mushy passages a day often containing undigested residue. A common symptom, also, is a pain in the lower part of the abdomen, this pain being increased by the taking of all food. Dizziness and headache are also common symptoms. Upon the part of the heart, overfeeding is shown by an increase in the pulse-rate. There is no question but that the kidneys are often injured by overfeeding

Patients frequently gain weight very rapidly upon forced feeding. They take this as a sign of cure, and with this false assurance they begin to do various indiscreet things and go rapidly down. Then again, if this forced feeding is persisted in, the weight is soon lost through the disturbances produced on the part of the stomach and bowels. The accumulation of weight, which is put on in this way, is, as a rule, a soft fat. It is not stable. The patient is fat, but has no endurance. He suffers from dyspnea upon the least exertion, and upon the least provocation loses a few pounds. When such patients start to go down, they are hard to save. A steady gain in weight which progresses with the general improvement of the patient is to my mind, more desirable, and much more to the patient's advantage. It is not fat that is desired; but, resisting power which comes from an increase of muscle, an improvement in the quality of the blood and a building up of nerve force.

Rational Diet.

A rational diet is one which suits the needs of the particular patient in question. There can be no one diet for all cases any more than there can be one suit of clothes to fit all patients. However, there are certain definite proportions of proteids, fats and carbohydrates which can be taken as a standard and then the amounts varied as seems best. I am in the habit of telling my patients that I want them to eat the least amount of food that they can and gain weight satisfactorily. Such a policy does not impair the digestive system nor does it in any way overburden the kidneys.

Dr. Goodbody, Dr. Bardswell and Mr. Chapman made a careful study of the effect of various amounts of food upon tuberculous patients (Medico-Chirurgical Transactions, Vol. LXXXIV, 1902) and endeavored to put the feeding of such patients upon a scientific basis. Their observations were made upon six patients. The amount of food consumed was carefully determined by first weighing the amounts served and then also weighing any portions that were left uneaten. The urine and feces were carefully collected, weighed and analyzed in order to show the amount of food retained.

These patients were tested on an ordinary dietary, then one a little more liberal, and, finally, a much more liberal one. Their results show that the most suitable dietary consists of about

$4\frac{1}{4}$ ounces of proteids
5 ounces of fat
$10\frac{1}{2}$ ounces of carbohydrates

An objection might be raised to this suggested dietary that the number of cases is too small; and, it might also be said against its adoption as a general measure that patients of a different character and from different walks of life and under different climatic conditions might show different results. It would be profitable to have similar experiments made upon a larger number of patients of different environments, suffering from various forms of the disease, in widely scattered localities, to see if there would be any great variation from the above.

It is interesting to compare this with what is considered a standard dietary for a man at moderate work. According to Voit such a man should consume about

4 ounces of proteids
2 ounces of fat
16 ounces of carbohydrates

Burton Fanning, in an admirable discussion of the subject of diet (The Open Air Treatment of Pulmonary Tuberculosis, 1905), quotes the above experiments approvingly, and gives the following as a standard dietary.

		Approximate Value. Proteid.	Fat.
Meat	5 oz.	1 oz.	½ oz.
Milk	3 pints	2 oz.	2½ oz.
1 egg	2 oz.	¼ oz.	⅕ oz.
Porridge	Plateful	⅓ oz.	
Bread	8 oz.	1 oz.	
Butter	2 oz.	Trace	1½ oz.
Potatoes, etc.	4 oz.		
Puddings	Plateful		
Total, about		4½ oz.	4½ oz.

The items of the dietary are thus distributed for the day:

Breakfast:

Porridge, or bread and milk.
1 egg. Bacon or ham, or fish or brawn, etc. . . . . 1 oz.
Bread. Butter . . . . . ½ oz.
Tea, coffee or cocoa . . . . . Milk ½ pint.

11 A. M.

Milk . . . . . ½ pint.

Lunch.

Meat . . . . . 2 oz.
Bread, vegetables, puddings . . . . . Milk ½ pint.

Tea.

Tea, coffee or cocoa . . . . . Milk ½ pint.
Bread, biscuits, etc. Butter . . . . . 1 oz.

Supper.

Meat . . . . . 2 oz.
Bread, vegetables, puddings. Butter . . . . . ½ oz.
Milk . . . . . ½ pint.

Bed-time, or on waking in the morning.

Milk . . . . . ½ pint.

Fanning also quotes the standard dietary from Mundesley Sanatorium which was supplied him by Dr. Bardswell and is as follows:

Breakfast.

Coffee or cocoa, made with milk . . . . . 1 pint.
Toast or bread . . . . . 3 oz.
Butter . . . . . 1 oz.
1 egg. Bacon, fish or tongue . . . . . 1 oz.
Marmalade . . . . . 1 oz.

Lunch.

Meat . . . . . 2 oz.
Fish . . . . . 2 oz.
Bread . . . . . 2 oz.
Milk pudding . . . . . 5 oz.
Butter . . . . . ⅓ oz.
Cheese and biscuits . . . . . Milk ½ pint.

Dinner.

Same as lunch.

The value of this dietary is:

Proteids.	Fats.	Carbohydrates.	Calories.
120 grammes.	110	240	2,500

Prof. Fisher, of Yale University, has done the cause of diet in the treatment of tuberculosis a good turn by showing what a chaotic state it is in. (American Journal of the Medical Sciences, October, 1906.) In this excellent paper, one point is made very clear and that is that there is a general reaction against the indiscriminate, unscientific use of forced feeding. There is gradually appearing a greater respect for the physiological economy, and more of a desire to aid it in every way possible. What advantage can be gained by forcing the diet at the expense of the physiological processes of the body?

Diet must not only be adapted to the patient and his disease but also to the climate in which he lives. A patient living in a warm climate will not require as much food as one living in a cold climate, neither will he require the same kind. Generally speaking warm climates call for less fats and proteids than cold climates.

Importance of Milk in the Dietary.

One of the most important articles of diet for the tuberculous is milk. Milk contains all the different elements which go to maintain the body. It is easy of administration, and can be increased or decreased at pleasure, and it is or can be made easy of digestion for most people.

Modification of Milk.

Patients often tell me that they can not take milk, for it disagrees with them. A careful investigation and intelligent trial, however, as a rule, convinces them of their error. One great advantage of milk is that it is such an elastic food. It can be used in so many ways. Often when it does not agree, I modify it. The modification can be made by adding from ten to twenty grains of bicarbonate of soda to the glass, by diluting with some aerated water such as vichy, by adding one tablespoonful of lime water to the glass, or by the addition of tropon, malted milk, Eskay's or Nestle's food or some of the various well-cooked grains. It can be given cold or hot. It is best not to boil it unless this is done for some special purpose; for the boiling makes it more difficult to digest. When the bacterial content of the milk is high, it may be reduced by straining through cotton or the bacteria may be destroyed by pasteurization.

How Administer Milk so the Patient Does Not Fear It.

When patients think they can not take milk and the physician has satisfied himself that it is only a notion, as it so often is, I have found the following plan to work very successfully. I first prescribe from one-half ounce to one ounce of it to be taken at one time, either plain or modified, as mentioned above. Then every day or two I order the addition of another half ounce. If there is no idiosyncrasy but only a notion of the patient at the bottom of the supposed inability to take milk, he soon sees the ridiculousness of his position and is willing, as a rule, of his own accord, to fill up the glass.

Can Milk and Fruit Be Eaten Together?

There is a popular idea that milk can not be taken with fruit because the acid of the fruit curdles it. If a patient vomits after drinking milk, and finds that the milk comes up in curds, he, consequently, is at once convinced that milk disagrees with him. It is perfectly natural for milk to curdle in the stomach; that is the first thing which happens in its digestion; so we can assure our patients that in case vomiting occurs after milk has been taken it is natural to find the milk curdled; and, in as much as curdling is the first process of digestion, what harm can come from eating fruits and milk together, unless this combination is otherwise contraindicated.

Milk Should Be Chewed.

Milk is not a liquid food in the true sense of the word. As soon as it is taken into the stomach it is curdled and then really becomes more or less of a solid mass. If it is taken into the stomach in large quantities at one time, it curdles, forming one large mass with which the digestive juices are unable to cope, except with difficulty. If milk is taken slowly, on the other hand, in small sips, each mouthful will probably be curdled before the next reaches the stomach and so digestion will be facilitated. Milk then should be eaten and not taken as water or other liquids. Modification of milk by such means as are mentioned above prevents the formation of large curds and makes them break up more easily under the action of the gastric juices. Eating some solid food with the milk answers the same purpose.

How Much Milk Should Be Taken?

How much milk should be taken by the tuberculous patient? We hear such varied advice regarding this that it seems necessary to give this point more than passing notice. This can be answered only for each individual patient; yet, general instructions can be given which are of value. The answer to this question depends upon how much other food the patient is taking and what we are attempting to accomplish by feeding. If our sole aim is the putting on of large quantities of fat in a very short time regardless of the after results, then there might be some excuse for feeding patients five or six quarts of milk a day besides other food, but even then such quantities are entirely unnecessary. If the purpose, on the other hand, is to build up a well-nourished patient with good resisting power, this use of enormous quantities of milk can not be permitted.

When patients are eating a good, substantial, well-balanced diet, as a rule, there is no necessity of using more than from a pint and a half to a quart and a half of milk daily. This amount can be increased to suit the case, but I rarely find it necessary to exceed the latter limit. If a patient does not gain satisfactorily, it is an easy matter to add another glass of milk a day; and, this small amount will often cause an increase in weight. It must also be borne in mind that sometimes patients who are not gaining on a large diet will gain when the amount of food is reduced. When patients are on an exclusively milk diet the amount, of course, must be somewhat increased. It requires about seven pints of milk to furnish the requisite four and one-quarter ounces of proteids.

It has been my observation that patients who have put on fat rapidly under the use of large quantities of milk, also lose it rapidly on the slightest provocation. While we prefer to see patients gain in weight, we should remember that this is not the most essential thing in treatment. Many patients who do not regain, during the early part of the term of treatment, the weight which they had lost, will do so as the tuberculous areas in the lung clear up and as they become restored more nearly to their normal condition. In such cases the attempt to put on weight by excessive amounts of food would doubtless do harm.

Where milk must be used for long periods by patients whose appetites are apt to be capricious, it is well to use it in different forms. Malted milk, Eskay's food, Nestle's food, milk and tropon when alternated with plain or modified milk give us a variety which helps very much in our dietary. Buttermilk offers a grateful change to patients at times, and some do well on Kumyss. Sometimes the milk remains about the teeth and causes a dislike for it; in such cases the mouth should be rinsed and the teeth brushed every time it is taken.

Kumyss.

Kumyss may be made at home in the following manner: To one quart of new milk add twelve ounces of warm water in which one-third of a cake of compressed yeast and one tablespoonful of sugar have been dissolved. Put this into two one-quart bottles, cork tightly and tie corks in. Shake well. Place the bottles on their sides or upside down in a cool dark place and allow them to remain for three days. Draw off with a faucet when ready for use.

What are Best Foods for the Tuberculous?

If the question were asked what are the best foods for the tuberculous patient, it would be answered differently by different men, according to their ideas of what is to be accomplished. As stated above, I do not believe that the best dietary for the non-tuberculous would differ widely from the best one for the tuberculous. I think, however, that the diet for the tuberculous should be somewhat more liberal. In fact the tuberculous patient, when put under the modern hygienic-open-air treatment will have an increased appetite which demands more food. This increased demand, however, is not alone observed on the part of the patient, for the same holds true in the case of nurses and attendants. However, aside from the increased demand made by the methcd of living, it is quite natural that an increased amount of food should be required in order to overcome the retrograde process present. At least, a fuller diet should usually be instituted than these patients have been in the habit of taking before they consulted a physician.

The question is, what form of food stuffs should be increased in order to make up this extra diet? If an increase of fat is most desired we could accomplish our purpose best by the increase of fats and carbohydrates; but, if our desire is not so much the increase of fat but the building up of muscle, nerve force, and blood and the prevention of tissue destruction, then proteids, the "tissue builders," should be increased most. Of course we would not expect the increase to be made entirely in one class of food stuffs, but one might be increased more than the others.

Whatever food is used should be furnished in as easily digestible a form as possible, so that the patient may gain a maximum of nutrition with the expenditure of a minimum of digestive energy.

Proteids. The proteids can be furnished by meats such as rare steaks, mutton chops, roast beef, roast mutton, poultry, game, fish, eggs and milk. In many cases meat can be best digested if scraped. The use of raw meat (zomotherapy) has been shown to be of great value in the treatment of tuberculosis by Richet and Hericourt and Phillip and Galbraith. Raw meat sandwiches made with stale bread and seasoned with salt are not unpleasant to the taste and at the same time are nourishing. Meat juice is also a very important article of diet. It is prepared best by cutting the juicy parts of the round steak into strips, and placing them on the coals long enough to sear the outside. The strips are then put in a meat press and the juice is extracted. Where no regular meat press is at hand a lemon squeezer may be used, but this is no economy; for, the juice left unextracted would soon equal the cost of a meat press. Before expressing the juice, the press and the receptacle for catching the juice should be warmed. The juice should then be consumed before it becomes cold. It can not be warmed up except by means of a water bath, otherwise the albumen coagulates and its worth is destroyed.

Eggs are another valuable proteid food. They can be used in many ways, but I have found that patients will take them raw without tiring for a longer time than any other way. They may be beaten up and put into milk, or served as eggnog, or as an egg lemonade; but my favorite way is to have them dropped into a cup, with a few drops of lemon juice added and then swallowed whole. Patients seem to tire of them least quickly when taken this way. I have known patients to consume as many as two dozen a day, but I do not believe this is necessary or rational. I rarely prescribe more than from three to six a day.

Fats. Fats can be furnished in the form of milk, cream, butter, bacon and olive oil. Patients who will eat plenty of bacon, butter and milk do not need cod liver oil. In fact, I never find it necessary to prescribe it. I have found bacon an easy form of fat for most people to digest and use it in liberal quantities.

Carbohydrates. The carbohydrates are furnished in the various fruits, cereals and vegetables, all of which are allowable in the tuberculous diet unless contraindicated; however, cabbage, turnips, parsnips and carrots are likely to disagree, and too much sweets are not advisable because of their tendency to ferment. Thus, it can be seen that the diet of the tuberculous can be quite liberal. One golden rule, however, should be remembered: "Avoid whatever is known to disagree and whatever is subject to question."

Minute Details as to Diet Necessary. Minute details as to diet must be given to each patient. We must not expect him to have any well-founded ideas as to what are the best foods for him to eat, or as to the best method of using them; consequently, it is the duty of the physician to instruct him. There should be sufficient time between meals to allow the stomach to become empty from the previous meal before the next one is eaten. There should be at least five hours between meals; thus, they may be served at 8 A.M., 1 P.M., and 6 P.M. By spacing meals properly, we obtain the best results in digestion and assimilation. The time for the meals should not vary. The patient becomes accustomed to having food at regular intervals. His appetite accordingly is ready for it at these times; and, if the food is brought either earlier or later, the relish is not so keen and digestion is not so good.

By allowing five hours between meals an opportunity is given for extra food in those cases where it is deemed necessary. When extra food is used, it should not be given later than two hours before the next meal, and the character of the food should be such as not to require a longer time than this for digestion. Milk, raw eggs, scraped meat and beef juice are especially suited for this extra nourishment.

The tuberculous patient should be a man of regular habits and nowhere is this more necessary than in his habits regarding the taking of food

Appetite Not Safe Guide. There is a common belief that the appetite is a safe guide as to what to eat and how much to eat. While I am in sympathy with the opinion that we should cater somewhat to the likes and dislikes of patients, remembering that they will often eat a meal with relish if some article of which they are especially fond be furnished, yet, generally speaking, it is essential for the physician to map out a dietary for the patient.

Of course, it is unnecessary to say that the variety of food should be as liberal as is possible. Regarding the amount of food taken by any individual patient the physician must be the judge. If patients are allowed to use their own discretion here it will be most disastrous. Some will continually overeat while others will not take enough food to keep them nourished. There is a certain class of patients that we often meet who have always been poor eaters. They are usually neurotic and almost always under weight. To allow such patients to follow their own inclination, while a chronic suppurative process is sapping their vitality, can not be other than disastrous.

Very often, in the course of tuberculosis, we note that patients lose their appetite or it becomes capricious. In fact this is a very common symptom of early tuberculosis and it follows along through the course of the disease manifesting itself whenever a recrudescence appears. Often this, with malaise, loss of weight, and slight rise of temperature, shows that an extension of the disease is taking place, or that an old focus is acutely inflamed. The anorexia in these cases is often of toxic origin. Sometimes it is due, especially in cases moderately or far advanced, to the fact that the walls of the intestinal tract partake of the general loss of tone and wasting which are so pronounced in this disease. For patients to follow their own inclinations as to appetite under these conditions would be suicidal. Such patients should be put under the best hygienic conditions and encouraged to eat liberally, for by eating and drinking is brought about a better state of nutrition and digestion and the appetite returns.

Often, patients who are suffering from fever, if allowed to eat according to their appetites would die of starvation, while by eating a liberal diet they can not only maintain their weight but increase it. The indications in acute fevers which are of short duration may be for a very restricted diet, but in tuberculosis the conditions are different, and we must insist on a liberal diet.

Gastric Neuroses of Toxic Origin.

Patients suffer from many of the gastro-intestinal neuroses which are due to the tubercle toxins. Such symptoms are relieved best by an improvement on the part of the patient. When no organic trouble is present, if the nutrition of the patient improves, these symptoms improve also. No special restricted diet need be pursued unless improvement of symptoms on the part of the gastro-intestinal tract fails to follow the general improvement.

Organic Diseases of the Gastro-intestinal Tract.

We should always make careful examination in order to determine whether or not our patients are suffering from pathological changes in the gastro-intestinal tract. If these be present, appropriate dietetic measures should be prescribed to meet the condition. The sooner such measures are adopted the better for the patient.

Hyperchlorhydria.

Observations on tuberculous patients show that many of them suffer from hyperchlorhydria. Some of these we describe as functional because of our lack of a better term, while others have a patent pathological condition underlying them.

Such conditions can often be corrected with relative ease if the proper dietary and other measures are adopted, while, if allowed to go, they become most intractable. Such patients must be treated by a bland non-irritating diet, free from condiments and irritants. While such a diet must be restricted, yet it can be very liberal, and conform to what is necessary for the nourishment of the tuberculous patient. These patients stand fats well for they depress the secretion of the acid. When creosote was in vogue as the treatment for tuberculosis it was found to disagree with a great many patients. We would expect it to disagree with those suffering from hyperchlorhydria, for by its stimulation it increases the already too abundant acid. Nux vomica, and other remedies which stimulate the gastric secretion, are also contraindicated. Large doses of alkalies often act well in these patients but must not be continued too long.

Hypochlorhydria. A deficiency of acid is also at times encountered. This may be of nervous origin. If so, it usually responds to treatment in a short time. The administration of ten or fifteen drops of dilute hydrochloric acid after meals, either with or without some of the bitter tonics such as nux vomica, will often restore normal conditions in a few days.

Dilatation of the Stomach. Another condition which we frequently meet in this day of overfeeding is dilatation of the stomach. Many patients, as soon as they find they have tuberculosis, either upon their own initiative or through the advice of their physician, begin an indiscriminate process of stuffing. Dilatation often results from it, and must be guarded against. When it is present, one must limit the amount of fluid ingested. To put such patients upon large quantities of milk will aggravate the condition. They should be put to rest in the open air and fed on concentrated proteid and carbohydrate foods. Fat should be excluded. Under such a diet with other appropriate measures, such as massage and electricity, patients often make satisfactory improvement.

Constipation. Constipation must be combated in a very large per cent of tuberculous patients; especially is this true of those who are in the advanced stages. The tuberculous patient is especially subject to just those conditions which favor constipation, viz., hyperchlorhydria, catarrhal and atonic condition of the stomach and bowels, neurasthenia and the consumption of large amounts of concentrated foods. Aside from this, especially, the patient in the advanced stage is forced to lead a life of inactivity which favors sluggishness on the part of the gastro-intestinal tract.

The cause, of course, should be removed whenever practicable. A dietary suited to the condition present is very essential to success. In constipation dependent upon an atonic condition of the bowels, a diet containing much residue which will stimulate peristalsis is necessary. Coarse grains, vegetables and fruits are very important articles of diet in these cases. A glass of hot or cold water taken on arising and on retiring is beneficial. When not contraindicated, fats in the form of cream, butter and, especially, olive oil are of great value. I frequently have patients, where it agrees with them, take from one-half to one ounce of olive oil after meals. It is better to begin with smaller doses, say one-half dram and gradually increase. A most successful way of administering olive oil is by putting it on bread and eating it with a little salt. The salt takes away the insipid taste which is objectionable to many. In constipation of the spastic variety, where the movements are ribbon like in form, belladonna pushed to its physiological action will remove the spasms and relieve the condition.

Non-tuberculous Diarrhea.

Whoever treats many cases of tuberculosis, especially those in the advanced stages, will often be obliged to treat diarrhea. Sometimes it is of a tuberculous nature, but it is often a simple diarrhea due to some irritation, other than tuberculosis, in the intestinal tract. It is very important to give these patients relief as soon as possible, for they can ill afford to lose strength and weight.

In non-tuberculous diarrheas the patient should be put to bed and the alimentary canal should be freed from the irritation of its contents as quickly as possible by some mild cathartic. For this purpose, castor oil in one-half to one ounce doses has served me best. Where this cannot be taken, salts, Epsom or Rochelle, serve well. All ordinary foods should be withdrawn, and the patient put upon a mixture of milk, two parts, and lime water, one part. Hot compresses should be applied to the abdomen for two hours a day. After twenty-four hours, if the condition has improved, boiled rice with boiled milk may be added. If all goes well, the whites of eggs or the entire egg, raw, or soft boiled, and then scraped meat and stale bread may be given. Baked potatoes and purees may then be cautiously added, leaving the coarser vegetables and fruits to come later. Eskay's food, Nestle's food or some of the other food preparations may be used to advantage for a while to modify the milk.

With this manner of dieting in these cases, much time is saved. The patient is brought out of his trouble with the least loss of strength, and in a few days is able to return to a fairly full diet. It is a wrong policy to undertake to check these diarrheas by the use of astringents. It blocks the bowels up, without the removal of the cause. If they are used at all, it should be only after the bowels have been thoroughly emptied. Where an astringent is required I always prefer subnitrate of bismuth.

Tuberculous Diarrhea.

In tuberculous diarrhea the treatment must be different; for here we have an irritation which we can not remove quickly. The problem is to nourish the patient in spite of it. All laxative food should be removed from the diet, and the patient fed upon such food as milk, modified with lime water or the various preparations mentioned above, scraped meat, toast or stale bread, raw eggs, soft boiled and poached eggs, tropon, baked potato, mashed potato and boiled rice. Other foods may be added occasionally in very small quantities, if they do not disagree. It is well to control the bowel movements by subnitrate of bismuth in doses of from thirty grains to one or two drams, while this diet is being persisted in. In severe cases opium or opium and lead may be added, as described on page 247. Hot compresses to the abdomen are valuable adjuvants.

We know from post-mortem evidence that tuberculosis of the intestines sometimes heals, and we have also seen this occur clinically; so we should endeavor, especially in cases where the symptoms are not too severe, to give our patients the best nourishment possible so as to give them the best chances of recovery.

CHAPTER XIII.

REST AND EXERCISE IN THE TREATMENT OF TUBERCULOSIS.

The question of rest and exercise in the treatment of tuberculosis is one of great importance. There are certain indications upon which the profession is fairly well united, which call for rest and exercise respectively. Whenever there is any question whether the patient should rest or take exercise, it is safe to advise rest. If there be any error let it be on the side of saving the patient from all questionable exercise.

It was Dettweiler, who first inaugurated the rest cure for tuberculosis. Sufferers from this disease owe a debt to him that they can never appreciate, for he it was who first combated the old idea of exercise being absolutely necessary to a cure. While he may have gone a little too far to the other extreme, yet he started a reaction, and modern therapists have been able to choose the golden mean which is proving so efficacious in the treatment of this disease. Brehmer showed us the value of exercise in strengthening the heart and improving nutrition, while Dettweiler demonstrated that too much exercise is harmful and maintained that health is regained best under a condition of absolute rest for the greater portion of the day. Most phthisiotherapists today make Dettweiler's teachings the basis of their actions and employ rest as an important factor in treatment.

Value of Rest.

Rest is that condition of existence wherein the physiological functions are carried on with the expenditure of a minimum of energy. During rest there is the least possible call upon the organism for action; in fact, during perfect rest only those functions which are absolutely necessary to life are carried on. Since man's natural state implies a certain amount of activity and the use of a certain amount of energy, rest, either natural or enforced, saves the organism and the cells which would be called into action by activity from this demand, and in this way acts as a conserver of force. Not only does rest save the body cells from the expenditure of energy but it also affords an opportunity for repair; hence rest is rightly called the great restorer. In confirmation of this point it has been shown that the resisting power of patients suffering from tuberculosis, as measured by the agglutinating power of the blood, is increased when the patient rests and is decreased by exertion, especially if this is carried to the point of tiring.

Value of Exercise.

While a state of rest makes requisition upon the individual for the least expenditure of energy, yet in health a certain amount of exercise is necessary in order to maintain a physiological equilibrium. While rest is essential to life, exercise is essential to the highest state of health and the best enjoyment of life. Where there is no contraindication, therefore, exercise should be a part of the daily life of the individual, for by it his cells will be better nourished, his organs will functionate better, and he will be a stronger, healthier man.

This question of rest and exercise should be discussed from two standpoints; first, rest or exercise for the tuberculous individual, and then rest or exercise for the tuberculous lung.

Rest in Fever.

When fever is present, rest is essential. This is a rule to which there are very few exceptions. Fever is an index which shows the presence of an inflammatory process. An extension of the disease, acute miliary tuberculosis, the development of a pleurisy or pneumonia, or the presence of inflammation of other organs, such as acute gastritis, are accompanied by a rise of temperature. Whenever such acute processes manifest themselves, the patient must be treated by rest. Rest insisted on promptly at the first indication of such conditions will often cut the attack short.

What degree of temperature shall be taken as an indication that rest should be prescribed? Shall we follow those who keep patients at absolute rest whenever the temperature reaches 99 degrees, or shall we be more liberal? Personally I believe in being a little more liberal, but hold that it is a question to be decided for each individual case. I make it my rule to try absolute rest on all patients whose daily temperature reaches 100 degrees. I sometimes find, however, a nervous patient who will not submit to this rest treatment, who chafes under the restraint and worries beyond degree and keeps the temperature elevated by the excited mental condition. In such cases it often proves best to allow the patient to sit up for a few minutes at that time of the day when the temperature is lowest. There is a certain rest and encouragement about this which relieves the mind and lowers the temperature. Mental unrest, such as is produced by worry, by great emotion, by reading or visiting with friends for a considerable time, will cause a rise of temperature just as surely as will physical exertion, and it is just as important to relieve this as it is to order rest for the body.

One should not be discouraged too quickly, however, if the patient's temperature does not lower by rest. He must not come to the conclusion that it is a case for exercise simply because the temperature is stubborn. I have seen patients with tuberculosis who had an elevation of temperature which exceeded 100 degrees for months, in whom there was no nervous element at all. Patients for whom it is advisable to chance a little exercise regardless of temperature can only be chosen by selection after carefully watching the course of their disease.

No matter how well a patient is doing, if he has gone beyond the early stages of tuberculosis, he will almost surely have spells when his temperature will be elevated and he will need to take advantage of rest in bed for a few days. It is very essential to keep accurate records of the temperature of tuberculous patients; and, if any tendency for the temperature to rise is noted, to enjoin rest. I believe such a course will often cut short acute processes; so, if the temperature is found reaching the hundred mark, then rest should be deemed essential. It is not at all uncommon to see patients lose their temperature in a few days when treated in this manner; on the other hand, it is not at all uncommon to see a continued fever follow carelessness in enforcing rest at this time. Wright has proven that this rise of temperature following exercise is due not to tiring, as is generally supposed, but to an autoinoculation of toxins. Exercise forces more toxins into the circulation than would occur during rest.

Sometimes, following a few days' rest in bed, we have noted a reduction of temperature in those chronic cases which have persisted in showing a rise, reaching about 99.5, for months. In all cases where there is a persistent rise which fails to yield to other treatment, rest should be enjoined. It may not affect the temperature at all or it may not affect it permanently, yet in certain cases it will; so it is worthy of a trial.

When a pneumonic condition is present or when a pleurisy develops, rest in bed is imperative. It not only gives the patient a chance to get well sooner but it also puts him in the best condition to ward off complications.

Rest in Non-febrile Cases.

Temperature can not be taken as the sole guide for rest or exercise. Many non-febrile cases can be best treated by rest.

Effect of Rest Upon Cough.

Oftentimes a cough is aggravated by exercise, even slight movements producing a paroxysm which tires the patient and causes a rise of temperature. Coughing should be discouraged as much as possible in the treatment of tuberculosis; for it causes an explosive action which tears the delicate threads that nature throws out to heal the lesion, and keeps stretching the air vesicles until it impairs their elasticity and causes an emphysematous condition. When the rest treatment is used and the patient trained to resist coughing, cough mixtures are rarely needed.

Rest in Hemoptysis.

Hemoptysis calls for the rest treatment. Rest should be enjoined at the least show of blood. While this may seem overcautious, yet it is a wise precaution; for the small streak of blood or the small mouthful may come from a minute opening in a large vessel. If rest in bed is adopted at once, it gives the lesion an opportunity to heal, while if exercise is persisted in the break may become large and the bleeding become difficult or even impossible to control.

I know full well that all hemoptyses are not due to the opening of large vessels. Some are congestive in their origin. But as yet we have no definite way of telling which is the one and which the other; and, until we do have such knowledge we should not expose the patient to unnecessary risk. The patient should be given the benefit of the doubt and rest should be instituted upon the first appearance of blood, no matter how small the amount.

The following case illustrates the importance of this: A few years ago I was making a test of streptolytic serum in the tuberculosis ward of the County Hospital. I was preparing to give an injection to a young man who had an advanced process with cavity formation in both lungs. The nurse was preparing the skin for the injection, when he began to expectorate blood. Inside of three minutes he was dead. The nurse then told me that he had spit up a little blood-streaked sputum in the morning, but it had not been heeded. The chances are that if he had been ordered to remain in bed at rest for a day the fatal hemorrhage would not have occurred.

I have always been glad that I had not given him the dose of serum, for I might have thought that it stood in a causative relation to the fatal hemoptysis.

Another reason for rest during the spitting of blood is to lessen the danger of a new infection taking place. All bodily movements call upon the heart for more work, and, if they are sudden, the heart must respond suddenly and there is undoubtedly greater danger of sweeping bacilli out of the ulcerated tubercle which occupies the vessel wall at the seat of the bleeding point and scattering them in other parts, than there would be if the patient remained at rest.

The Heart and Rest.

One of the most important organs to be considered in tuberculosis is the heart. From the standpoint of prognosis it is at least of equal importance to the stomach. I believe that a patient will stand better chances of overcoming tuberculosis with a good strong heart and poor digestion than he will with a good digestion and a weak heart. Therefore, the heart must receive most careful consideration.

As mentioned in the chapter on prognosis (page 95) the heart bears the brunt of the fight in tuberculosis. Early in the disease it is affected by the toxins. A little later it shares in the general muscular wasting and loses tone. This is often very marked when high fever continues with or without mixed infection. From the destruction of lung tissue and obliteration of blood vessels together with the catarrhal condition of the air passages and emphysema which develops, the right heart is subjected to an enormous strain in order to overcome the resistance which is offered to the pulmonary circulation. When we add to this, the fact, which is patent in nearly all cases of advanced tuberculosis, that the heart is pushed and pulled out of place by compensatory emphysemas and contractions and bound down and embarrassed by adhesions, we see the necessity of sparing this organ whenever it is possible to do so. The heart must always be kept in mind by him who wishes to combat tuberculosis successfully.

Many a time injudicious exercise will put a strain upon the heart which, if often repeated, will do irreparable damage. Many hearts are so injured in the early stages of the disease that there is no possible opportunity for them to regain their tone and, of course, the patient's life is sacrificed as a result.

In cases where a rapid extension of the tuberculous process is taking place or where a pneumonic condition is present, or where, for any cause, there is a rapid obliteration of the pulmonary vessels, throwing extra burden upon the heart, rest should be enjoined. At these times it must also be remembered that an increased tendency to muscular wasting is present, and that the heart muscle is affected along with the others.

A patient suffering from tuberculosis, who has a weak, rapid heart, should always be subjected to the rest treatment. Sometimes the heart will respond to this treatment, improve its tone and after a little while be able to stand the burdens thrown upon it, when at first it seemed that it would give way. So whenever there is doubt as to what to do, it is safer to employ rest.

The Heart and Exercise.

We have endeavored to show why rest is important from the standpoint of the heart, in some of the conditions which arise during the progress of tuberculosis. We also believe that exercise has its place, and will endeavor to show its benefits when judiciously used at the proper time.

There comes a time in nearly all cases of tuberculosis which are progressing favorably, when the disease becomes more or less quiescent, when the heart is no longer affected by the toxins and when it has adjusted itself to the changes which have had a tendency to embarrass it. When such a time comes, exercise is valuable. It should be begun very cautiously and the effect watched carefully. If the condition of the heart has been such as to make it necessary for the patient to remain in bed, then the first exercise should consist of simply sitting up in bed, later sitting up in a chair, then walking across the room.

During all of these procedures, the effect should be watched carefully. If the exercise, no matter how slight it may be, causes a rapid, weak pulse, it is more than the patient can stand with safety. When the patient begins to walk, he should go a few steps only and make it a rule to always stop short of the appearance of dyspnea. The patient is usually inclined to want to go too far, so the physician must guide him. If the pulse becomes rapid the amount of exercise should not be increased next time.

After a few trials at exercising have been made, if the heart is going to be strengthened by it, we will find that the pulse becomes less sensitive and does not beat as rapidly as at first. If the pulse becomes more rapid and weaker it shows that the exercise is not being well borne and should not be persisted in except with great caution.

The danger to the heart was indelibly impressed upon my mind by an incident which happened when I first began the treatment of tuberculosis. A young man, twenty-five years of age, who had always been strong, developed tuberculosis. The disease made rapid progress and there was extensive destruction of tissue in a short period of time. When the temperature began to drop, his physician told him he might spend a little time on the roof garden of the hospital, which required the climbing of one flight of stairs. While ascending the steps he was seized by a sudden pain in the heart, accompanied by syncope. His pulse immediately became very much accelerated. He had suffered an attack of acute dilatation of the heart. The pulse continued at the rate of one hundred and twenty to one hundred and fifty for a number of months. I had charge of him for the next ten months and was obliged to keep him in a recumbent position nearly all the time. His heart finally strengthened and the pulse settled down to about 100 beats per minute. While this is an extreme case, yet it is a good one to show what occurs in others to a lesser degree.

In cases of tuberculosis where it is not necessary to confine the patient to bed, a certain amount of exercise depending on conditions present may be taken to advantage. The heart, however, must always be watched. Exercise must never be in excess of what the heart will stand. Our object in treating tuberculosis is not alone to cure the tuberculous process but to bring our patient through to as near perfect health as is possible; so we should strive for healed lungs with a strong heart, and the strong heart will be an important factor in producing healed lungs.

Rest and Dyspnea.

When dyspnea is present, or if it is produced by exertion, then rest should be enjoined, unless the dyspnea be due to a fat flabby condition such as is often produced by overfeeding. Where such is the case, exercise, carefully graduated, with attention to the diet is very beneficial.

Rest When Weight is Much Reduced.

There is great fear on the part of some patients who are very much reduced in strength and weight that, unless they exercise, they will never gain. Such a notion has no foundation. In fact the reverse is nearer the truth; if they exercise, they will never gain. Such patients must be treated by rest along with other remedial measures.

When Shall a Patient Exercise?

Where there are no complications present such as those mentioned above and where no deleterious effects are noted on exertion, such as rise of temperature, pulse-rate and dyspnea, exercise, if properly carried out, is beneficial. Exercise keeps the body fluids moving. It brings more blood and lymph to the tissues. It stimulates digestion and assimilation. It induces sleep. It increases the activity of the skin, kidneys and bowels. Hence its usefulness.

An early stage case after all activity is past and an arrestment attained, if there are no contraindications, may walk from one to five miles a day with benefit. An advanced case must increase the amount of exercise with caution. He can not go so far and he has more contraindications to hamper him. A walk from one-half to one mile may be all that he can take with profit.

During the early weeks of treatment I think it is well to keep the patients quiet. After we learn to know them better and are sure of their condition and complications, their weaknesses and their strong points, then we are better able to suit exercise to them, and they are better able to adopt it.

When patients are allowed to take exercise, they should be cautioned not to do so immediately before a meal. Patients should always go to their meals rested. It is very important to insist on a half hour's rest before the principal meals of the day. Very often, if a man goes to the table tired, his food does not digest, and a tuberculous patient can not afford to take any such risk.

When a patient has been under the physician's charge and he has arrived at the place where he is about ready to be dismissed, if his condition warrants it, he should be hardened and brought to a point of endurance as near to that of a normal man as is possible before he is again thrown upon his own responsibility. Here is where a mistake is often made in sanatoria. Patients are kept well, they live under ideal conditions, they are fat, but they are not strong. They leave the institution with its careful regime and hygienic surroundings and soon begin to lose weight. They are discouraged and, if the result of their treatment was an improvement or arrestment instead of an apparent cure, they may even lose much that has been gained by treatment, If patients would allow themselves sufficient time for treatment, they should be brought down before discharge to a point where they can maintain nutrition on an ordinary dietary and where they can endure exercise such as they will be called upon to perform when they leave the institution. I like to have my patients remain quiet until the disease is quiescent and then, as soon as they are able to take exercise without harm, begin by very short walks and gradually lengthen them, where there is no contraindication, to four or five miles a day.

Lest I should be misunderstood, I will again say that I am primarily in favor of rest; but, when there are no contraindications and the patient has advanced to a point where my experience tells me that he can exercise to advantage, then I believe it should be recommended.

What Form of Exercise is Most Suitable?

Perhaps the injudicious use of exercise in tuberculosis has been the cause of more deaths than any other one measure. Unfortunately it is very difficult to find a varied program of exercise which is suitable for those suffering from tuberculosis. All things being considered, perhaps walking is the best exercise for those who are strong enough to take it.

The patient should walk leisurely. He should not try to make time. He should rest frequently. In fact, the walk should be more in the nature of a stroll. Walks should be arranged either on the level or, if there is a hill, so that the ascent be made when the patient starts out and is fresh. Then his homeward course, when he is more easily fatigued, would require less expenditure of energy. Patients should never walk fast enough to cause coughing, shortness of breath or tiring, neither should the exercise cause a rise of temperature. These symptoms are proofs that the exercise has exceeded the limits of safety.

Horseback riding has often been recommended, but, personally, I do not think it has any place in the treatment of tuberculosis during that short time that a patient is usually under a physician's care endeavoring to attain either a cure or an arrestment of his disease. After this has been attained, and the patient has continued in health for some time, and the scar tissue has become firm, then, possibly, horseback riding on a horse with an easy gait is not objectionable.

Croquet is perhaps the least objectionable of all out-of-door sports. It does not call for violent exercise of any kind. Golf and tennis are not suitable. The great trouble with all games is the tendency to play too long. Patients get tired without realizing it and if they do they feel that they can not stop the game.

Overexertion. The danger in all sports and games is that of overexertion. Oftentimes a single overexertion will produce an exacerbation of the disease, and I have known it to be the cause of death. The following is a case in point. A young man was spending a short time in the mountains just for a change of scene. He had been trying for a year to overcome his disease, and had made many sacrifices in order to do so. He had arrived at the point where the process was stationary, and he was making excellent progress toward recovery. A young lady who was in the same camp, asked him to go with her to take some pictures. In their interest they forgot distances and walked farther than they should have done, and when they returned, he was very tired. This was followed by an exacerbation of the disease from which he never recovered. The cause was trivial, the result most serious. This is only one of many instances that I have seen. It teaches caution. A very good rule for a tuberculous patient to follow is never to undertake anything in the way of exertion that can not be stopped before he finds himself becoming tired.

Rest and Exercise for the Lung. A point which has caused almost endless discussion is the relative merits of rest and exercise for the lung itself. The advocates of exercise have seemed to think that one of the principal factors in tuberculosis, operating both as a cause of the disease and as a prevention of cure, is the lack of oxygen, and they have suggested deep-breathing as a means of supplying the supposed deficiency in this important element. The trouble with these premises is that they have never been proven. It has been clearly demonstrated that pure air is a valuable asset in treatment and that deficient ventilation is a causative factor in producing the disease, but it has never been shown that the amount of lung area which is in use in a given individual unless he be so far advanced as to be beyond help, is not sufficient to supply him with the oxygen necessary to carry on his life functions, providing there is sufficient oxgyen in the air breathed.

Nature has endowed man with an abundant lung capacity. It has been estimated that a man can live a useful life and only use one-half of his lung area, and that a much smaller area is not incompatible with existence. An experience with cured and arrested cases of advanced tuberculosis, shows that patients can get along and lead more or less active lives when large portions of lung tissue are incapable of functionating. When areas of lung tissue are destroyed others increase their activity and take upon themselves increased function; so, nature maintains an equilibrium without any intervention on our part.

Breathing is an involuntary act presided over by a center in the brain. When there is a deficiency of oxygen, this center is stimulated and the respiratory effort is increased, being both quickened and deepened. The muscles which are called into action during respiration are also voluntary; so the act can be governed somewhat at will; nevertheless, without bringing voluntary action into play, the physiological mechanism of the respiratory act is so adjusted that the balance between respiratory need and respiratory activity is maintained.

If nature had intended that tuberculous patients should breathe deeply in order to secure oxygen to ward off their disease she would have made some arrangement by which such action would not depend upon the voluntary actions of man. The fact that we are provided with a respiratory center which calls for a quickening and deepening of the respirations when this is necessary, as is shown by the accumulation of waste products in the blood, should make us feel quite at ease in leaving this act to nature.

If prevention or cure depended on deep-breathing, it should be kept up; otherwise the supposed advantage would be lost. We often see individuals who have previously practised deep-breathing and increased the expansion of their chests lose their increased expansion as soon as they cease the exercise. In my experience I do not think I have found more than half a dozen individuals who persisted in deep-breathing exercises after they had begun them. It is unnatural, and, from the standpoint of oxygenation, unnecessary.

Motion of Lung not only Unnecessary but Harmful.

Not only is deep-breathing unnecessary from a theoretical standpoint, but it is actually harmful in its effect, especially during the active stage of tuberculosis.

The ideal method of treating all inflammations is with rest. This has been recognized in all forms of bone and joint tuberculosis for years. It is strange that the same principle was not sooner applied to tuberculosis of the lung. Owing to the functions of the lung it is impossible to put it at rest, but we can avoid unnecessary exertion on its part and it seems but common sense to do so.

It has been my observation that those areas of lung tissue which lie next to the heart, when they become the seat of a tuberculous infection, are slowest to heal, and that a right-sided infection heals more quickly and more surely than a left-sided one. I believe that this slowness in healing is due to the constant motion kept up by the heart, and I further believe it gives us an important hint in the treatment of these cases. To me it furnishes a strong argument in favor of rest for the lung as a promoter of healing.

In this connection I would like to call attention to the action of corsets. Their use causes a constriction of the lower portion of the chest, and consequently forces the upper portions of the lungs to do more work. In as much as the upper lobes are most frequently the seat of tuberculous infiltration, it is plain that by wearing corsets forced exercise is being thrown upon parts that should be kept as nearly at rest as is possible.

That forced breathing does have an injurious effect where active disease is present is suggested by the fact that a rise of temperature is observed after deep-breathing exercises.

Healing of the lung takes place by the formation of scar tissue. The first attempts at healing are the throwing out of minute threads of delicate tissue. Rest favors the preservation of these, while action of the lung and, especially, overaction—such as is found where deep-breathing is practised—tends to destroy them. When they are destroyed, new fibers must be thrown out, and such action can not help but increase the amount of scar tissue required in healing.

Coughing as mentioned above has the same effect. The explosive efforts produced by the attempt to dislodge particles of mucus from the air passages or those called forth by some other irritation can not be otherwise than harmful. That this is not an imaginary danger can be shown by the effect of the cough or chronic bronchitis or whooping cough in the production of emphysema; also, by the cough of tuberculosis, causing an actual rupture of tissue with resultant hemorrhage.

While healing must take place by the formation of scar tissue, yet, it is important to have as little scar tissue as is consistent with healing; for scar tissue can not functionate and must be considered as a foreign body. The greater the amount of scar tissue the greater the amount of contraction that is likely to occur and the greater the disturbance and distortion of the organs within the thorax.

Deep-breathing Favors Aspiration of Mucus into New Parts.

There is a fear that seems well grounded that deep-breathing during the time when mucus is present in the air passages may aspirate it into new parts and thus spread the disease. Prudence forbids the use of deep-breathing as long as such danger exists.

Have Breathing Exercises any Part in Treatment?

While personally I rarely prescribe deep-breathing exercises, and consider them absolutely contraindicated wherever any activity in the lungs is present, yet I can see how the increased motion of the lungs hastens the flow of lymph and blood through them and thus aids in absorption. This might be of value at a time when an old pneumonic area is trying to resolve; yet, this is just the time when it would be contraindicated for other reasons as mentioned above. It might also be of some value in cases when activity is absent and secretion has either disappeared or is confined to a cavity. Such cases to my mind are the only ones where deep-breathing might hasten absorption and the clearing up of the lungs with practically no possibility of doing harm. The good effect here can not be ascribed to better oxygenation but to a hastening of the lymph and blood flow and a promotion of absorption.

CHAPTER XIV.

HYDROTHERAPY IN TUBERCULOSIS.

Value of Hydrotherapy in Tuberculosis.

No work on the modern treatment of pulmonary tuberculosis would be complete without a brief discussion of the various hydrotherapeutic procedures which are applicable to this disease. There is no tonic, aside from fresh air itself, which is so flexible, so adjustable to all conditions, and so helpful as water. When the temperature, force, duration and style of bath are carefully adapted to the patient's condition, we have a means at our command which will aid very materially in improving nutrition, restoring tone and relieving symptoms of the tuberculous patient.

Relief of Temperature Least Important Function of Hydrotherapy.

A great many have associated the idea of reduction of temperature with hydrotherapy. This is only one and I might add one of the least important of its functions. Hydrotherapy influences the action of the skin, the nervous system, the heart, the respiratory organs, in fact, every function of the body, either for good or evil according to the manner in which it is used. Simply because it is the use of water, is no reason why we should not exercise care in its use. If it is not used properly, it is capable of doing harm. We should exercise the same care in suiting our bath to the patient and the condition to be treated as we would in the employment of any other remedy. No man must undertake to prescribe hydrotherapeutic measures without being precise in his directions.

Reaction.

Whatever effect comes from the use of water in treatment depends upon its mechanical and thermic action.

I quote the following description of reaction from Baruch:*

"Reaction after cold-water applications is the resultant or secondary physiological effect of the latter upon the sensory terminals and vessels ramifying through the skin. The primary effect—constriction of the muscular and elastic structures enveloping the cutaneous vessels—is action; the secondary effect—return of blood to the affected part—is reaction.

"Clinical observation has established two forms of reaction, which, though usually acting in combination, must be considered separately.

"1. Nerve (Reflex) Reaction.—At the risk of reiterating trite facts, the action of thermic irritants upon the sensory nerve terminals in the skin demands consideration. It is a recognized physiological axiom that such irritants cause

*Principles and Practice of Hydrotherapy, pages 86-88.

local excitation, and that the latter is not confined to the surface irritated but is at once conveyed upon sensory tracts to the central nervous system and reflected thence to other parts. Cold being a thermic irritant, it is not difficult to trace most of the notable effects of hydrotherapy upon the above simple physiological law. That these therapeutic results from the application of cold water cannot be rivaled by medicinal agents is a matter of daily experience. Nerve reaction is manifested when the central nervous system is aroused to respond to the demand made upon the cutaneous sensory terminals by cold applications.

"The first palpable evidence of nerve reaction is the sudden gasp and staccato breathing—a phenomenon as familiar to the practitioner as its rationale is to the physiologist.

"The final effect of nerve reaction is evident in the refreshment of the entire organism after a properly applied cold procedure. In health the man whose reactive capacity enables him to indulge in the morning cold plunge testifies to this result by his appearance and sense of general invigoration. In disease each bath or other cold procedure gives a fillip to the depreciated nerve centers and sends new life to the organs depending upon them for functionating force. The whole machinery of the organism receives an impetus which endures a longer or shorter period in proportion to the temperature, duration, and technique of the cold procedure. Whoever has witnessed how the dull eye of a typhoid patient brightens, and how the apathetic countenance disappears after a cold friction bath; whoever has seen him lapse from muttering delirium or coma vigil into a gentle slumber, after a properly administered cold procedure, must be convinced that the rapidity of the salutary effect can be attained only through an influence over the central nervous system.

"That the degree of nerve reaction differs as the extent and degree of cutaneous excitation differs is a subject of daily observation and a fact based upon established physiological law. In the clinical chapters the application of the latter will be made clear.

"2. Vascular (Vasomotor) Reaction.—The effect of thermic excitations upon the arterioles and capillaries which ramify in the skin has been fully discussed (page 31.) The following data may be accepted as established:

"(a) That the vessels lying in contact with and beneath the point of a cold application are immediately contracted by the muscular and elastic cutaneous fibers, in proportion to the degree and extent of the procedure, and the blood is driven into the interior, chiefly into the intraabdominal vessels.

"(b) That the removal of the cold from the skin is followed by a return of the blood which had been driven out of the arterioles and capillaries, and in proportion to the degree of cold and duration of the procedure it flows back into its wonted channels.

"(c) That arterial blood rushes into the empty vessels with avidity, while venous blood flows back more sluggishly (Bier, Exp., 27 and 28, p. 291, loc. cit.).

"Thus we obtain a clear conception of local reaction after cold procedures. The action of the latter upon the part receiving it starts a physiological process which is at once interesting and of vast import in the production of general vascular reaction, through whose agency those striking influences upon hematosis, nutrition, secretion, and excretion are obtained which have been fully discussed above."

Effect Upon the Skin.

The beneficial effect of the reaction upon the skin is at once apparent. The skin of the tuberculous patient partakes of the general malnutrition. It is usually dry and lifeless. The effect of the cold bath with its reaction is to hasten the flow of blood and lymph through the cutaneous blood and lymph channels, and bring better nutrition to the part.

It has been demonstrated that following the use of cold baths, the lungs are relieved of part of their work by an increased excretory activity upon the part of the skin.

The better tone which is given to the skin makes it less sensitive to cold, and in this way the bath helps to harden the patient and enables him to derive most good from the open-air life.

It also makes him less subject to cold.

As the nerves of the skin stand in a peculiar relation to the nerves which govern the bodily functions, and transfer impulses from the surface of the body to the centers, the more normal we keep the skin the more normal will these reflex actions be.

Effect Upon Other Organs.

Thus the circulatory, respiratory, digestive and vasomotor systems are all influenced for the better by a properly given cold bath. The effect of this is manifested on all the functions of the body. The organs are supplied by better blood, cell activity is augmented, tissue change is effected, and the secretory and excretory functions are carried on in a more healthful manner. In as much as these are the very conditions which we wish to maintain in order to gain a condition of health, the value of such hydrotherapeutic measures in tuberculosis must be apparent; in fact, hydrotherapy supplements the open-air treatment most effectively.

Conditions Governing Bath.

In order to derive benefit from a cold bath it must be given in the proper manner. In the first place, it should be given when the patient is warm while the superficial capillaries are dilated. When we are training for the cold bath we must do so gradually. The water must at first be taken much warmer than we wish it to be when the bath is fully established, then its temperature should be gradually reduced each day until the proper degree has been reached. The rapidity with which the temperature may be reduced will depend entirely upon the manner in which the patient reacts. If the skin fails to glow satisfactorily, it should be taken as a warning to stop reducing the temperature until the reactive powers of the patient have improved, which will usually occur in a very short time. Until the patient's skin is educated it is best to wet only a small surface of the body at a time and dry it before proceeding to another.

If these two conditions are heeded, first, having the patient warm when the bath is given, and, second, having the bath suited to the patient's reactive power, most excellent results may be obtained by hydrotherapy.

In tuberculosis a cold bath should not be taken when the surface of the skin is cold, nor when the patient is chilly, nor when the patient is spitting blood.

Alcohol Baths. There is a common belief that many people can not take cold baths; in fact, many tuberculous patients are afraid to take baths at all. Physicians share in this fear and advise that alcohol baths be used, or that a little alcohol be put in the water, or that an alcohol rub be used after the bath. This is an entirely mistaken idea. In the first place, if water is used carefully and according to instructions laid down in this chapter, I feel sure that it can do no harm. Alcohol is but a poor substitute for water for bathing purposes in tuberculosis, for it increases the dryness of the skin, and interferes with its functions. Its use should be discouraged and people should be taught to appreciate and not fear the free use of water.

Cold Sponge. The cold sponge bath is one which has a very general application. It is very simple in its technique. Nothing is necessary but a basin of water at the proper temperature, a wash cloth or friction mit and a bath towel. This bath is one which nearly all tuberculous patients can and should take. If the patient is strong enough and can take the bath without causing shortness of breath, rapidity of the heart's action, or dyspnea, it is better for him to take it himself. If not, it should be given by an attendant. The best time to give it is when the patient arises in the morning. He has been in a warm bed, and consequently the superficial capillaries of the skin are dilated. If a patient's reactive powers are feeble, extra cover may be thrown over him in order to insure that he be warm when the bath is taken.

I usually have my patients drink a glass of warm water or milk on awakening, then take the bath about twenty minutes later. Patients are instructed to begin the bath immediately upon arising so as not to wait until the superficial vessels have been contracted by the impact of the cold air. Only a small surface of the body should be wet at a time, especially where the reactive powers of the patient are feeble. The wash-cloth used should be rough so as to cause stimulation to the skin. A sponge is not suitable.

First one arm should be bared and bathed with a cloth in the opposite hand, the water being applied by a few rapid strokes. Then the arm should be thoroughly dried with a bath-towel, gentle friction being used until the skin takes on a good glow. This arm should be covered at once. Next the other arm, then the front and the back of the chest should be bathed in a similar manner. After these parts have become educated to the bath, if it is thought best, the remaining portions of the body may be gone over in a similar manner.

This bath should be given quickly. It requires only three or four minutes for an entire bath when given properly. After a bath the patient should either return to bed or dress at once and move about. Patients who are able to walk find a little exercise taken at this time very refreshing.

The temperature of the water for the bath should be suited to the patient. When patients have warm water in their rooms I have the first bath taken with water at about the body temperature, then I have it gradually reduced according to the patient's powers of reaction. It usually requires about one week to get the water down to a temperature of about 60 degrees Fahrenheit. When patients do not have the conveniences of hot water in their rooms I find that the following plan works very satisfactorily. For the first few mornings have the patient dip his hand into water at room temperature and rub with it instead of a wash cloth. Then after a few mornings have him use a wash cloth wrung nearly dry. Then each morning a little more water should be left in the cloth until at the end of a week the regular cold bath should be established. This answers the purpose very well, although it is not quite as scientific as the former plan. The best plan of all is to use a bath thermometer and reduce the temperature of the water about two degrees Fahrenheit each day. When it is convenient to do so the patient may stand with his feet in water at a temperature of 100 degrees Fahrenheit when taking a cold sponge over the entire body. The suitableness of the bath must be judged from the reaction of the skin and the feelings of the patient. After such a bath, if properly given, the patient should feel warm and comfortable.

This procedure is one of the best methods at our command for hardening the tuberculous patient, insuring him against colds and all ailments that may be produced or aggravated by chilling. It also improves the neuro-vascular tone, and has a good effect upon neurasthenic conditions and upon the circulatory, respiratory and digestive systems.

Tepid Sponge. Hydrotherapy offers many different procedures which may be used in the reduction of temperature. The one that I have found of most value is simple sponging with tepid water. In febrile cases when the temperature approaches 101 degrees Fahrenheit, sponging the chest, face, arms and hands with tepid water and allowing the water to evaporate will prove of great service. This procedure should be kept up for about twenty minutes and then repeated at intervals of a half hour until the temperature is reduced. The value of keeping the surface moist and allowing the water to evaporate lies in the greater amount of heat that is abstracted in this manner. In my experience tepid water does just as well as cold water and patients who have a tendency to chill bear it much better, although cold water may be used if it is preferred.

If the patient begins to chill, the bath should be stopped. Sometimes, however, even then, the hands and face may be sponged with advantage and without increasing the tendency to chill.

The Dripping Sheet.

A measure that I have found very useful in the treatment of patients who are anemic, and especially in the treatment of that class of confirmed neurasthenics who are almost a burden to themselves and all who come in contact with them, is that form of bath described by Baruch as the "dripping sheet."

The results in these distressing cases are often almost brilliant. The digestion improves, the heart becomes more stable, and the patient loses one whim after another. I have found these neurasthenics the most troublesome of all my tuberculous patients, and have found this form of bath to be the best aid in treating them.

Caution must be exercised in using it. I do not think it advisable to make the change in the temperature of the water too suddenly, otherwise the demand on the patient's reactive powers will be too great. The proper use of friction here is of great importance, for we must bear in mind that we have a skin whose neuro-vascular tone is low and we are making an application to a large surface at one time.

In describing this form of bath I can do no better than quote Baruch whose technique I have always followed:

"*Technique of the Drip Sheet.*—The temperature of the room should not be less than 70°. The patient stands in a foot or bath tub containing twelve inches of water at 100° F., to prevent chilling; a sheet dipped in water at 75°—daily or less frequently reduced until it reaches 60°—is placed dripping over his shoulders and back in the following manner: The left upper border of the sheet is held by the left hand, while the right hand gathers the right border into folds. The sheet is now dipped into a bucket of water, from which it is taken dripping and applied under the right axilla of the patient, as shown in Fig. 22. Pressing the sheet firmly to his side with the right arm (Fig. 23) the patient is directed to turn and thus envelop himself in the wet sheet (Fig. 24). When the entire body is thus covered, the upper border of the sheet is tucked in around the neck and the lower border is wrapped around the legs. The attendant now makes rapid passes over the sheet up and down the back, sides, and lower extremities with the outstretched hand (Fig. 25), occasionally slapping the surface to increase mechanical irritation. A basin of water from ten to fifteen degrees below the temperature of the sheet water is poured over the head and shoulders two or three times at short intervals. This is alternated with frictions for from five to ten minutes. The sheet is now rapidly withdrawn. In most cases, especially after the treatment has been pursued for some time, the skin becomes decidedly hyperemic. The patient now steps upon a woolen rug or blanket, and is thoroughly dried with soft linen towels. This is followed by friction with a warm sheet or towel, which increases the cutaneous suffusion. The patient emerges from this bath,

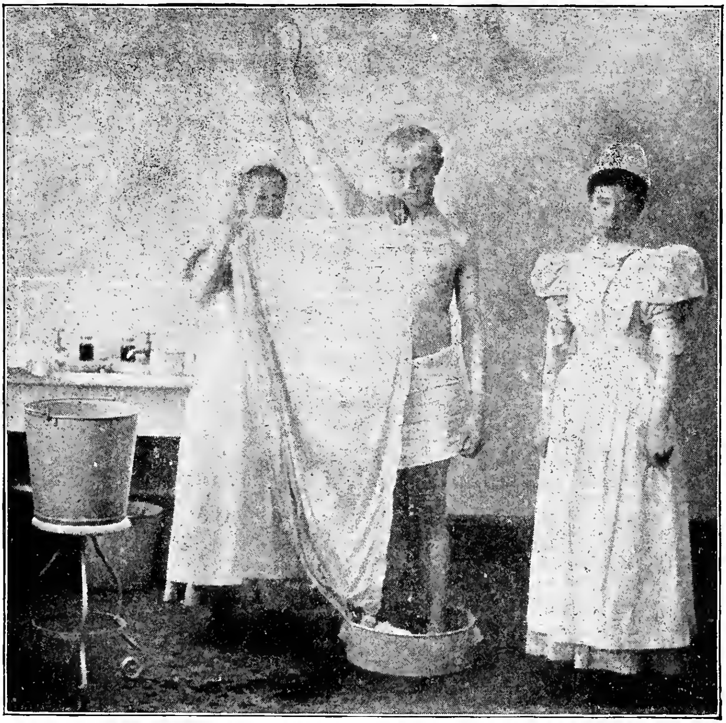


FIG. 22.—Drip sheet. First position. (*Baruch.*)

during the first few days, somewhat fatigued but refreshed. If the fatigue is decided, the procedure should be shortened until the patient evinces more resisting and reactive capacity. Usually he is able to walk out, which is a great advantage. In good weather a gentle promenade after the treatment is a sine qua non, because the respiration is deepened and more oxygen may thus be made to enter the lungs.

"The rationale of the drip sheet may be explained upon the same principles which govern other similar procedures. As the wet sheet envelops the entire surface of the body, the thermic irritation is more pronounced than it is from an ablution. It stimulates the cutaneous vessels and the muscular structures of the skin also to contract for a brief time, and to dilate just as quickly and completely. The frictions made by the rapid to-and-fro passage and pressure of the flat hand over separate portions of the sheet-covered body greatly enhance the reactive dilatation of the cutaneous vessels. A large quantity of blood is thus drawn from the interior to the general surface.

"Physiological investigations having shown that two-thirds of the entire

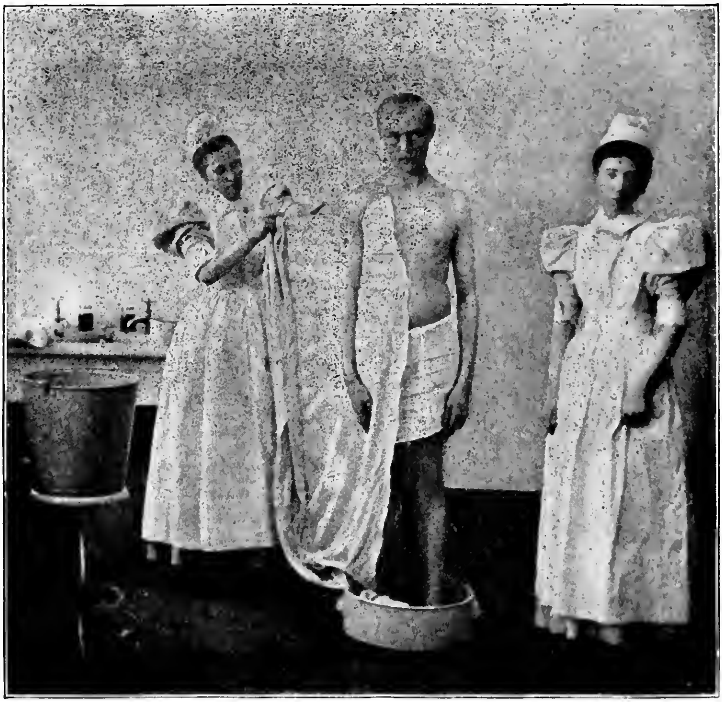


FIG. 23.—Drip sheet. Second position. (*Baruch.*)

blood quantum may find lodgment in the skin, the enormous derivative effect of a good sheet bath becomes evident.

"The repetition of the thermic irritation incident to the renewed pouring of cold water upon those parts of the body which have been warmed by friction of the attendant's hands affords a renewal of all these results, which in chronic cases produce tonic, and in acute cases antifebrile effects of unmistakable value."

"*Therapeutic Indications.*—There are many chronic ailments to which the drip sheet is applicable, especially as a substitute for the douche, which can be had only in institutions, viz.: as a tonic in chlorosis, anemia, and neurasthenia; as a derivative in intestinal catarrhs; as a revulsive and alterative in melancholia, hypochondriasis, neuralgias; and in pulmonary and bronchial diseases.

"The flexibility and simplicity of the method commend it especially. It is probably the most flexible hydriatric measure known. By wringing the sheet well out, or by using a coarser sheet or a lower temperature or a shorter time, or by slapping with instead of simply pressing the outstretched hand over the wet sheet, the local excitation of the cutaneous nerves and vessels will be enhanced just to the extent which the judgment of the practitioner

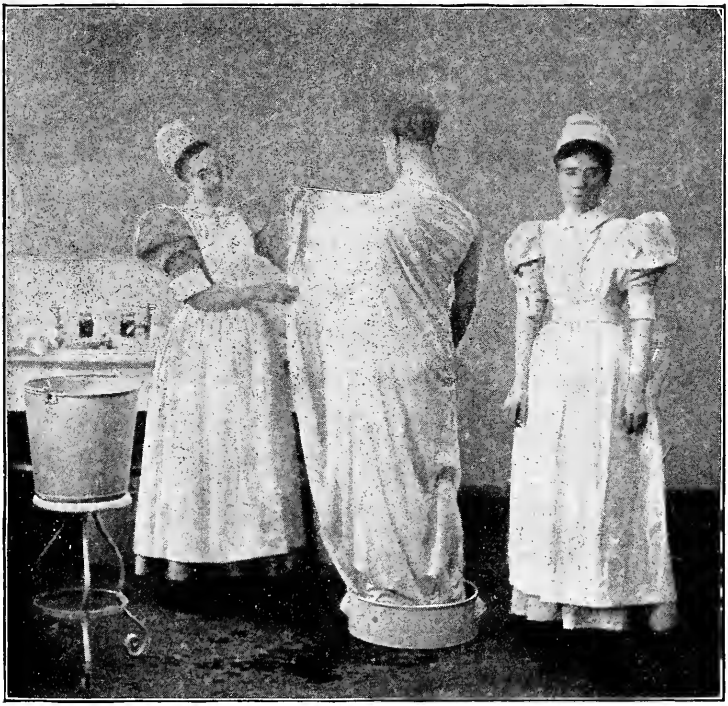


FIG. 24.—Drip sheet. Patient turning. (*Baruch.*)

may deem requisite. By saturating it with more water the antipyretic effect is increased, which may be still more intensified by more prolonged application and more frequent addition of colder water, or by a finer texture of the sheet. The duration of the sheet bath is a matter for the most careful discrimination. Two to five minutes suffice in most cases for the tonic effect, while for the antipyretic effect fifteen to twenty minutes may be necessary. It is, of course, understood that the excessive sensitiveness of the skin in the presence of cutaneous diseases, or any inflamed surface, preclude the use of the sheet bath entirely."

The Wet Jacket.

I have found the wet jacket of great value in many cases of irritating cough which interferes with the patient's sleep. I have also thought it seemed to be an aid in treating some advanced cases with extensive bronchial catarrh and profuse expectoration. It has a very happy effect also in reducing temperature and acts in checking night sweats. The method of application which I have used is as follows: A jacket is made of three or four thicknesses of old linen. It is made to fit close up about the neck and to come down to the lower edge of the ribs. Holes

FIG. 25.—Drip sheet. Friction. (*Baruch.*)

are left for the arms. The sides are brought forward so as to lap in front. This is wet in water of a temperature of 70 degrees Fahrenheit and put on so as to fit snugly. This may then be covered by another jacket made of flannel whose edges extend about one inch beyond those of the linen jacket in all directions. This may be bound on by a bandage; or a cotton flannel bandage about ten yards long and about six inches wide may be put on immediately over the linen jacket. This must be put on carefully. All edges must be carefully covered and the bandage wound sufficiently tight so that the jacket will stick close to the chest (Fig. 26). If it fits loosely, air enters and produces chill. If this is put on right, aside from the first shock, it is very comfortable. While the first thought of this often causes a shudder to the patient, yet the relief is so great that he does not mind it after a night or two. The wet jacket should be put on at night and be removed in the morning and followed by the usual cold sponge.

Throat Compress.

In all cases of tuberculous laryngitis, as well as in acute attacks of inflammation of the throat, the throat compress (Fig. 27) has a very important use. Aside from the fact that it affords comfort to the patient, it seems to have a beneficial effect on the progress of the disease.

FIG. 26.—Wet jacket.

FIG. 27.—Throat compress properly applied.

For the throat compress take pieces of old linen and sew them together, making a compress about four inches wide and long enough to reach one and one-half times around the neck. This should be wet in cold water and placed around the neck so that the front part of the throat will be covered with a double thickness. This, then, should be covered by a piece of flannel which fits snug and extends over the edge or by a bandage of cotton flannel. The edges should be well covered so as not to allow air to enter and cause chill.

Cleansing Bath.

Besides the special measures herein described a word should be said about the ordinary cleansing bath. Tuberculous patients should take such a bath once or twice a week. This should not be hot. A hot bath should not be taken unless ordered for some special purpose. There is a tendency for most people to use their bath water too hot. A hot bath is weakening and may prove harmful. After taking it, there is a feeling of chilliness instead of warmth such as follows a cold bath. The temperature of the bath should be about that of the skin and it should be finished by a cold sponge. In this way the patient comes out of the bath with a feeling of warmth and is greatly refreshed.

The cleansing bath, in fact any of the more elaborate hydropathic measures, should not be taken immediately before or soon after a heavy meal. The best time is about midway between meals, or at least two and one-half hours after a meal, when digestion has been nearly completed.

There are other hydrotherapeutic measures which can be used to advantage in the treatment of tuberculosis; in fact, Baruch thinks the circular douche the most valuable of all hydrotherapeutic procedures. It has one great drawback and that is its benefit can be secured only in specially equipped institutions. I shall not attempt to discuss it nor shall I express my opinion of it for I have not had experience in its use. The various measures which I have discussed above have proven of great value to me in my practice. I know what they will do and can heartily recommend them for a more extensive trial. Every one of them can be used at home, the advantage of which can be readily seen when we consider that the vast majority of tuberculous patients must be treated at home.

CHAPTER XV.

THE SPECIFIC TREATMENT OF TUBERCULOSIS.

Nature of Cure in Tuberculosis.

In my introduction to the subject of treatment, I endeavored to show what I believe to be the aim of all remedial measures which are directed towards the cure of tuberculosis. Tuberculosis being a disease which is caused by a specific microorganism, the cure of it must come through measures which are directed against the micro-organism. In other words the cure of tuberculosis comes about through the establishing of immunity on the part of the organism to the tubercle bacillus and its toxins. It will be well to recall some of the points mentioned previously.

Immunity is brought about by the action of certain protective substances which are found in the body fluids. Man is naturally endowed with these protective substances, hence wards off many attempts at infection. During the struggle between the bacillus and the organism at the time of infection many bacilli are destroyed by these protective bodies. This destruction of bacilli, however, is accomplished at the expense of the content of the blood in protective substances. The protective substances are restored to the blood to a certain extent by the stimulation of the machinery of immunization which comes through the products which are set free in the blood by the destruction and solution of the tubercle bacilli. This process of immunization can be called into action by the injection of dead bacilli or products made from the bacilli. Therefore, we have in the products made from the tubercle bacillus remedies with which we can artificially stimulate the physiological process of immunization to the production of specific antibodies which enter the blood and destroy the invading tubercle bacilli. The marvelous and painstaking work of Wright and his co-workers has established these points beyond doubt, and given us an explanation of the action of specific remedies in tuberculosis which puts them on a much firmer basis than was possible through clinical experience alone.

Discovery of Tuberculin.

The history of the discovery and early trial of tuberculin reads like a tragedy. This remedy was evolved by years of painstaking investigation and made possible only by many experiments and the keenest observations. It was announced to the world in 1890 (Deutsche medizinische Wochenschrift, Nov. 3, 1890).

The following are the observations which led to the discovery of tuberculin by Koch (Deutsche medizinische Wochenschrift, 1891, Vol. 2):

If a healthy guinea pig is inoculated with pure cultures of tubercle bacilli, the seat of inoculation usually heals. In the course of about two weeks a small nodule appears which soon breaks down and forms an ulceration. If on the other hand a tuberculous guinea pig is inoculated, the point of inoculation also heals but no nodule appears. The point of inoculation becomes hard, the skin becomes necrotic, sloughs off, leaving a flat ulceration which usually heals in a short time. It was also noticed that dead tubercle bacilli from pure culture when rubbed up in water could be injected into healthy guinea pigs in large quantities without harm, and that small quantities, when injected into tuberculous guinea pigs seemed to improve their condition very markedly.

While Koch had very few principles of immunity to guide him, nevertheless he grasped two essential points: first, that cultures of bacilli act differently upon healthy and tuberculous guinea pigs, and, secondly, that cultures of dead bacilli are not harmful to healthy guinea pigs, but when injected in large doses in tuberculous guinea pigs cause a fever reaction and even death, if the dose be sufficiently large, but, when injected into tuberculous guinea pigs, in small amounts, help in bringing about a cure.

After further research he found that the healing properties of the bacillus are given out into the culture medium during its growth, and after many experiments he produced the remedy which was called at that time "Koch's lymph," but which is now known the world over as tuberculin, or rather as old tuberculin to distinguish it from other preparations.

What is Tuberculin?

It is surprising to know what misconceptions are held both on the part of the members of the medical profession and the laity with reference to tuberculin. It is commonly spoken of as a serum which of course is incorrect. Sera are made from the blood of some animal and what curative properties they contain are due to protective bodies being thrown out into the blood stream of the animal in question in response to stimulation from inoculations of certain vaccines. Wright believes their curative properties are due to the passage of some of the toxins over into the blood, and that they act as vaccines, and not as passive immunizers.

Tuberculin, on the other hand, is the filtered culture fluid upon which tubercle bacilli have been grown, either unchanged, or changed by methods of concentration. During the growth of the bacilli, certain soluble toxins are given off into the culture fluid, and it is to these that the curative properties of tuberculin are due. The bacilli are grown on a slightly alkaline glycerine bouillon medium, and after they have grown from six weeks to two months, the fluid is passed through a porcelain filter to remove the bodies of the bacilli and then it is evaporated to one-tenth of its original bulk. Tuberculin appears as a dark yellowish fluid somewhat thick, owing to the large amount of glycerine which it contains.

Dosage of Koch's Tuberculin.

Koch's old tuberculin may be used both for diagnostic and therapeutic purposes. For diagnosis the dosage should be from $\frac{1}{10}$ to 10 milligrammes according to circumstances (see page 43). For treatment this preparation is not used as much as T. R., Bacillus Emulsion and some of the other preparations which contain more of the bacterial proteins. However, when employed therapeutically the initial dose should be from $\frac{1}{10}$ to 1. milligramme, to be gradually increased by from $\frac{1}{10}$ to 1 milligramme every third or fourth day according to circumstances until 5 milligrammes has been given, when the increase may be by 2 milligrammes. After 10 milligrammes has been given the increase may be much greater. As a diluent it is best to use normal salt solution containing .4 per cent, phenol. A feeling of nervousness, malaise or aching either with or without a slight rise of temperature should be taken as a sign of a reaction. The dose should not be repeated until this has disappeared and the amount should not be increased until this amount, when injected, fails to produce these symptoms. Sometimes it may be increased very rapidly thus: 2, 4, 7, 10, 15, 20, 30, 40, 60 and 80 milligrammes may be given at properly spaced intervals, but this should not be attempted by one who does not understand the remedy well. Sometimes patients are very sensitive to tuberculin. When such is the case the dose can be increased only very cautiously, it taking even one or two months to attain a dosage of 1 milligramme. Patience and perseverance in these cases will usually overcome the condition.

Convenient Method of Making Dilutions.

For convenience in administering the various substances made from the tubercle bacilli it is well to employ a series of dilutions which are each $\frac{1}{10}$ of the strength of the next higher. Then, by using a syringe graduated to the metric scale, our dosage is very easy. For example, suppose we take old tuberculin (Koch) and make a 10 per cent and a 1. per cent dilution. A cubic centimeter of the 1 per cent dilution equals $\frac{1}{100}$ of a cubic centimeter or 10 milligrammes of the original tuberculin, and $\frac{1}{10}$ of a cubic centimeter equals 1 milligramme, the usual initial dose for diagnostic purposes. One cubic centimeter of the 1 per cent dilution equals $\frac{1}{10}$ of a cubic centimeter of the 10 per cent dilution and 1 cubic centimeter of the 10 per cent dilution equals $\frac{1}{10}$ of a cubic centimeter of the original tuberculin.

Hope Aroused by Koch's Discovery.

Perhaps there never was an announcement made in the realm of medical science that carried with it so much hope as did that of the discovery of tuberculin. When the news flashed over the wires that the great savant, who had discovered the cause of tuberculosis, had now discovered its cure, people almost went wild. Those who were afflicted with the disease were aroused to such a state of hopefulness that they felt that if they could only go to Berlin their disease would disappear almost as if by magic. Many undertook the long journey only to be disappointed. Physicians from all parts of the world hastened to Berlin to see the new remedy used, hoping to learn the method of its administration and return home prepared to give its benefits to those suffering from the disease in their own country. Patients and physicians who had taken the long journey returned home not only disappointed but so turned against the remedy that fifteen years have not sufficed to dispel their prejudice.

Koch's Rules for Treatment.

Koch made two claims for tuberculin, first, that it causes a specific reaction in tuberculous individuals, and, second, that it has curative properties. He laid down the following very sensible rules for its administration, and if they had been followed the world would have been spared those dreadful scenes which attended its early trial:

"1. Only patients that have no fever and in whom the process has not advanced too far, are suitable for treatment.

"2. One begins with a very small dose and increases it so slowly that only very slight reactions or even none at all take place.

"3. If reactions take place tuberculin must not be injected again until the temperature has been normal for one or several days.

"4. The treatment with tuberculin must be repeated till, after an interval of three or four months, the capability of reaction is permanently extinct." (Quoted by Francine, page 62.)

These rules are safe even for today. While fifteen years of experience have taught us different methods of administration, and shown us that when a physician has had sufficient experience he may attempt the cure of more advanced cases, yet these rules should not be disregarded by those who are beginning the use of this remedy.

Koch's Rules Disregarded.

Koch's rules were not regarded. His experience was turned aside. Patients suffering from advanced tuberculosis were treated; they were given doses which caused violent reactions, and these doses were repeated and even increased before the previous reactions had disappeared. The result was only such as could follow such a course —disaster.

The strange part of this tragedy is that those who were administering the remedy did not see that they were disregarding the instructions of Koch, and, when they saw they were doing harm to their patients, did not stop and question either the remedy or their manner of using it. We can hardly believe that men educated in the medical sciences could continue to administer a remedy day after day when each injection was seen to bring the patient nearer the grave.

It was most unfortunate that Professor Koch had not tested the remedy on a sufficient number of human beings to prove the very best method of use before its announcement to the world. It is never safe to put a remedy as powerful as tuberculin in the hands of men who do not understand its use without giving them explicit instructions.

The science of bacteriology was then in its infancy. Modern theories of immunity were still hidden from us, and it was impossible for many besides the discoverer himself to understand anything of the nature of tuberculin, and even Koch himself was entirely wrong in his conception of the way in which it acts.

Neither was tuberculosis itself understood at that time. Few, indeed, knew anything about the minute pathology of the disease. It was one of those diseases which were treated in the text books as being hopeless and consequently passed over by students with little thought. We are then forced to behold a spectacle of men attempting to treat a disease with which they were not at all familiar, with a powerful remedy whose action and dosage they did not understand. What further could be asked in order to insure defeat? Is it any wonder that tuberculin failed to do what was expected of it? It was recommended to be used in early cases but was used in advanced ones. It was recommended to be used in small doses short of that necessary to cause a reaction but was used in doses which caused severe reaction and was repeated at such frequent intervals that the reactions were never allowed to subside. Yet, in spite of this faulty administration, a scientific profession has accepted this trial as sufficient to show that tuberculin is of no value in the treatment of tuberculosis and capable of doing only harm; and, upon this early experience is based the opinion of most physicians as to its value. Why do not these same men condemn strychnia because in overdoses it produces convulsions and death, or chloroform and ether because when used in too large doses they overcome the patient? It is possible to overlook to a certain extent the prejudice against this remedy which was caused by its misuse because of the disastrous results which followed; but, the members of a learned profession like that of medicine should not allow the misuse of a measure to blind them against its proper application.

The following is a fair example of the way in which the remedy was used. This is the kind of evidence which was brought against tuberculin in 1890–1891.

January 17, 1891, a patient in von Leyden's (Berliner klinische Wochenschrift, 1891, p. 237) clinic had a paracentesis made, removing a clear, serous exudate. Examination showed rales in the right apex, relatively dull percussion note, slightly tympanitic, and diminished respiration. The spleen was somewhat enlarged. Temperature 100.4 degrees Fahrenheit; next day after the operation, 102.5 degrees Fahrenheit. On the 19th an injection of two milligrammes of tuberculin was given. By February 12 the patient had received ten injections, the last being 50 milligrammes. During the period the patient became rapidly worse. On February 10 the temperature reached

104 degrees Fahrenheit, where it remained continuously until the patient's death on the 19th of February. Reutimeyer (Berliner klinische Wochenschrift, 1891, p. 124) reports a case in which he gave eleven injections in eleven days, in spite of reactions of 104 degrees Fahrenheit.

These two cases are not exceptions to the usual method of employing the remedy at that time, but such was the method generally employed when tuberculin was first put upon trial.

Reaction Against Tuberculin.

Tuberculin suffered in a twofold manner during this early trial. In the first place, it was used wrongly as mentioned above, and in the second place, its use caused tuberculosis to be observed and studied as it had never been observed and studied before and all findings, hitherto unobserved, were attributed to the remedy. Physicians who had been accustomed to pass over tuberculosis as uninteresting, now began to watch it. Even the great pathologist, Virchow (how far his personal antagonism to Koch influenced his opinions, we are unable to say) began the study of the minute pathology of tuberculosis as he had never studied it before, and found many new conditions some of which should have been attributed to the action of tuberculin as then used, others to the natural course of the disease whether treated or untreated. Even the findings which were rightly attributed to tuberculin should not have carried any more evidence against the remedy when used properly than the post-mortem findings in a case of opium poisoning should against opium when administered in small doses. But people were disappointed. Their hopes had been stimulated to the highest pitch possible and they were in a frame of mind not to be appeased. They had been promised a cure for tuberculosis, and they had been deceived, at least so far as they could judge from the trial. Even the good results were lost sight of in the general disappointment. This reaction was so strong and the feeling against tuberculin was so bitter, that a man did not dare for several years to raise his voice in favor of it for fear of having his motives questioned. The medical profession even branded men as quacks who dared use it, and well meaning men advised patients who were being treated with it to have the use of the remedy discontinued.

Some Good Results.

In spite of the general disappointment which followed its misuse, in spite of the fact that much harm was done and death hastened in many instances, there were a few men who partially grasped the meaning of the remedy. They saw that tuberculin was a remedy not altogether without merit, and believed that it deserved a further trial.

From Fraentzel's Clinic in the Royal Charité very encouraging results were reported in the autumn of 1890 (Deutsche medizinische Wochenschrift, 1890). Especially were these results favorable in cases of pulmonary tuberculosis where the disease was not far advanced.

Bardeleben (Deutsche medizinische Wochenschrift, 1890) showed improvement in cases of lupus.

Paul Guttman (Deutsche medizinische Wochenschrift, 1890) exhibited a number of cases at the Moabit that had been treated with tuberculin. Among the number were two young girls who had been treated two months and, although at the beginning of the treatment they showed marked apical tuberculosis, all signs had disappeared.

Langenbuch and Wolff (Deutsche medizinische Wochenschrift, 1891, page 935) reported 99 cases of tuberculosis treated with tuberculin and 99 without. Of the former 33 were cured, 40 improved; of the latter, 9 were cured and 45 improved. Of tuberculin treated cases, 73 per cent were improved and cured; of those treated without it 54 per cent were improved and cured.

Landgraf (Berliner klinische Wochenschrift, 1891, page 286) observed the disappearance of tubercles from the choroid and epiglottis. Renvers (Berliner klinische Wochenschrift, 1891, page 285) cured a patient whose pharynx, epiglottis, and mucous membrane over the arytenoids were ulcerated.

One great trouble with this trial of tuberculin, was that cases absolutely unfit for treatment were chosen and then they were reported upon after they had been under treatment only a few weeks. It requires time to cure simple lesions, and, of course, in these advanced processes it must be very much lengthened. It is surprising to me that so many favorable reports were made when the treatment was carried on under such unfavorable circumstances.

Tuberculin Revived.

While Koch was very much disappointed at the blow which his remedy had received, yet he did not lose faith. He and his pupils worked steadily on with tuberculin. A few followers here and there in other countries also took up its administration. They saw the mistakes that had been made, and avoided them, and, a few years later, were able to report upon cases that had been treated with small doses—doses short of reaction. These results were very favorable and once more brought tuberculin before the eyes of the profession.

The favorable reports of Spengler, Turban, Petruschky, Krause, Heron, Thorner, Bandelier, Rembold and especially that of Goetsch (Deutsche medizinishe Wochenschrift, 1901, page 405) in Europe and those of Trudeau, von Ruck and others in this country have been instrumental in causing a reconsideration and new trial of this remedy.

Goetsch's report was the object of much comment. In 1901 he reported 175 cases which had been treated by him in the preceding ten years. Of this number 125 or 71 per cent were apparently cured. In the choice of patients he used extreme care. No case with fever was treated, and reactions were painstakingly avoided.

Soon after this report was made the writer undertook a collective investi- tion to ascertain the attitude of physicians who were interested in the treatment of tuberculosis, toward tuberculin (see appendix, Chapter III). In that report it was thought well to secure data upon early cases, such as Koch recommended as suitable for tuberculin treatment, which had been treated with and without the remedy to see how the results compared. While many more reports are available and the number of cases could be largely increased, yet I will quote from my original paper (Therapeutic Gazette, 1903, page 163).

"That these remedies will do what is claimed for them is proven by the results obtained by those who have had experience with them, as shown in the following:

"Jessen (Centrabl. f. inn. Med. 1902, No. 23) treated 14 first-stage cases, curing 14, or 100 per cent.

"Goetsch (personal letter to the writer) treated 356 first-stage cases, curing 278, or 78 per cent.

"Trudeau (Trans. of the Association of American Physicians, 1900) treated 24 first-stage cases, curing 20, or 83 per cent.

"Von Ruck (Journal of Tuberculosis, Vol. I, page 23, Clin. Report of Winyah Sanitarium, 1899 and 1900; Therapeutic Gazette, May, 1896) treated 105 first-stage cases, curing 98, or 93 per cent.

"Rembold (quoted by Wilkinson, British Medical Journal, June 7, 1902) treated 16 first-stage cases, curing 12, or 75 per cent. (The classification as cured was made six years after.)

"Turban (Beitraege zur Kenntniss der Lungentuberkulose.) treated 20 first-stage cases, curing 20, or 100 per cent.

"Wilkinson (Observations on Tuberculin as a Remedy in Treatment of the Lungs. British Medical Journal, June 7, 1902) treated 12 first-stage cases, curing 12 or 100 per cent.

"Petruschky (Specifische Behandlung der Tuberkulose. Paper before the 71st assemblage of the German Naturalists and Physicians, Munich, 1899) treated 18 first-stage cases, curing 18, or 100 per cent.

"Klebs (Berliner klinische Wochenschrift, 1902, No. 23) treated 14 first-stage cases, curing 14, or 100 per cent.

"Pottenger (unreported) treated 10 first-stage cases, curing 10, or 100 per cent.

"Here we have for consideration 589 cases in the first stage of the disease treated with tuberculin and allied products. Of this number 496, or 84.2 per cent were apparently cured. This is certainly enough cases upon which to base an opinion, and our verdict must be that culture products stand the test and accomplish that for which they are recommended, namely, the cure of pure tuberculosis. This is all the more emphasized when we compare these results with those obtained without culture products in the same purely tubercular cases:

"Bowditch (Report of Mass. State Sanatorium at Rutland) treated 66 first-stage cases, curing 39, or 59 per cent.

"Clapp (Report of Mass. State Sanatorium at Rutland) treated 82 first-stage cases, curing 53, or 64.6 per cent.

"Trudeau (Reports of Adirondack Cottage Sanitarium) treated 300 first-stage cases, curing 204, or 68 per cent.

"Stubbert (Reports of Loomis Sanitarium) treated 163 first-stage cases, curing 95, or 58 per cent.

"This table furnishes us with 611 cases, all of which were not only in the first stage of the disease, but all of which had the advantage of sanatorium treatment. Of this number 391, or 64 per cent were apparently cured. Now we must admit one of three things: the difference is accidental, or those who use culture products are the abler men and more successful in their treatment, or that culture products do contribute materially to the cure. The first we cannot believe, and if either of the latter alternatives be true, they speak well for the remedies, for if the ablest men in the field of phthisiotherapy are convinced of the value of these remedies, we should certainly give their opinions weight; and, on the other hand, if they are no more skilled but are able to produce better results, curing 20.2 per cent more patients by the use of them than can be cured without them, we should certainly be convinced of their value."

Other Preparations of Tuberculin and Allied Products.

The name tuberculin has been applied to nearly all products made from the tubercle bacillus, but in reality belongs only to those which are made from the culture fluid on which bacilli have been grown. Tuberculin represents only the soluble toxins of the tubercle bacillus. All tuberculins are merely modifications in the culture medium or in the manner of treating the culture medium after the bacilli have been grown. Other preparations, made from the tubercle bacillus such as T. R., Bacillus Emulsion and Watery Extract, are usually spoken of as such. The physiological action of these remedies differs according to their composition. The action of the soluble toxins (tuberculin) is different from a product made from the body of the bacillus such as the extracts of the bacilli and the emulsions.

Tuberculin (Denys).

Tuberculin, Denys (Le Bouillon filtré du Bacille de la Tuberculose dans le Traitement de la Tuberculose Humaine, 1905), is a filtrate made from the bouillon on which the bacilli have grown. It is prepared without being subjected to heat and is not concentrated as is Koch's old tuberculin. Denys claims that some of the curative properties of the culture fluid are lost by subjecting it to heat. This preparation represents the culture fluid and the toxins that have been given out into it during the growth of the bacilli, without any change except what occurs during filtration through a porcelain filter.

Denys offers in proof of his claim that heat alters tuberculin, the fact that tuberculous patients will react to very much smaller doses of his preparation than of the old tuberculin, hence presumably some of the active properties of tuberculin have been lost by the heating process.

Treatment is begun with $\frac{1}{10}$ of a cubic centimeter of a 1 per cent solution (1 milligramme of the pure tuberculin) and increased by $\frac{1}{10}$ of a cubic centimeter at each dose unless reaction occurs, until 1 cubic centimeter (10 milligrammes of the pure tuberculin) is reached; when a 10 per cent solution is used and increased by $\frac{1}{10}$ of a cubic centimeter (10 milligrammes of the pure tuberculin) until 1 cubic centimeter (100 milligrammes of the pure tuberculin) is given; then, the pure tuberculin is used making the usual progression in dosage by $\frac{1}{10}$ of a cubic centimeter (100 milligrammes of the pure tuberculin). When fever is present, or when, for any other reason Denys suspects the patient to be sensitive to the remedy he begins with very minute doses even as small as $\frac{1}{1000}$ of a cubic millimeter of the original solution.

Perlsucht Tuberculin (Spengler).

Perlsucht Tuberculin (P. T. O. Spengler) (Deutsche medizinsche Wochenschrift, 1904, No. 31; 1905, Nos. 31 and 35) is made from bovine bacilli. Spengler finds the preparations made from the bovine bacillus much less toxic for human infections than those of the human bacillus, and at the same time finds them more active in their stimulation of the machinery of immunization as is shown by their power to increase the specific agglutinins of the blood. This preparation is made without subjecting the culture fluid to heat, which he believes injures its activity. The bacilli are grown until they form a covering on the culture medium when they are removed by filtration and the filtrate concentrated by placing it in an incubator until it equals one-half of its original volume. It is then restored to its original volume by the addition of glycerine. One cubic centimeter of this preparation equals 100 milligrammes of P.T.O. The beginning dose of P.T.O. is from $\frac{1}{100}$ to $\frac{1}{10}$ of a milligramme. In sensitive cases $\frac{1}{1000}$ of a milligramme should be used. The dose should be gradually increased. When a dose of one cubic millimeter has been attained it may be increased thus: 1–2–4–7–10–15, etc., and given every three or four days. Spengler considers the flexor surface of the fore-arm as the best point for injection, and never injects a second dose until all local signs of the previous injection have disappeared, believing that there is a connection between the local reaction at the site of injection and the reaction in the tuberculous area. Not only redness and swelling but the least feeling of warmth is taken as a sign for delay in administering the dose.

Tuberculin (Beraneck).

Tuberculin (Beraneck) is a product which contains both the extracellular and intracellular toxins. The extracellular toxins are obtained from the growth of bacilli upon a special medium which is free from peptones while the intracellular toxins are abstracted from the bodies of the tubercle bacilli by means of a 1 per cent solution of orthophosphoric acid. Both of these toxins contain immunizing properties, and yet, they are feebly toxic. The preparation is praised very highly by Doctor W. R. Phillip of Edinburgh.

New Tuberculin (T. R., Koch). Koch's faith in tuberculin, in spite of the opposition of his confreres is shown by his continued search for a better preparation. With an insight keener than that of other scientists he was sure that he was working along right lines. He was not a dreamer, and he was able to interpret the vast amount of laboratory experiment that he had done as meaning that the cure of tuberculosis must come through the action of the toxins of the tubercle bacillus.

In 1897 (Deutsche medizinische Wochenschrift, 1897, No. 14) he brought forth a new preparation which he designated as T.R. This preparation is entirely different from the old tuberculin in its method of preparation. It is made by grinding dried cultures of highly virulent bacilli in an agate mortar and then centrifugalizing them in distilled water. After centrifugalizing, the fluid is poured off and this is called tuberculin O or T. O. It is then centrifugalized again when the fluid remaining is named tuberculin R or T.R. This preparation is standardized so that it contains 1 per cent of the solid extract of the tubercle bacillus. It is preserved by the addition of glycerine. When it is to be prepared for administration it should be diluted with a 20 per cent solution of glycerine in water (made by boiling 20 parts of pure glycerine and 80 parts of distilled water for several minutes) and be made up fresh every few days. If the solutions are made very carefully they may be suitable for use for about ten days. If they become cloudy they should be discarded. The initial dose is $\frac{1}{1000}$–$\frac{1}{500}$ of a milligramme of the solid substance. This equals $\frac{1}{10}$–$\frac{2}{10}$ of a milligramme of the original solution before dilution. The dose may be calculated by remembering that $\frac{1}{10}$ of a milligramme of the original solution equals $\frac{1}{1000}$ of a milligramme of the solid tubercle substance. The dose may be given every other day at first, and should be gradually increased in amount. It can usually be doubled at each dose until $\frac{1}{10}$ milligramme of the solid substance has been given which equals 10 milligrammes of the original solution. After this, the injections should be farther apart and the relative increase less, thus 10–15–25–35–60–80–100 milligrammes may be given. After 5 milligrammes of the solid substance has been given the dose should be employed twice a week only, and as the dose increases, once a week is sufficient. The dose of 20 milligrammes of solid matter is rarely exceeded. At the least sign of reaction the dose must be withheld until all reaction has disappeared; and, it must not be increased until the patient fails to react to the dose which has once caused a reaction.

Bacilli Emulsion (T. E., Koch). By continuous experimentation Koch found that the greater the amount of the substance of the bacillus in the preparation, the greater the increase of specific agglutinins in the blood (Deutsche med. Wochenschrift, 1901, No. 48). Hence he concluded that the greatest amount of immunity could be produced by an emulsion of the bodies of the bacilli. This preparation is preserved in glycerine. Theoretically it is one of the best. It has one difficulty, however, and that is to secure the ready absorption of the bodies of the bacilli. The slowness of absorption seems to be increased by giving the doses at too frequent intervals, thus pointing to the fact that this failure of absorption is a sign of saturation upon the part of the patient. The bacilli remain in the tissues for some time and act more or less as mechanical irritants. Of course they are incapable of producing tuberculosis but if they are injected in large quantities, they may absorb very slowly and sometimes cause an irritation of the tissues with the passing out of serum, causing what appears to be an abscess although it is not acutely inflamed, and cultures taken from it prove negative. This usually disappears after a short time, but if it does not, upon opening it there is obtained either a thin serum, much like liquid taken from the pleura or a sterile substance which resembles pus.

At the initial dose 0.0025 milligrammes of the bacillar substance ($\frac{1}{2000}$ milligramme of the original preparation) is given. The dilution is made with normal salt solution plus .4 per cent phenol in the following manner:

"0.1 cc. is taken from the original bottle with a 1 cc. pipette divided into 100 equal parts and to it added 9.9 cc., 0.8 per cent sodium chlorid solution (or sodium chlorid-phenol solution). This 100-fold dilution contains 0.05 milligramme bacillar substance in 1 cc."

Then, "Of the 100-fold dilution 1 cc. is mixed with 9 cc., 0.8 per cent sodium chlorid solution (or sodium chlorid-phenol solution) or made up to 10 cc. therewith. This 1000-fold dilution contains in 0.5 cc. 0.0025 milligramme bacillar substance, the above mentioned initial dose."

The dose is administered every second or third day, each time increasing the amount given by twice or three times the amount previously injected. When a reaction has been produced, the injections are given at longer intervals, say every six or eight days. The injections are increased until 20 milligrammes is reached. It is not best to go higher than this because of the slowness of absorption. These large doses are given only every two or four weeks.

Watery Extract of Tubercle Bacilli (von Ruck).

This preparation is an extract made from the powdered bodies of the bacilli after the removal of the fats by alcohol and ether. Von Ruck claims that the presence of fats interferes with the extraction of the bacilli with water, and, since these are removed before such extraction is made in the preparation of Watery Extract, this product necessarily contains a greater percentage of the soluble substances of the bacillus than other extractions. While there may still be other curative substances in the bodies of the bacilli which do not yield to this watery extraction, yet von Ruck claims that this method of preparation offers the greatest percentage of solid substance of any preparation short of the Bacillus Emulsion, which has as yet been prepared, with the advantage over the latter of being readily absorbed. This preparation like T.R. is standardized so that it contains 1 per cent of the solid substance made from the bodies of the bacilli. For administration it is well to begin with a 1 per cent solution of the standard solution. One-tenth of a cubic centimeter of this, represents 1 milligramme of the extract or $\frac{1}{100}$ milligramme of the solid extract of the bacillus. It is usually safe to begin with this dose although I frequently begin with $\frac{1}{10}$ of a milligramme which represents $\frac{1}{1000}$ of a milligramme of the solid extract of the bacillus. The dose of 1 milligramme may be gradually increased by 1 milligramme each day until 10 milligrammes are given; then the dose may be increased more rapidly, usually by 10 milligrammes each day until 250 milligrammes are given, when the dose should be given on alternate days and increased by 50 milligrammes at each administration. When 500 milligrammes has been reached then the dose should be given on every third day, when 750 milligrammes, every fourth day and when 1000 milligrammes, or 1 cubic centimeter of the original solution, every five to ten days. With this preparation doses as high as 1500 or 2000 milligrammes, which equals one and one-half and two cubic centimeters of the original solution, may be given to advantage in certain cases.

Perlsucht Emulsion (P. E., Spengler). Perlsucht Emulsion, P. E., is a glycerine emulsion of crushed bodies of bovine bacilli. It has very high immunizing properties, and is greatly praised by those who have given it a trial. Its administration should be begun with very small doses, $\frac{1}{1000}$ or $\frac{1}{2000}$ milligramme and gradually increased until 5 milligrammes have been reached.

T.B. Vaccine, P.B. Vaccine (Spengler). As mentioned in the chapter on diagnosis, page 34, Spengler has worked out a therapy which is based upon the double etiology of tuberculosis, that is upon its being a disease process caused by both the human and bovine bacillus, most often together but occasionally by one variety alone.

According to Spengler's method, every patient's sputum is carefully examined in order to determine which variety of bacilli are present; and, where both are present, which variety predominates. Where the intestines or kidneys are involved the feces and urine are also examined in the same way.

The laboratory findings are used, with certain limitations which clinical experience has warranted, as a guide to therapy.

Clinically bovine and human tuberculosis seem to assume somewhat different forms. Everywhere these two bacilli seem to be antagonistic. In their method of growth the human bacillus wants to be surrounded by plenty of oxygen but demands little oxygen in the culture medium; the bovine bacillus, on the other hand is directly opposite demanding little oxygen in the air, in fact, it grows best when the culture flask is sealed, but demands a good supply of oxygen in the culture medium.

From this observation taken from the life history of the bacillus when artificially grown, it would be expected that each bacillus would seek out in the body those conditions which are best suited to its growth. We would expect to find the human bacillus infecting those organs which are in free communication with the air and the bovine those distant from it.

Such is the fact. In the lungs the human bacilli predominate, in the intestines, and the kidney, the bovine type seems to be the principal etiological factor. In the larynx superficial ulcerations seem to be due to human bacilli and deep infiltrations to bovine bacilli.

In all situations the infections from the human bacilli seem to be most virulent, those from bovine less so and the double infection runs a chronic course, the two varieties antagonizing each other.

Thus the laboratory and the character of the disease as observed clinically both give us evidence upon which we may base a diagnosis as to which bacillus is responsible for the symptoms present. It must be remembered that both bacilli are usually present but one is often producing the most urgent symptoms; for example: the lungs may be chiefly infected by human bacilli and the intestines by bovine bacilli, the former may be quiet but the latter may be producing very urgent symptoms.

It is necessary to know which variety of bacillus is responsible for the urgent symptoms in order to apply the proper remedy. A further test may be made by an injection of vaccines made from the two varieties of bacilli. These same vaccines are used therapeutically.

These two vaccines, Spengler calls T.B. Vaccine and P.B. Vaccine. The former (T.B.V.) is made from the human tubercle bacillus. It has a toxic effect when injected into patients who are suffering from an infection caused by the human tubercle bacillus and an antitoxic effect when the bovine bacillus is the etiological factor. The latter (P.B.V.) is a product made from the bovine bacillus and is entirely opposite in its action, that is, it has an antitoxic action where the human bacillus is the etiological factor and a toxic action where the bovine bacillus is the causative factor. When given in the proper manner, these preparations seem to have the power of producing all the antibodies necessary to cure tuberculosis, and consequently act as true vaccines.

When from the laboratory and clinical observation one is satisfied that one variety of bacillus is the cause of the most urgent symptoms, he gives an injection of the vaccine from the other variety of bacillus. If the diagnosis is correct the patient usually experiences an improvement. The temperature, if elevated usually lessens and the patient will declare that he feels better; if, on the other hand, the diagnosis is wrong, then the remedy acts as a toxin and the patient experiences an increase in the symptoms.

When the patient feels better after the injection of a vaccine, this preparation may be taken as the vaccine suited to the case, and may be used thera-

A

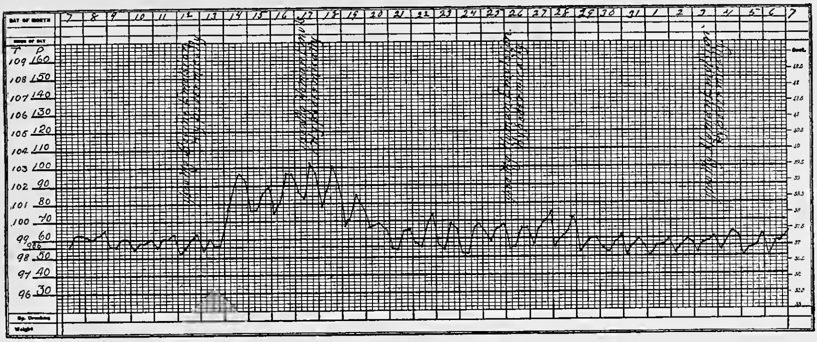
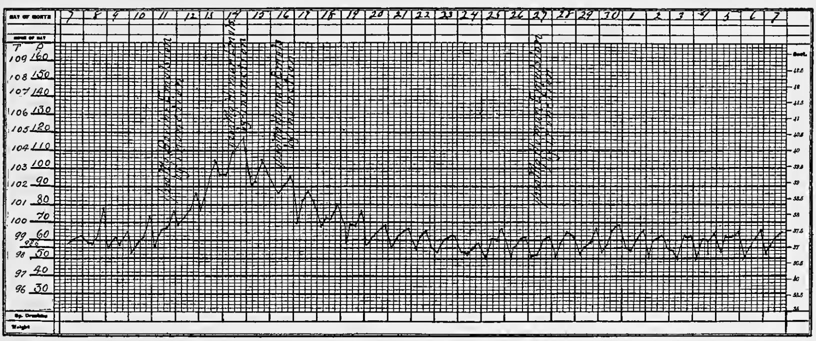


FIG. 28.—A and B. Illustrating the antagonistic action of homologous vaccines made from bovine and human tubercle bacilli.

A. On the 12th the patient received an injection of $\frac{1}{500}$ mg. bovine emulsion which resulted in a very severe reaction. The reaction failing to decline $\frac{1}{200}$ mg. human emulsion was injected on the 17th resulting in the decline as shown in chart. On the 26th and 3d further doses were given with continued decline of temperature.

B



B. On the 11th of the second month $\frac{1}{200}$ mg. of bovine emulsion was again given, but this time by inunction. The severe reaction shown in B. resulted. At the height of the reaction on the 14th $\frac{1}{200}$ mg. of human emulsion was again given, also by inunction, resulting in a beginning of a decline in the reaction. On the 16th $\frac{1}{100}$ mg. was given (by inunction), resulting in further decline of temperature. A further dose of $\frac{1}{200}$ mg. of human emulsion was given on the 27th with continued low temperature.

peutically. After one has been used for some time the other is employed until the patient is immunized to both.

For proof of the antagonistic working of these two vaccines and what seems to speak very much for this therapy is the fact that if one preparation is injected and it proves to be the toxin for the patient instead of the vaccine (as Spengler calls the one which does not act toxically), a dose of the other may be injected at once and it will serve to counteract the toxic action of the first preparation as is shown in Fig. 28 A and B.

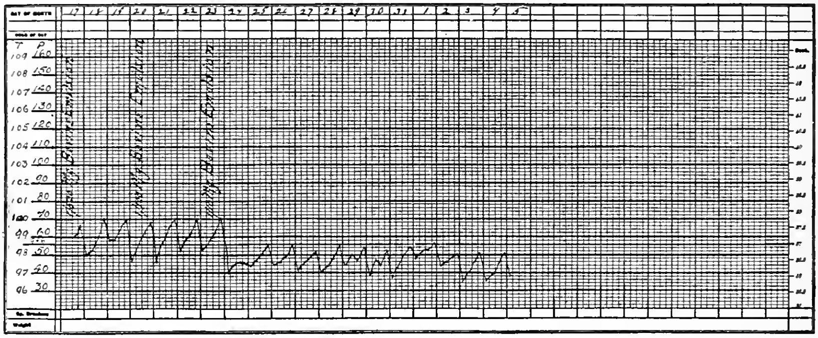


FIG. 29.—Chart of patient with fever for three months. Free from fever after three doses of bovine vaccine.

This therapy has proven very successful in the treatment of fevering cases, see Figures 29, 30 and 31, also in the treatment of such conplications as tuberculosis of the larynx, intestines and kidneys. Figure 31 shows a curve of a

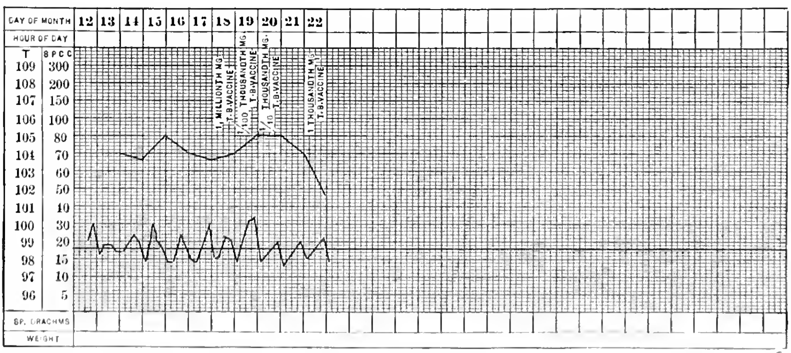


FIG. 30.—Chart of patient with fever for many months. On the 18th, 19th, 20th and 22d, injections of human tubercle bacillus vaccine, resulting in lowering of temperature and decrease in sputum as shown by upper curve.

very stubborn fever case that was quickly relieved by the injection of the proper vaccine.

The dosage here as in all other remedies varies with the patient and condition present. The beginning dose is from $\frac{1}{1000}$ millionth to $\frac{1}{10}$ millionth of a mg.

and the dose is usually increased by ten times the previous dose, but this is only a general rule and the administration must be learned by experience.

The principal thing in this therapy is to be exact in the diagnosis, and to find out which is the vaccine and which the toxin. It is needless to say that it requires skill in laboratory work and a thorough knowledge of tuberculosis to carry it out with best results. Of course, it must not be expected that such a therapy can be made by a "two and two are four" method; it requires care, careful observation, and close attention to detail.

Tulase. Von Behring's announcement of his new remedy for tuberculosis made at the Paris Congress in 1905, has not yet been made good. Just what it is or what it will be is a matter of speculation. It would seem from his later publications that he has somewhat abandoned his

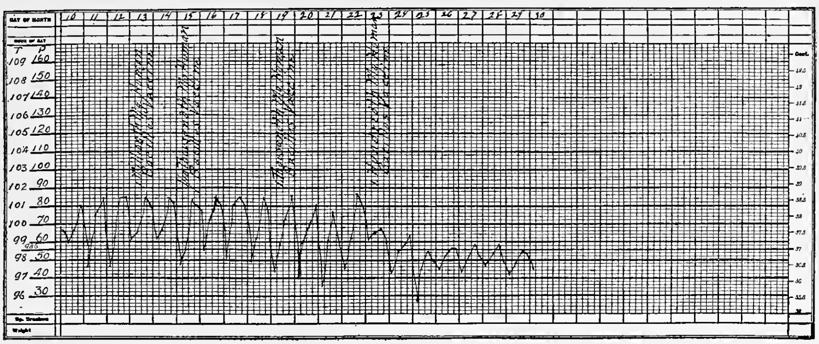


FIG. 31.—Curve of patient with fever many months. Temperature relieved after four injections of human tubercle bacillus vaccine.

original idea. He now seems to be aiming at incorporating all the properties of the bacillus into a remedy. We will await its final announcement with interest and withhold judgment.

How Do Tuberculin and Allied Products Act? While we are unable to explain fully the manner in which tuberculin and its allies act in producing a cure in tuberculosis, yet we have made much progress in the solution of the question. An experience of more than eleven years in their use leads me to the conclusion that these remedies act in a dual manner. The first action is that of artificially increasing the specific immunizing substances which are found in the blood as is shown in the laboratory by an increase in the agglutinins and opsonins; and by animal experimentation whereby animals are rendered more resistant to infection when they have undergone treatment by the injection of specific vaccines made from the tubercle bacillus, either before or immediately following inoculation; and by clinical experience whereby the disease shows less tendency to spread to new tissue, a greater tendency to heal and much less tendency to relapse after an apparent healing has taken place. The second action seems to be that of a local stimulant to the tuberculous area whereby more blood is directed to the part and healing and scar tissue formation are hastened.

Koch's Original View of the Manner in which Tuberculin Acts.

It is surprising how many people still cling to Koch's original statement of the probable manner in which tuberculin produces its favorable results (Deutsche medizinische Wochenschrift, 1890, No. 46 and 1891, No. 3). While Koch distinctly said that he did not know, at the time, in what manner it acted, yet few people have gone beyond his original statement of its probable action. In spite of the fact that his opinion was given in 1890 and 1891, many text books which profess to be up to date are still quoting Koch's original opinion and ignoring all modern views. Koch suggested that tuberculin probably acts by causing a coagulation necrosis of the cells surrounding the tubercle whereby the nutrition of the bacilli contained therein was cut off, eventually causing their death, and whereby the tuberculous mass was eventually destroyed and cast off as a slough carrying the bacilli with it.

Biedert's View.

Every one did not accept Koch's explanation of the action of tuberculin at that time. Biedert (Berliner klinische Wochenschrift, 1891, page 197) appreciated a more moderate, a conservative action. He said: "When the irritation (caused by the local reaction) is moderate, an increased cell growth takes place in the encapsulating wall of the tubercular process. If the inflammation is more intense, marked exudation occurs, while in the stage of extreme inflammatory irritation, cell death, necrosis, results," thus recognizing the fact that the action varied with the dosage.

Trudeau's View.

Trudeau (Transactions of the American Physicians, 1900) is of the opinion that tuberculin acts "probably by inciting the formation of fibrous tissue."

Wright's View.

Wright (Medico-Chirurgical Transactions, Vol. 89, London, and many other contributions) has studied tuberculin from an entirely different standpoint. In fact he has absolutely ignored the local reaction of tuberculin and studied it from the standpoint of its immunizing qualities. He claims that large doses are not necessary, and recommends very minute doses $\frac{1}{1000}$—$\frac{1}{500}$ of a milligramme of solid substance ($\frac{1}{10}$ to $\frac{2}{10}$ milligramme of the original solution) of Koch's T.R. He has shown that tuberculin, when injected in these small doses will set the physiological machinery of immunization into action and cause an increase in the specific protective bodies (opsonins) of the blood.

Evidence of Immunizing Power, Animal Experimentation.

The first proof of the immunizing power of specific products made from the tubercle bacillus is furnished by animal experimentation. Koch's first contribution (Zehnter International Medizinische Kongress, Berlin, Bd. 1, S. 46) was to the effect that he had been able to produce a certain product from tubercle bacilli which conferred upon guinea pigs a certain immunity to tuberculosis and which checked the progress of the disease when present. Since that time, Spengler, von Ruck, Trudeau and many others have confirmed these facts experimentally and von Behring has successfully immunized cattle with live cultures of human origin.

Agglutinating Power of Blood Increased.

The next observation which, aside from clinical evidences, proves the immunizing power of tuberculin and allied products is its ability to increase the agglutinating power of the blood. When Koch made known his emulsion of tubercle bacilli (Deutsche med. Wochenschrift, 1901, No. 48) he gave the results of a number of experiments upon the agglutinating power of the blood in animals and man. He tested this power in 78 tuberculous patients, of whom one showed a reaction of 1:50, four showed 1:25 and all the rest failed to show an agglutinating power of 1:25. Twenty-four failed to react to 1:10. These patients represented all stages of tuberculosis as well as such local lesions as those of bones, bladder and skin. These tests show that normally the blood of tuberculous patients has little agglutinating power.

He then examined 74 patients who had been treated by products made from the tubercle bacilli (in these cases, tubercle bacillus emulsion was used intravenously) and found that he had been able to increase the specific agglutinins. The results were as follows:

14	reacted	to	1:25
28	"	"	1:50
9	"	"	1:75
10	"	"	1:100
6	"	"	1:150
1	"	"	1:200
1	"	"	1:250
1	"	"	1:300

Four did not react at all, being apparently cases of healed tuberculosis

Spengler (Deutsche med. Wochenschrift, 1905, No. 35) has also tested the agglutinating power of the blood, and found that he is able to produce much higher reactions with P.T.O. than Koch did with bacillus emulsion. He tested 80 cases and found the results as follows:

6	reacted	to	1:100
1	"	"	1:150
11	"	"	1:200
2	"	"	1:250
21	"	"	1:300
8	"	"	1:400
11	"	"	1:500
1	"	"	1:600
2	"	"	1:750
12	"	"	1:1000
2	"	"	1:1500
2	"	"	1:2000
1	"	"	1:3000

While there has been some question regarding the evidence of immunity as based upon the agglutinating power of the blood, some writers claiming that such an increase does not necessarily mean that a degree of immunity is present, yet the weight of opinion recognizes it as a fact that where an increased agglutination is produced there is also an increased immunity.

Increase in Opsonic Power of Blood Serum.

Perhaps the most wonderful, if not the most practical, contribution to the modern treatment of infectious diseases, is that made by Wright by his discovery of the opsonic content of the blood which can be taken as a measure of the specific protective properties which are present in the blood at any given time. His work with tubercle vaccines, as he calls all products made from the tubercle bacillus or its toxins, has done more to satisfy those who have doubted the efficacy of tuberculin and allied products than all the clinical results that have been produced since Koch's first announcement.

The opsonic power of the blood exists in the serum, the leucocyte as claimed by Metchnikoff is the element which destroys the tubercle bacillus, and other organisms, yet it is powerless to do so until these bacteria have been acted upon and prepared for destruction by the blood serum. The opsonic power of the blood then means that power of the serum by which it acts upon bacteria and prepares them for phagocytosis.

By an ingenious method Wright takes equal parts of leucocytes, standard emulsion of bacteria and serum to be tested, mixes them together, places them into an incubator for a few moments at 37 degrees Centigrade (imitating the normal heat of the body), then removes the mixture, makes a smear on a slide, stains, and, then, by counting the bacteria contained in a number of leucocytes, say 100, and taking the average, he is able to determine the relative power of different blood serums for protecting their hosts from infection. The index of a given individual is found by comparing his serum with that of a pool of several individuals who are known to be free from the infection in question.

It has been shown that in localized infections this opsonic index is persistently low. In systemic infections it varies from time to time owing to autoinoculation. In localized tuberculosis the index is low. Non-febrile tuberculosis is practically a localized tuberculosis, hence the index is usually low. This low index of resistance shows that the individual who is infected with tuberculosis is not as able to combat the disease as one who is not infected, and offers a satisfactory explanation of the ease with which bacilli escape from tuberculous foci and start up new foci in adjacent or distant areas.

By inoculation of small doses of tubercle vaccines, the opsonic index can be increased (Fig. 32) and often raised not only to normal but even above. This means that these specific vaccines are able to artificially increase the power of the blood to destroy bacilli, and even raise it beyond the normal.

The table prepared by Lawson and Stewart and reproduced on page 119

Chap. X shows the effect of specific inoculations upon patients suffering from pulmonary tuberculosis. Here we have the opsonic index shown both before and after inoculation. No better illustration could be produced to prove the specific action of tuberculin in the treatment of tuberculosis.

Bulloch (The Principles Underlying the Treatment of Bacterial Diseases by the Inoculation of Corresponding Vaccines, The Practitioner, Nov., 1905)

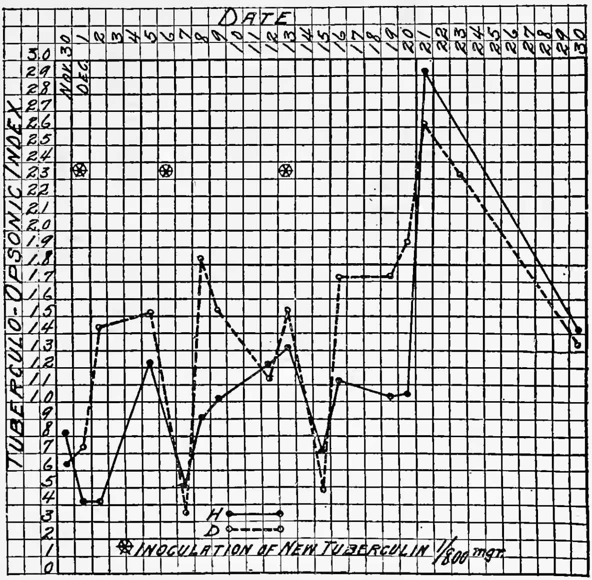


FIG. 32.—Tuberculo-opsonic curve (Wright) showing the effect of inoculations of tuberculin in two children with tuberculous glands. Before inoculation the opsonic index stood at .6 and .8 respectively. Following the third inoculation the index arose to 2.6 and 2.9 respectively.

examined the blood of 150 patients suffering from lupus and compared it with the average index of 86 healthy individuals. The index of the healthy individuals was .97, that of the lupus .75 distributed as follows:

Opsonic Index.	Number of Cases.	Percentage.
Between .2—.3	3	2 per cent
" .3—.4	3	2 " "
" .4—.5	21	14 " "
" .5—.6	29	19.6 " "
" .6—.7	33	22 " "
" .7—.8	22	14.8 " "
" .8—.9	18	12 " "
" .9—1.0	7	4.6 " "
" 1.0—1.4	14	9.3 " "

These two series are sufficient to show that when a localized or non-febrile tuberculous process exists, the defensive power of the blood, measured by its ability to prepare bacilli for destruction (opsonic power) is almost always low. The former series (see table, page 119) further shows that this index may be increased by the proper use of tubercle vaccine.

Effect of Tuberculin Upon Cells and Leucocytes.

Mitulescu (Zeitschrift f. Tuberkulose, Bd. IX, Heft 3, 1906, page 259) claims that certain changes in the nutrition of the cells occurs after a tuberculin reaction, and mentions the results of the studies made by Arneth on the leucocytes, thus:

"I have proved that in cases where after the injection the reaction fever sets in, momentarily a deficit in cellular nourishment takes place, but this is immediately accompanied by a greater retention capacity. This corresponds exactly with the observations of Arneth, namely, that immediately after the injection a slight leucopenia takes place, followed by a slight leucocytosis of neutrophile cells.

"We are also able to confirm by our former experiments the fact that after the injection of tuberculin there is an increase in the leucocytes. Arneth was actually able to prove that the neutrophile cells after the injection of tuberculin show a larger increase in granulation than is the case after ordinary methods of treatment.

"Rightly the author (Arneth) maintains that, on the one hand, the reserve food for nutrition, and, on the other hand, the accumulation of antitoxic substances arise through cellular secretion, and that these are poured out again into the circulatory system. The injection of specific substances in suitable cases produces not only an increase in reserve materials and neutrophile leucocytes, but gradually a strengthening of the power of agglutination of the blood serum."

Effect of Tuberculin and Allied Products Upon Infected Areas —Increase of Fibroid Tissue.

Besides the action of tuberculin as a stimulant to the physiological process of immunity, it has a local action which is doubtless of value. One difficulty in the way of curing tuberculosis is dependent upon the fact that, owing to the nature of the tubercle, the blood supply of the body is shut off from the areas of infection, and there is a stagnation of serum. Thus the part of the lung where the bacilli are found is deprived of the circulating blood and the antibacterial properties of the stagnating lymph are used up, leaving none of the natural protective substances to oppose the action of the bacilli.

The injection of bacterial products made from bacilli, when used in proper doses, causes a local stimulation which shows itself as a hyperemia, or, if the stimulation be a little more pronounced, as a congestion; the vessels are dilated, more blood is sent to the part and consequently new protective substances are brought to bear upon the bacilli in the foci of infection. This, when taken in conjunction with the increased immunizing content of the blood due to the stimulation of the bacterial inoculations, explains to us why cases treated with tuberculin heal more quickly and more surely, and show less tendency for the disease to spread. The bactericidal properties of the blood are increased and also brought in closer contact with the bacilli.

This local reaction also causes, as has been suggested, a stimulation which results in a more rapid formation of fibroid tissue. This fact is corroborated by my experience, which shows a more rapid healing, especially in those patients suffering from advanced tuberculosis, when bacterial products have been used in treatment, than when the patients have been treated by hygienic methods alone.

Tuberculin Reaction. When the dosage of tuberculin is pushed to its recognizable effect, a certain train of symptoms ensues, as described in Chap. IV, which is known as a tuberculin reaction. This is characteristic of all the products made from the tubercle bacillus and is applicable to all. The amount of the toxin necessary to produce this effect varies within wide limits. Some persons are very sensitive, others may require large doses to produce any symptoms at all, and still others take a graduated dosage, rapidly increased, and never show any symptoms of a reaction. Some men, like Wright, claim that reactions are unnecessary and always harmful. Others think the best results are obtained through securing slight occasional reactions. Wright bases his assertion on the fact that the opsonic content of the blood is increased by very small doses while larger ones cause a pronounced reduction of the opsonic content (exaggerated negative phase). The other opinion is based on the observation that the greatest agglutinating power of the blood is obtained after slight reactions. While, as a rule, I believe the safest policy is to avoid reactions, yet I have seen much good follow slight reactions in old chronic cases where improvement seemed to be at a standstill. I have repeatedly seen a reduction in the amount of secretion in a chronic suppurating cavity date from a slight reaction, and I frequently use this method, graduating my dosage in such a manner that the reaction is practically controlled. I would not recommend it to be tried, however, except by men who are expert in the use of these remedies. That the terrible catastrophe feared by Wright, when large doses are used, does not occur has been demonstrated by most men who employ these remedies; yet, we believe that his work has demonstrated many valuable points in their administration.

When the amount of tuberculin which would be considered proper for the usual dose has been given there is no disturbance of the physiological economy noticeable. If this amount be increased a little there is a slight feeling of well being; if increased a little more the patient may feel slightly nervous; if increased still more, there is a sensation of being tired with perhaps a feeling of heaviness in the limbs. If the amount of toxin employed be still greater the patient experiences an aching of the limbs, back and head, with a slight rise of temperature, and, if the dosage be even still greater, this may be preceded by a chill and vomiting and the temperature may go as high as 103 to 104 degrees, and be accompanied by dyspnea and pain in the chest. Sometimes a reaction will show on the pulse when it does not on the temperature (Fig. 33). The severest reactions mentioned above are never called for, and never obtained in the regular treatment of cases, unless there be some special idiosyncrasy. The dosage of tuberculin is absolutely under the control of the physician who employs it, and, if he exercises caution in its administration, beginning with sufficiently low doses and increasing the amount slowly, he need not obtain such reactions.

The reaction usually comes on some time between four and twenty-four hours after the injection has been given, the time varying with the different

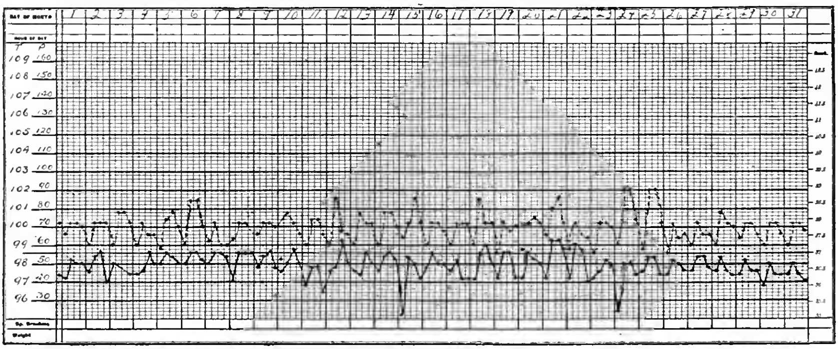


Fig. 33.—Chart showing the tuberculin reaction as affecting the pulse rather than the temperature. Doses were given on the 3d, 6th, 10th, 12th, 15th, 18th, 21st, 24th and 28th.

preparations used, and the idiosyncrasies of the patient. It usually passes off in four or five hours if the reaction is slight but may last twenty-four hours or longer if it is severe. The reaction following the use of P.T.O., usually reaches its highest point on the day following the injection.

Secondary Reaction.

We not infrequently have what we might term a secondary reaction coming on usually from three to five days after a dose has been given. This usually manifests itself by a slight temperature reaction and is sometimes accompanied by some of the slighter symptoms mentioned above. This is probably due to an autoinoculation of bacterial products from bacilli which have been destroyed as a result of the previous injection. That this explanation is probably correct may be inferred from the fact that if another injection of tuberculin be given at this time an increase of the reaction symptoms is apt to occur, showing that the dosage plus the amount of bacterial products of the autoinoculation taken together is too great a dose for the patient at the time. A dose should not be administered when such a secondary reaction is present. That this secondary reaction is not due to the "mobilization of bacilli" is proven by the fact that the temperature disappears at once. In fact, this "mobilization of bacilli" which was talked of so much by Virchow's followers is a myth when the remedies are used properly. I have given many thousands of injections and have never seen it occur. Moeller (Therapie der Lungenschwindsucht, Schroeder und Blumenfeld, page 246) also says that he has never seen it occur in 28,000 injections that he has given.

Should Tuberculin be Used on a Patient with Fever?

There has been some discussion on this point, and like many others it is still an open question. The objection to the use of tuberculin at such a time is based upon the belief that the rise of temperature is due to an autointoxication due to tubercle toxins being set free and being poured into the blood stream from the tuberculous focus. The adherents to this theory claim that a further addition of toxin under such conditions is harmful. Before accepting this theory, it is well to inquire whether this explanation accounts in a satisfactory manner for the rises of temperature which are frequently met with in tuberculosis, and, if so, could not properly spaced doses be used to advantage between the periods of autoinoculation?

It is usually believed that unless the areas are so thickly studded as to cause an acute tuberculous pneumonia or the tubercles are so disseminated as to cause acute miliary tuberculosis, the normal temperature for the usual case of tuberculous infection of the lung is a low temperature, rarely exceeding 101 degrees. Other causes of a rise in temperature are mixed infection, a pneumonic condition, pleurisy, and other complications.

The experience of many men who use tuberculin, including that of the writer, is that those patients who are suffering from temperature of 101 degrees and under are assisted materially in the reduction of temperature by small doses ($\frac{1}{100}$—$\frac{1}{1000}$ milligramme) of tuberculin. I have seen this result most often when I have had tuberculins made from both human and bovine types at my command. In cases where the rise in temperature is probably due to other causes than autoinoculation, such as mixed infection and pleurisy, the objection of increasing the amount of tubercle toxins set free in the system can not hold. During the rise of temperature, patients often seem to be hypersensitive, but in many of them, minute doses can be used to advantage. The following charts (Figs. 34 and 35) illustrate the advantage gained by a patient so treated during a long siege of fever. If the rise in temperature is not due to absorption of toxins from the tubercle bacillus, and these toxins when injected will cause an increase in the resisting power of the patient, it seems wise to give patients the benefit of such treatment. Tuberculin should never be used in this manner, however, by those who are not thoroughly familiar with its administration.

Fig. 34, A. B. C. and D., shows findings on auscultation, representing the improvement made by a patient who was treated by tuberculin while running constant temperature as shown by charts, Fig. 35.

1			Sl. H. I. Sl. pr. E. • •		H. I. Sl. pr. E.		
2	H. I. pr. E. ○ ○ ○ (3)	H. I. pr. E. ○ ○ ○ (3)	H. I. pr. bl. E. ○ ○ ○ (3)	I	Sl. H. it.I. ○ ○ (3)	Sl. H. it.I. pr. E. ○ ○ (3)	Sl. H. it.I. ○ ○ (3)
3	r. H. I. pr. E. ○ ○ (3)	H. I. H. pr. E. • • • (3)	H. I. pr. E. • • •	II	H. I. pr. E. ○	H. I. Sl. pr. E. • • • (3)	H. I. Sl. pr. E.
4	Sl. H. I.	H. I. Sl. pr. E. ○ ○ (3)	r. H. I. ○ ○ (3)	III	H. I. ○ (1)	H. I.	Sl. H. I.
5	C.	nc	nc	IV	Sl. H. it.I.	Sl. H. it.I.	Sl. H. it.I.
6	C.	C.	C.	V	Sl. H. it.I.	Sl. H. it.I.	Sl. H. it.I.
7	C.	C.	Heart Sounds:			Sl. H. it.I.	Sl. H. it.I.

Fig. 34.—A. Anterior surface of chest March 18th.

1			Sl. r.H. I. Sl. pr. E.		H. I. H. pr. E. ○ ○ ○ (3)		
2	C.	Sl. H. I.	Sl. r. H. I. Sl. pr. E. • (3)	I	H. I. H. pr. E. ○ ○	H. I. pr. E. ○ ○	C.
3	Sl. H. I.	Sl. H. I.	Sl. r. H. I.	II	Sl. H. I. Sl. pr. E. • • • (3)	Sl. H. I. Sl. pr. E. • • (3)	nc ○
4	Sl. H. I.	Sl. H. I.	Sl. H. I.	III	Sl. H. I. • • (3)	nc	C. wk.
5	Sl. H. I.	Sl. H. I.	Sl. H. I.	IV	C.	C.	C.
6	nc	nc	nc	V	C.	C.	C.
7	C.	C.	C.	VI	C.	C.	C.
8	C.	C.	C.	VII	C.	C.	C.

Fig. 34.—B. Posterior surface of chest March 18th.

1			sq.		Sl. H. I. .. (1)			1
2	Sl.H.I. & E. sq. .	Sl. H. I. Sl. bl. E. sq. oo (1)	Sl. H. I. Sl. bl. E. o	I	H. I. Sl. pr. E. o	Sl. H. I. Sl. pr. E. sq. .	C.	2
3	nc	nc . (3)	Sl. H. I. .. (1)	II	Sl. H. I. Sl. pr. E. ..	nc	C.	3
4	nc	Sl. H. I. ..	Sl. H. I. ... (1)	III	C.	C.	C.	4
5	C.	C.	C.	IV	C.	C.	C.	5
6	C.	C.	C.	V	C.	C.	C.	6
7	C.	C.	Heart Sounds:			C.	C.	7

FIG. 34.—C. Anterior surface of chest July 3d.

1			nc		H. I. bl. E. W. V. ...			1
2	C.	C.	C.	I	Sl. H. I. bl. E. ... (1)	Sl. H. I. W. V. Sl. bl. E. o	C.	2
3	C.	C.	C.	II	Sl. H. I. Sl. pr. E. o	Sl. H. I. ... (1)	nc .. (3)	3
4	C.	C.	C.	III	C. ... (3)	C.	C.	4
5	C.	C.	C.	IV	C.	C.	C.	5
6	C.	C.	C.	V	C.	C.	C.	6
7	C.	C.	C.	VI	C.	C.	C.	7
8	C.	C.	C.	VII	C.	C.	C.	8

FIG. 34.—D. Posterior surface of chest July 3d.

SIGNS AND ABBREVIATIONS.

bl.—blowing.
C.—clear vesicular.
E.—expiration.
H.—harsh.
it.—interrupted.
I.—inspiration.

nc.—nearly clear.
pr.—prolonged.
r.—rough.
Sl.—slightly.
Sq.—squeak.
W. V.—whispering voice.

... fine dry rales.
ooo medium moist rales.
(1).—rales heard only on deep breathing.
(3).—rales heard only after coughing.

In this connection I wish to quote Wright in order to explain further how the injection of tubercle vaccines might assist in bringing about a cure even if the fever were due to tubercle toxins circulating in the blood (On the Foundations of Serum Therapy, Being a Contribution Made to a Debate Held Under

FIG. 35.—A.

the Auspices of the Chelsea Clinical Society, reprinted from the Clinical Journal, May 16, 1906):

"Passing to consider the possibility of bacterial vaccines rendering useful service in connection with the treatment of septicemic infections, I have to confess that the idea that bacterial vaccines could here play a useful role was

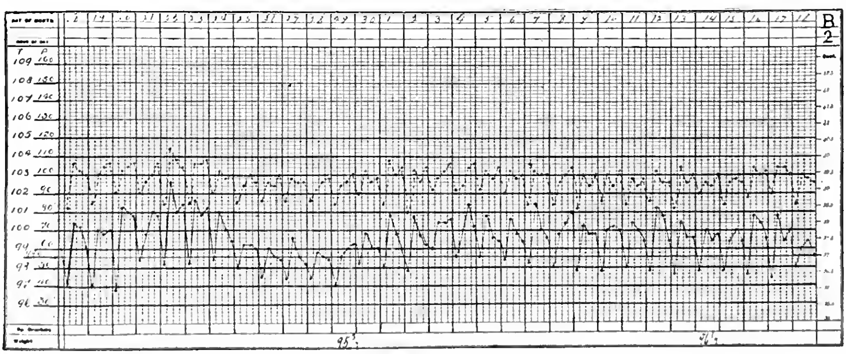


FIG. 35.—B.

only a short time ago very uncongenial to my preconceived notions. I conceived that when bacteria found access to the blood and generalized themselves in the system the machinery for immunization which is at the disposal of the organism was fully called into action. In accordance with this I assumed that to inoculate bacterial vaccines in such circumstances would be to add fuel to the fire without contributing anything to the elaboration of those antibacterial elements which serve to extinguish the conflagration.

"I have now recognized that both the premises upon which I built and my inferences from those premises are assailable.

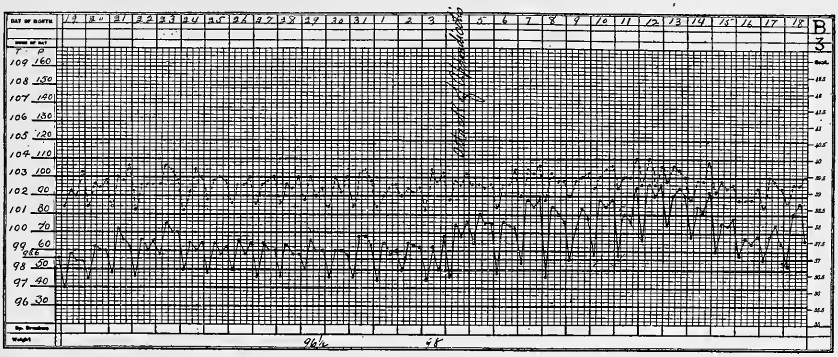


FIG. 35.—C.

"In the first place, while it is true that the machinery for immunization with which the organism is provided is called into action in septicemic diseases, it would seem certain also, under the conditions which obtain in such diseases, that the machinery is often not working to its full capacity.

"An unmistakable indication of this is furnished by the fact that in the ex-

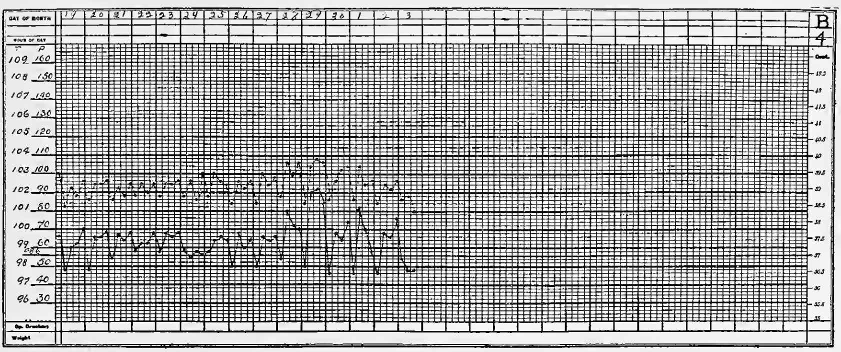


FIG. 35.—D.

FIG. 35.—A. B. C. D. Temperature curve of patient whose findings on auscultation are shown in Fig. 34. Patient received small doses of tuberculin during entire time. Temperature much improved until attack of appendicitis. Patient operated July 3d after which improvement continued.

actly analogous conditions which obtain where bacterial cultures or the filtrates from these are inoculated intravenously into horses there is obtained, in some cases at least, only a very poor yield of protective substances. These observations on horses fall into line with observations recently made by Douglas and myself upon men in connection with cases of Malta fever and in connection with a case of infective endocarditis which will be further referred to.

"Again, in the reasoning which I above rehearsed the possibility of a different effect being produced by bacterial elements introduced into the blood stream and the same bacterial elements introduced directly into the tissues were overlooked. Yet consideration will show that there may be quite important differences, first in the matter of the toxic effects exerted, and, secondly, with respect to the immunizing response elicited, by one and the same quantum of bacterial elements introduced directly into the blood stream or directly into the tissues as the case may be. The general intoxication effect—which above all we have to apprehend in septicemic conditions—may be expected to be greatest where, as occurs in these infections, bacterial derivatives find direct access to the circulating blood, and least where, as would be the case in the inoculation of a vaccine, the bacterial elements are introduced into the tissues. In this latter case, as may often be seen in connection with the inoculation of small quanta of antityphoid bacilli when the patient keeps his bed after the inoculation, the toxic effect of the vaccine may expend itself exclusively upon the tissues at the seat of inoculation, constitutional symptoms being here practically absent.

"Equally important are the differences which may manifest themselves in the matter of the immunizing response according as one and the same quantum of bacterial elements is incorporated into the blood, or, as the case may be, directly into the tissues. In the case where bacteria are, as in septicemic conditions, found in the blood stream, or in organs standing in direct relation with this, the bacterial derivatives are of necessity diluted by the whole volume of the blood and lymph before they can come into application upon the tissues in which, we may take it, the machinery for the elaboration of protective substances is located. In conformity with this great dilution of the bacterial derivatives a comparatively speaking ineffective immunizing stimulus will here be administered. In contrast with this, where a bacterial vaccine is inoculated directly into the tissues, the bacterial products will come into application upon these in a very concentrated form, calling forth a correspondingly larger production of protective substances.

"Such larger production of protective substances is in point of fact regularly achieved in the horse in connection with the production of diphtheria antitoxin, when in lieu of intravenous inoculations, subcutaneous and intramuscular inoculations are resorted to and, it would seem, in particular in the case where the inoculations are made with very concentrated toxins."

Hypersensibility.

Occasionally we find a person who is very sensitive to the tubercle toxins; or, this hypersensitiveness may suddenly develop in an individual who has been taking large doses of the bacterial products. A case in point is a young man who was taking 750 milligrammes of von Ruck's Watery Extract of Tubercle Bacilli and who became so sensitive that he could not take 1 milligramme without showing reactions. In such cases I have found that a reduction of the dose to a small fraction of a milligramme, at infrequent intervals when persisted in for some time, will usually allow this hypersensibility to disappear. In some cases it seems best to discontinue the remedy for a time. If it shows at the beginning of treatment, caution and patience will usually overcome it. This hypersensibility is perhaps best overcome by changing to another preparation, and especially from the human to the bovine preparations and vice versa.

Change of Toxins in Treatment.

For the past three years I have been using different preparations in the treatment of the same case, first immunizing to one and then to the other; and, for the past two years, I have done this invariably. Not only have I alternated between different tubercle vaccines but I have employed vaccines made from different races of bacilli, first immunizing to large doses of vaccine made from the human bacillus, then changing to a vaccine made from the bovine bacillus or vice versa. I believe by this system of change that I have been able to produce better results than when I employed the same product continually. One advantage of the employment of both human and bovine vaccines is that a patient who is sensitive to one is rarely sensitive to the other. My experience in the employment of vaccines made from both human and bovine bacilli and especially this peculiar characteristic by which those who are sensitive to one will usually take the other well, makes me believe with Spengler that the toxins of the human and bovine bacilli differ. It has been suggested by Spengler that patients are infected by bacilli of both the human and bovine type usually symbiotically, and, that those infected chiefly by human bacilli are best treated by the bovine preparations and those infected chiefly by the bovine bacilli are best treated by preparations made from human bacilli. Time will determine whether this is correct or not. For a more complete description of this subject see pages 177 to 181.

Site of Injection.

Injections may be made deep into the muscle or subcutaneously; and in order to be given painlessly the needle should be kept sharp and should be inserted quickly. They may be given in the muscles or under the skin of the upper arm or fore-arm, in the interscapular space or in the muscles of the loin. The skin should be cleansed and all antiseptic precautions observed. One advantage of injecting subcutaneously instead of deep into the muscle is that the local reaction at the point of injection can be the more carefully studied, and an extended experience tells me that this is of value. A second dose should not be given as long as there is any local inflammatory symptoms at the point of the previous injection.

Wright's Method of Employing Tuberculin.

As mentioned above, Wright uses only very small doses of tubercle vaccines, and administers the dosage only as indicated after examining the opsonic content of the blood. The following description (Medico-Chirurgical Transactions, Vol. 89) of the principles which he follows in regulating dosage, sets forth his ideas very plainly:

"There appears to be everywhere a fixed idea that to secure the greatest yield of protective substances we ought in each case to begin with a dose which produces a certain amount of constitutional disturbance, and that we ought in subsequent inoculations to employ doses which increase by geometrical progression. This fixed idea rests as a matter of fact upon the preconception that immunization cannot be either initiated or followed up apart from constitutional disturbance, and on the further preconceptions that the capacity of the organism for immunizing response is practically unlimited, and that the yield of antibacterial substances will increase pari passu with the dose. This is not so. I obtain almost every day maximal immunizing responses from the inoculation of doses of tuberculin which have not produced any constitutional disturbance. Further, I have for periods extending over a year continued to inoculate with doses of new tuberculin corresponding to from $\frac{1}{1000}$ to $\frac{1}{600}$ milligramme of tubercle powder* without registering any falling off in the immunizing response. Again, I have in some of these cases repeatedly registered worse and not better results whenever larger doses than these were employed. Lastly, I have before my mind the fact that the horses which, in connection with the manufacture of diphtheria antitoxin, are inoculated with large doses of diphtheria toxin, all sooner or later lose their power of responding to the stimulus of inoculation, and recover that power of response only after a long period of rest.

"In view of these facts I would submit that the whole question of dosage requires to be reconsidered. For myself I am day by day more impressed with the fact that the machinery of immunization can be brought into action by very small stimuli, and that it can very easily be overtaxed. In accordance with these facts I regard it as a matter of great moment, especially in connection with immunization against tubercle, to employ in every case the smallest doses which will elicit a satisfactory response; to repeat the dose only when the effect of the preceding inoculation is passing off; and to increase the dose only when it becomes clear that the dose previously employed is ceasing to evoke a sufficient immunizing response. Acting in accordance with this principle, I now begin with a quantum of tuberculin corresponding to not more than $\frac{1}{1000}$ milligramme of the tubercle powder, and never advance to doses larger than $\frac{1}{600}$ milligramme.

*The doses in this paper have reference in each case to the weight of tubercle powder held in suspension in the new tuberculin as used.

"I may before passing on just refer to two further points with regard to the dosage of tubercle vaccine. Where on observing the results of a series of inoculations I find that the negative phase phenomena are becoming with each inoculation more pronounced I know that I am exceeding my proper dose. Where, on the contrary, the negative phase phenomena are becoming after each inoculation less well marked I know that I am employing the proper dose and am making good progress. The last point to which I would call attention is this: Where a dose has been administered prematurely, or where too large a dose has been administered, there may result from this, in the case where the positive phase of the previous inoculation has not yet exhausted itself, only the cutting short of that phase, or, as the case may be, the production of a negative phase which is unduly accentuated and which is followed up somewhat tardily by a positive phase. But the case will also occur where, after the administration of an excessive dose or premature re-inoculation, the positive phase makes default. Where the positive phase is long delayed I take it that the proper policy is not to wait indefinitely for its arrival but to re-inoculate again with a smaller dose as soon as ever the blood disturbance has come to rest."

Negative Phase.

The clinical experience of many careful observers, extending over the entire period since Koch made his announcement of the discovery of tuberculin, shows that Wright has probably exaggerated the importance of the negative phase. If the small doses of tubercle vaccines employed by Wright invariably produce a negative phase, during which time the content of the body fluids in specific protective bodies is lowered, and, a repeated injection at this time still further reduces the amount of such protective bodies, it can readily be seen that the employment of vaccines, except as administered after an exact measurement of the antibodies in the blood, would be attended by grave danger. Experience, however, shows that disaster does not follow the administration of tubercle vaccines when much larger doses than those recommended by Wright have been employed; and that in the phenomena associated with the tuberculin reaction (both local and general) we have a safe guide to the administration of these remedies; a good rule being, to employ a dose sufficiently small to avoid all perceptible signs of reaction.

If the negative phase were as important as Wright maintains, we would have killed our patients by the dosage which we have been employing. On the contrary, those who have used tuberculin and its allies intelligently, depending upon clinical symptoms and local signs as the guide to dosage, have been able to produce the best results that have been obtained in the treatment of this disease. If a negative phase does follow every injection of tubercle vaccine, we must assume that it is of less importance than has been attributed to it. While we would in no way minimize the value of Wright's work, for we believe it furnishes us a key by which we may solve many of the problems associated with the phenomena of immunity and the treatment of infectious diseases, yet, we do not believe that the fact that many careful clinicians are not so situated as to avail themselves of the knowledge obtained by estimating the opsonic content of the blood should deter them from giving their patients the benefit of intelligent treatment by specific products made from the tubercle bacillus. It must be said, however, that an increased experience seems to show that results may be obtained with smaller doses than we have been wont to employ.

Clinical Results.

The final test of all remedies must be clinical results; for many remedial measures which are of great value theoretically, fail when it comes to the practical application. The question to be decided is, whether or not the products made from the tubercle bacillus will accomplish, when administered clinically, the results which seem to be warranted by the properties accredited to them. Will their practical application increase the agglutinating and opsonic content of the blood, and stimulate the healing process in tuberculous areas? Will they have a similar action in man to that which they have in animals?

The question must be answered from experience. I have used the culture products made from the tubercle bacillus for more than eleven years. During the past seven years there has been no time when I have not had from five to ninety patients under my immediate care and observation. During this time some five hundred patients have been observed and treated for periods varying from two weeks to three years (the latter receiving several different courses of treatment). Of course those patients who were treated for as short a time as two weeks should not be counted as showing what any remedy can do, in fact I have never considered a case in my reports which was treated less than two months, no matter by what method. During this experience I have given many thousand injections of the various culture products and have carefully noted the effects. A complete chart of the chest is made at the beginning of treatment and then another made for comparison at the end of each month. Extra examinations are made whenever necessary and often after each injection. The effect of the injections on other tuberculous infiltrations such as those of the larynx, glands, bowels and ear have been watched with greatest care. With this opportunity for observation, I have demonstrated to my own satisfaction that the culture products made from the tubercle bacillus will do certain things. I have learned also something of their limitations. My opportunity for observation has been particularly fortunate for I have had other patients who were not treated with culture products, with whom I could compare results.

Disease Shows Less Tendency to Spread.

One of my earliest observations on the treatment of tuberculosis with specific remedies was that the disease showed much less tendency to spread to new areas where the culture products were used. This observation has been confirmed by my later experience.

I have tried to show (see page 1) that one of the reasons why tuberculosis kills the patient is because of the tendency to spread to new tissue, therefore this action of tuberculin is a very important one. Its rationale is very easy to understand.

As mentioned above, tubercle vaccines increase the amount of specific protective bodies in the blood, and consequently enable it to destroy more bacilli when they pass out of the area of infection and attempt to form new foci. To show how much the resisting power of the organism is increased by these vaccines it is but necessary to refer to the table on page 119 which shows a comparison of the opsonic index or power of the blood to prepare tubercle bacilli for phagocytosis in twenty-three patients after a term of sanatorium treatment only, and after a term of sanatorium treatment plus tuberculin inoculations. The average opsonic index of these patients compared with that of normal individuals taken as 1 was only .73; but after tuberculin injections it increased to 1.21. This means that the power of the blood of these patients to destroy bacilli as they find their way out of the old tuberculous areas and endeavor to start new foci has been increased from less than three-fourths of the normal to one-fifth more than normal. In other words the power of these patients to prevent those bacilli which escape from tuberculous areas from starting new foci has been increased 65.7 per cent by the use of tuberculin. What this means for the protection of the individual can be readily understood.

That this is not only theory, but fact, we are led to believe from the observations that while more than 50 per cent of patients suffering from advanced tuberculosis have tuberculous complications on the part of the larynx and intestines, and also complications in many other organs, during an extensive experience in treating many advanced cases of tuberculosis, I have seen very few of these complications develop during the period of tuberculin treatment, unless it was in those who were rapidly approaching death.

Disease Heals more Surely and more Quickly.

The same action of tubercle vaccines which increases the specific protective bodies in the blood and tends to prevent spreading of the disease is also a powerful factor in healing out the lesions when present. And, when we add to this the local reaction which causes an increased flow of blood, which has been artificially enriched in protective bodies by the specific inoculations, to the tuberculous foci to take the place of the stagnating serum which has been deprived of its protective properties by its prolonged contact with the bacilli, together with the irritation caused by this local reaction whereby more rapid formation of fibroid tissue occurs, we can readily understand that the addition of tubercle vaccines must not only increase the chances of cure but must enable this result to be produced in a shorter time.

My own experience bears this out. In one hundred and twenty-one cases of tuberculosis treated by bacterial vaccines plus the hygienic method (Therapeutic Gazette, 1906) reported by me, the following results were obtained:

Stage of Disease.	No. of Cases.	App. Cured.	Arrested.	Improved.	Unimproved.	Dead.	Tuberculin Test.	Bacilli.		Remarks.	Time of Treatment.
								Adm.	Dis.		
I	27	25 cases 92.6%	2 cases 7.4%				20	6	1	83.33% lost bacilli.	4.1 months.
II	28	19 cases 67.85%	7 cases 25%		2 cases 8.15%		6	22	6	72.73% lost bacilli.	6.5 months.
III	66	5 cases 7.58%	32 cases 48.48%	22 cases 33.33%	5 cases 7.58%	2 cases 3.03%		66	53	19.7% lost bacilli.	8.7 months.

This report includes cases treated prior to Jan. 1, 1906. Since that time about two hundred more have been discharged with results which do not vary materially from the above. I do not wish to give the entire credit for these results to the bacterial vaccines, for I do not consider any treatment of tuberculosis complete short of employing all remedies that we believe will aid. I believe close personal attention to these patients had much to do with the results. These patients were afforded every advantage that fresh air, good food, carefully regulated lives, hydrotherapy, favorable climatic conditions, local hyperemia, and most diligent care could give, besides the injection of the vaccines; but, to the latter, I know much credit is due.

It will be noticed that many of the patients were far advanced. Of 103 far advanced patients who were admitted to the institution the 66 who were reported were those who remained more than two months. The remaining 37 were so far advanced that they left the institution before the end of the second month. Of the 66 who remained more than two months and were counted in these statistics, 24 had temperatures ranging above 100.5 degrees when admitted and 15 had a maximum temperature above 101 degrees at the time of admission, and 55 had periods when their temperature reached 101 and over during their stay. This shows that much more can be done for advanced cases of tuberculosis than is generally believed, yet in no wise excuses a failure to diagnose the disease early.

Moeller (Jahresbericht der Heilstaetten, Belzig, 1904) reports 600 patients treated at Belzig during 1904. Of those treated with tuberculin 36 per cent were apparently cured, while of those treated without tuberculin 10.9 per cent were apparently cured.

Turban reports that of 327 patients treated in his sanatorium, 52 per cent of those treated with tuberculin and 39 per cent of those treated without tuberculin were apparently cured.

Weicker (Beiträge z. Frage der Volksheilstaetten) apparently cured 40 per cent where tuberculin was used and 20 per cent where it was not used.

Tuberculin Relatively of more Value in the Treatment of Advanced Cases.

My experience would lead me to the conclusion that these specific remedies are relatively of much greater advantage in the treatment of advanced cases than in the treatment of early cases. A large proportion of early cases can be cured by hygienic measures alone. As mentioned above, of 589 cases treated by tuberculin, 496 or 84.2 per cent were apparently cured, while, of 611 treated by sanatorium methods without tuberculin, 396 or 64 per cent were apparently cured, showing that even in early cases 20.2 per cent more were apparently cured by tuberculin than without it, although the results without tuberculin were very good. In advanced cases, however, those treated with tuberculin have a much better opportunity of cure.

In the advanced cases reported by me it will be seen that an apparent healing occurred in 7.58 per cent and an arrestment in 48.48 per cent. I do not believe it would have been possible to produce such results without the aid of specific remedies, but by their aid the physiological processes of immunity were kept stimulated and the body fluids were flooded with protective substances which destroyed the bacilli as they made their way out of the original areas to invade new tissues and even killed them in their original foci; and, by the local reaction, the infected areas were stimulated to healing.

In this connection I will quote from Trudeau (Second Report National Association for the Study and Prevention of Tuberculosis, May, 1906) to show the difference between cases treated with and without tuberculin.

COMPARISON OF 185 CASES TREATED AND 864 UNTREATED.

	Incipient.			Advanced.		
	App. Cured.	Dis. Arrest.	Active.	App. Cured.	Dis. Arrest.	Active.
Treated . .	56%	34%	10%	27%	55%	18%
Untreated .	50%	38%	11%	6%	51%	43%

The above percentages have been calculated on the basis of an equal number of treated and untreated in each year.

Bacilli Disappear From Sputum.

It is always gratifying to secure the disappearance of tubercle bacilli from the sputum, for this is necessary to a cure. While all such closed areas are not cured, yet we can not have a cure unless this is accomplished; and, in cases where a cure is not obtained, if we can secure the disappearance of bacilli from the sputum, it takes away the danger of scattering infection and makes the patient more comfortable.

In my first-stage cases it will be noticed that six had bacilli in their sputum upon admission and one upon discharge. Thus 83.83 per cent of first-stage cases lost bacilli. Of second-stage cases 22 had bacilli on admission and 6 on discharge, or 72.73 per cent. lost their bacilli. Of third-stage cases 66 had bacilli on admission and 53 on discharge or 19.7 per cent lost their bacilli.

Nagel (Beitraege zur Klin. der Tuberkulose, Bd. V., Heft 4, page 489) in a report of the Cottbus Sanatorium makes a comparison of the results of patients treated with tuberculin, and those treated without it. He makes as the basis of comparison the disappearance of tubercle bacilli from the sputum. In the years 1902–1904, 96 patients in all stages of tuberculosis with bacilli in their sputum were treated by tuberculin. Of these 48, or 50 per cent, lost their bacilli. During 1900–1904, 65 patients in all stages, with bacilli in their sputum were treated without tuberculin. Of these 13, or 20 per cent, lost their bacilli. The author remarks that those treated without tuberculin were mostly treated in 1900 and 1901, for after the good effects of tuberculin in causing the disappearance of bacilli was shown, it was used in nearly every open case.

Turban reports 86 patients out of 227 as having bacilli in their sputum. Of those treated with tuberculin 41 per cent lost bacilli, while of those treated without it, 27 per cent lost their bacilli.

Brown (Zeit. f. Tuberkulose, Bd. VII, p. 235) reports that 24.7 per cent of 990 patients treated without tuberculin at the Adirondack Cottage Sanitarium, who had bacilli in their sputum at the beginning of treatment, had lost the bacilli on discharge. Of 147 cases treated with tuberculin who had bacilli on admission, 47 per cent contained none in discharge. Thus nearly twice as many lost their bacilli under tuberculin treatment as did without tuberculin.

Von Ruck (Report of Winyah Sanatorium, 1903–1904) reports 244 patients treated with Watery Extract of Tubercle Bacilli who had bacilli in their sputum at the commencement of treatment. Of these, 159 or 65 per cent lost them during treatment.

Tuberculous Complications Disappear.

Not only is it possible to cure tuberculosis of the lungs, but tuberculous complications such as those of the larynx, glandular system, and even now and then of the bowels (see Chapter XIX) will yield to tuberculin treatment. And recently Wright (Medico-Chirurgical Transactions, Vol. 89) has reported most encouraging results in the treatment of such hopeless conditions as those affecting the bladder and kidney. During the past year (see page 267) I have seen the apparent cure of a tuberculous ovary.

Permanency of Results.

The question of greatest interest to patients is whether or not they will remain well after they have been apparently cured. It is worth a greater struggle to regain health, if this condition when attained can be preserved.

From our previous discussion it is plain that the results obtained in tuberculin treated cases should be more permanent than in those treated without it. Patients who get well without treatment or with the usual open-air-hygienic dietetic treatment are more apt to have a quiescence rather than a cure. This is shown by the fact that many of them will still react to tuberculin, which they would not do if they were cured, and also by the fact that a greater percentage of those suffer relapses than of the tuberculin treated cases.

Of the 27 first-stage cases mentioned above, the time since discharge varies from one to seven years. I have had direct or indirect reports from all and not only are the 25 who were apparently cured still well, but one of the arrested cases has gone on to a cure, while the other is to all appearances well, although I have not examined him. Of the 28 second-stage cases discharged from one to seven years, 26 are still living, and only one of the 19 apparently cured has had any further trouble. Of the third-stage cases which were apparently cured, one died during operation, one went through a severe operation, followed by septicemia and broke down again, and three are living and well, although one went through a severe attack of double pneumonia more than a year ago. Several of the arrested cases have gone on to a cure, and many of them are working with their capacity only slightly impaired.

Brown (Zeit. f. Tuberkulose, Bd. VI, p. 235) has analyzed the post-discharge mortality of the patients who had been treated with tuberculin at the Adirondack Cottage Sanitarium and compared it with that of the total number treated in the institution during the same period. His results are very interesting and bear out the claim made that the results of tuberculin treatment should be more permanent than those obtained without it.

"The method adopted for comparing the post-discharge mortality of the tuberculin cases and the total number of cases is as follows: Each series of cases was classified by condition on discharge and the year of discharge. On the basis of English Life Table, No. III, the probable number living at the same time was calculated for each series according to the age condition and discharge and date of admission. For example, 307,572 males aged twenty-nine, 301,466 are alive after two years according to the foregoing life table. Having three males aged twenty-nine on discharge from the sanatorium two years ago the "expected living" was calculated as $3 \times 301,466$ divided by 307,532 which equals 2.94. If we find say two living, the number surviving is 68 per cent of the "expected." A summary of the results thus obtained is given in Table II. This table is made by grouping the years together so as to obtain a more regular progression. One difficulty arises from the fact that a considerable number of cases cannot be traced at all and the figures accordingly are presented in two ways:

"1. By treating all the cases untraced as dead.

"2. By eliminating entirely all those untraced.

"Both these lead to incorrect results but in opposite directions. The assumption that all or even a majority of the untraced cases are dead, is not borne out by careful investigation of the facts. More especially is this so in cases of females. On the other hand it appears highly probable that the percentage of dead among the untraced is somewhat higher than among traced cases. As, however, the comparison in these cases is not between the cases treated in this institution and the general public but between two series of cases treated in the institution, the particular assumption made makes very little difference and a mean of the results obtained by the two methods appears a convenient standard of comparison.

TABLE II.

	Untraced Counted as Dead.				Untraced Eliminated.				Mean.	
Number of Years Discharged	Ap. Cured.		Dis. Arrested.		Ap. Cured.		Dis. Arrested.		Ap. Cured.	
	Total (1)	Tn. (2)	Total (3)	Tn. (4)	Total (5)	Tn. (6)	Total (7)	Tn. (8)	Total (9)	Tn. (10)
3	85	102	68	84	100	102	82	89	93	102
4–6	74	93	51	75	88	97	67	79	81	95
7–9	69	88	39	36	99	102	48	44	83	95
10–12	48	79	12	19	87	93	17	20	68	86
Total.	73	88	52	58	95	98	65	63	84	93

Number of Years Discharged.	Dis. Arrested.		Column 10 Per cent of Column 9.	Column 12 Per Cent of Column 11.
	Total (11)	Tn. (12)		
3	75	86	110	114
4–6	64	77	117	120
7–9	44	40	114	91
10–12	15	19	126	126
Total.	58	60	117	103

(Comparison of total and tuberculin cases classified by condition on discharge showing percentages that living are of "Expected living" at various periods subsequent to discharge.)

"The results arrived at by this method of comparison of tuberculin treated cases and of the total number of cases show a remarkable advantage in favor of the tuberculin treated cases. During the first three years it was found that of the apparently cured cases treated with tuberculin more are alive than the life table indicates for persons in health. But in each successive year the proportion of tuberculin cases in comparison with the number of healthy people who should be alive grows successively smaller. The cases discharged apparently cured show very much better results than those discharged with their disease arrested. On comparing the tuberculin treated cases to the total number of cases in the cured and arrested cases it is found that as more time elapses after discharge the number of tuberculin treated cases that remain well is greater than the number of total cases that remain well. This is well shown in the last two columns of Table II. These columns show what percentage the percentage of tuberculin treated cases that remain well is of the percentage of the total number of cases that remain well. It is seen that as the years elapse the percentage increases."

Limitations. It is wise to know what a remedy will not do as well as to know what it will do. I have endeavored to show how tuberculin and allied products act and what may be expected from their administration, but I feel that I would fall short of my duty if I failed to point out some of the things that these remedies will not do. The greatest misfortune that can happen to any remedy or measure is to have too high an estimate placed upon it. When people expect a thing and do not receive it, they are not only disappointed but they make known their disappointment, as was shown when tuberculin was given its first trial. The impossible must not be expected. These remedies are not a panacea for all ills; they are specific remedies for tuberculosis.

I have endeavored to make clear that there is a great difference between early tuberculosis and advanced consumption; the former a disease, the latter the result of that disease. Tuberculin and its allies are specific remedies for tuberculosis and if administered early in conjunction with other proper measures will cure a large per cent of these cases, in fact, a death should be considered the exception. In cases further advanced the addition of these remedies to other measures gives the patient the best chance that he can have of cure, but it must not be expected that nearly so many will be cured. That specific inoculations are of value in these advanced cases, is shown by the greater number of such cases that can be brought to an arrestment or apparent cure, when treated by them, and also by the disappearance of bacilli from the sputum in a much larger percentage of cases when they are used.

These remedies will not remove fibroid tissue nor will they restore tissue lost by ulceration. They can not restore shrunken lungs nor can they replace distorted and damaged hearts. They can not destroy other bacteria which are the cause of mixed infection. They can not furnish recuperative power when the system is totally undermined. In short they can not overcome the consumption which has taken place as a result of the tuberculous process. Yet this is what many have expected a specific remedy for tuberculosis to do.

Specific products made from the tubercle bacillus are remedies which, when combined with other suitable therapeutic measures, offer the best possible chance of cure to those suffering from tuberculosis in any stage; but from their uniformly good results in early tuberculosis they demand an early diagnosis and their early intelligent employment. In advanced tuberculosis no more should be expected than is possible to be obtained.

Who Shall Employ Specific Remedies?

Who shall employ specific remedies? This question should answer itself. Any man should be capable of employing them if he has sufficient intelligence and sufficient determination to acquire a knowledge of their action and the proper method of their use, and if he will familiarize himself thoroughly with tuberculosis. They are not safe remedies for a man to employ haphazardly, nor should they ever be used in a routine manner. It is just as rational to put the surgeon's knife in the hands of a blindfolded physician as to put these specific remedies in the hands of a man who does not understand both them and the disease to be treated by them.

In order to be able to determine whether specific remedies are doing good or not it is necessary to be able to note the minute changes going on, which are revealed only by a careful use of the stethoscope, as well as to observe grosser changes which are patent to the eye.

Patients treated by tuberculin should be under the close observation of the physician. The ideal place for the administration of this remedy is in an institution where the patient can be properly controlled. While it is possible to secure good results in office practice, yet advanced cases, as a rule, can not be so well handled outside of an institution as in.

Intelligence, care, patience and perseverance are indispensable to the proper administration of tubercle vaccines.

If so Valuable Why not Recognized?

The fact that a remedy or measure is not generally adopted at once, upon its announcement, is no argument against it; and especially is this true of a remedy which proved so disappointing when first announced. Scientific truths make place for themselves slowly because they compel men to give up their already established beliefs. It took more than half a century for any considerable number of the medical profession to adopt the fresh air cure for tuberculosis, and it will perhaps be at least three-quarters of a century before it is fully appreciated. Fresh air is not only a remedy for tuberculosis but for all diseased conditions, as well as our best prophylactic; yet how long will it be before its value will be recognized?

Tuberculin has been gaining rapidly. Heads of sanatoria throughout the world are fast falling into line, and employing it in their institutions. The great mass of clinical evidence which is accumulating in its favor can not be ignored. Modern studies in immunity and especially those of Wright have shown it to be founded on scientific fact. Its general recognition is simply a matter of time.

Antitubercle Serum.

When antitoxin was discovered for diphtheria this stimulated a hope that a similar remedy might be found for tuberculosis, but the difference in character of the two diseases seems to preclude this hope.

While most investigators, who have endeavored to find specific remedies for the treatment of tuberculosis, have busied themselves with the production of active immunization, a few have endeavored to produce a serum which contains the specific protective bodies, and, which, when introduced into the human body, acts at once directly upon the tubercle bacilli and their toxins. The best known antitoxic sera are those of Fish, Paquin and DeSchweinitz in America and Maragliano and Marmorek in Europe.

Personally, the writer's experience with these sera is too limited to warrant an opinion; however, it seems that if they can be produced in such a manner as to contain large quantities of antibodies that they should be of special value in those cases where the patient seems to suffer greatly from toxemia of tubercle bacillus origin.

Antitoxic Serum (Maragliano).

The serum which is best known in the treatment of tuberculosis is the antitoxic serum of Maragliano. There is one respect in which Maragliano's products differ from those of others—they contain no preservative. Even the products which he uses for injection into animals for the production of the sera are free from preservatives. In this way he aims to introduce the toxins of the bacillus in their natural form, in the form in which they are found in the bacilli themselves. It should further be added that neither the bacilli nor the products made from them are subjected to heat.

This antitoxic serum is made in the following manner: Animals, preferably horses, are subjected to increasing doses of a Watery Extract of Tubercle Bacilli until their blood shows a high content in antitoxic units. The animal is then bled and the serum prepared under strict asepsis for use upon the human being.

The Watery Extract used is made as follows: The bodies of tubercle bacilli, are extracted with warm distilled water until they are deprived of their toxic power. It is then standardized so that one cubic centimeter of extract will kill one hundred grams of healthy guinea pig within three days.

Bacteriolysin (Maragliano).

Recently Maragliano has produced another remedy which he calls Bacteriolysin. For the preparation of this serum the goat is preferred because it responds better to the inoculations. Bacteriolysin according to Maragliano contains not only antitoxins but agglutinins and bacteriolysins as well.

It is produced by the inoculation of the animal with bacillus pulp which is a product made by triturating living, highly virulent tubercle bacilli with fine sand in distilled water until the bodies of the bacilli are thoroughly destroyed. (This process also mechanically separates the fat.) It is then filtered through a Chamberlain filter to remove the bodies of the bacilli. To be sure that no virulent bacilli remain, a culture is taken. This preparation contains a maximum amount of bacillus substance and is unchanged by heat or preservatives.

Marmorek's Serum.

Marmorek's serum has enjoyed a good reputation among some men who are well qualified to give an opinion. Recently he has produced a new serum which contains protective bodies, not only against tubercle bacilli, but against the streptococcus which is so frequently found producing an accompanying mixed infection.

CHAPTER XVI.

HYPEREMIA.

During recent years our attention has been called to the importance of hyperemia in the treatment of disease, by Professor Bier, of Bonn. While at first, like all new methods of treatment, it did not receive the credit that was due it, today it is recognized as being a measure of great value. While, as yet, we may have no method of applying this hyperemia to tuberculosis of the lung acceptable to the medical profession as a whole, yet I feel that a book devoted to the treatment of tuberculosis would not be complete without emphasizing the importance of hyperemia. Bier has employed hyperemia in treating tuberculosis of the joints, since 1892, with excellent results. (Bier, Uber ein neues Verfahren der konservativen Behandlung von Gelenktuberkulose. Verhandlungen der deutschen Gesellschaft für Chirurgie, 1892, 1. Bd., S. 91.)

Active Versus Passive Hyperemia.

He recommends active hyperemia in some conditions and passive, in others. He defines active hyperemia as being that condition wherein more blood than normal flows into and through the capillaries of a given part in contradistinction to passive hyperemia, which is that condition where, through a lessening of the venous outflow, there is more blood in the capillaries than is found normally, but a lessened volume of blood passing through the part.

Theories of Disease.

Our conception of the cause, nature and cure of disease has changed very much and very often during the past century. Formerly, disease was thought to be due to a certain humor in the blood, and the cure to be established by cleansing of the blood. This theory was displaced by Virchow's cellular pathology and the science of bacteriology as developed by Pasteur and Koch. For a time, the brilliant discoveries of these scientists directed the attention of the medical profession away from the blood, and centered it upon pathological changes in the body cells resulting from inflammatory change, and upon specific bacteria. More recently, von Behring, Ehrlich, Metchnikoff, Wright and others have once more rehabilitated the humoral theory, but they have given it a new meaning and placed it upon a scientific footing. While disease is not due to a humor in the blood, whatever that may mean, yet the cure of a great many diseases is brought about through the blood. Especially is this true of diseases of bacterial origin.

14

Role of the Blood in Infection and Immunity.

When an organism is inoculated, either artificially or through a natural infection, the blood elements come at once to the rescue. As has been shown in Chapters X and XV the natural defensive elements of the body are found in the blood. The bacteria are acted upon by them and, if the bacteria are not present in too great numbers, or if their virulence is not too great, the protective elements found normally in the blood will be sufficient to prevent infection from taking place.

Although the process of infection, of warding off infection, and of curing infection when it has once occurred, is based upon the same principle in the various infectious diseases, yet, there are certain differences peculiar to the various infecting micro-organisms. I shall confine my remarks to the question of tuberculosis, since that is the subject under discussion.

Blood Prevented from Entering Infected Areas.

When tubercle bacilli have once gained lodgment in the body, a wall of cells is thrown about them forming the tubercle. This is most likely a conservative action to guard the organism against the escape of bacilli into new areas. While the process is primarily protective to the organism it is secondarily protective to the invading bacilli; for, as the tubercle increases in size, conditions favorable to the micro-organism are developed, thus allowing the bacilli to multiply unhindered. The tissue becomes infiltrated with many tubercles, necrosis occurs, the blood supply to the entire affected area is interfered with, and stagnation of the circulation results. Whatever protective elements there are in the blood become used up, and the bacteria are allowed to follow their life cycle undisturbed. That the defensive elements of the blood serum are used up when kept in contact with bacteria through stagnation, is shown by the almost total absence of them in fluid which comes from local infections such as boils.

Effect of Hyperemia.

It can readily be seen that, if the blood as it circulates in the vessels carries the elements which are antagonistic to tubercle bacilli, and if, upon stagnation in the areas of infection, the protective elements are used up, the tubercle bacilli are existing under conditions which are unusually favorable for them. It can further be seen that, if some way can be devised by which a greater amount of blood can be caused to enter the areas of infection, and the lymph flow through it can be hastened, the very conditions which are favorable to healing are going to be produced.

While Bier conceived his ideas of the action of hyperemia several years ago, yet he had to wait for recent years to confirm his views and to show the method of its action. The opsonic power of stagnant lymph found in areas of tuberculous infection is very low, while that of the circulating blood may be little, if any, below the normal; so it is a demonstrable fact that by increasing the amount of blood to the part affected and hastening the flow of lymph according to the Bier method we are aiding nature in such a way as to bring her defensive elements to bear upon the bacilli in a manner which is the most advantageous possible.

Chronic Heart Disease and Tuberculosis.

Bier gives the following description of the manner in which he was led to recognize the value of hyperemia (Hyperemia als Heilmittel, Leipzig, 1906, p. 249): "I came upon the thought of using hyperemia in the treatment of tuberculosis through the following observations of older physicians: Farre and Travers called attention to the frequent coincidence of stenosis of the pulmonary artery and pulmonary tuberculosis in 1815. Louis again directed attention to this in 1826 and explained the coincidence as being due to the high grade of anemia in the lung produced by this cardiac disease. The observations of those physicians were confirmed so that Frerichs (Übersicht über die Ergebnisse der med. Klinik. zu Breslau. Wiener med. Wochenschr., 1853, No. 53, S. 635) stated it as a general proposition: 'Pulmonary tuberculosis, no matter what the relation of this affection of the heart to the other forms of tuberculosis, is the usual cause of death in stenosis of the pulmonary artery.' On the other hand Rokitansky (Medizinische Jahrbücher des k. k. österreichischen Staates. 26. Bd. oder der neuesten Folge 17. Bd. Wien. 1838, S. 417) announced the theory that those chronic heart lesions which cause the lung to be overfilled with blood grant an immunity to tuberculosis. His own words are as follows: 'The relation of hypertrophy of the heart to tuberculosis is the subject of many observations. Among 143 cases belonging to this category (simple and eccentric as well as concentric hypertrophy) I find in fifteen cases that one had a fully healed tuberculosis, but in all the rest (persons of different ages, genders, occupations, etc.) never a tubercle had been present, whereupon it can be judged that these two pathological conditions can not exist in the same individual at the same time, but especially that when the above mentioned heart affection is present there can develop no tuberculosis, at least no pulmonary tuberculosis.'"

Rokitansky (Österreichischen, Jahrbücher, 1836, Vol. XVII) even went farther and said: "Cyanosis, or rather every disease of the heart, vessels and lungs that causes cyanosis is incompatible with tubercle formations; that is, it offers an extraordinary immunity from tuberculosis."

The observations of Rokitansky in relation to heart affections and tuberculosis have been in the main confirmed by modern observers and we now know the rationale of their action. We know that it is not the hyperemia, but the fact that through this hyperemia there takes place in the lung a concentration of the blood with its protective bodies.

Bernard Schulze (Beitrag zur Statistik der Tuberkulose verbunden mit Herzklappenerkrankungen, Inaugural Dissertation, Kiel, 1891) in 1891 brought together the statistics upon the relative coincidence of tuberculosis and heart lesions. He found that stenosis of the pulmonary artery is followed by pulmonary tuberculosis in 83.3 per cent of the cases, while lesions of the aortic valve in only 15.4 per cent and those of the mitral valve in only 4.76 per cent.

Bier reasoned that, if hyperemia has immunizing power against tuberculosis of the lungs, it should also have the same power against tuberculosis elsewhere.

His first experience was with the treatment of tuberculosis of the joints; but since then he has applied it to tuberculosis of nearly all forms and also to many other infections and conditions.

Preciseness in Method Necessary.

Bier warns against the careless use of hyperemia and says that much harm can be done by it if it is used improperly; and reports from his own experience cases of cold abscess following faulty methods. In applying hyperemia he formerly began by using it for one hour a day only, then he increased the time to several hours a day, and finally to an almost continual use of it. The compress was worn day and night, but twice daily its position was changed, and usually once a week it was entirely removed. The compression was entirely removed in order that the swelling and edema might pass away so that the exact condition of the limb would be known. He has now discarded this method and instead uses a very pronounced hyperemic condition for one or two hours a day. This is produced by the use of a rubber bandage which is fitted so carefully that "the subcutaneous veins become markedly swollen, the skin becomes uniformly bluish-red and toward the end of the hour a prickling sensation sometimes appears in the limb."

Bier recommends that the part which is being treated should be kept in a condition as nearly aseptic as is possible, also that only a very limited motion should be allowed and finally shows his good judgment by recognizing that other measures which are of value should also be employed.

He lays down the two following rules:

"1. The congestion should never cause pain else it is wrongly applied or the case is unsuitable for treatment and must be treated by other means."

"2. The congested area must not be cold. The temperature of the skin must not be less than that of the other limb. It is favorable for the cure of the tuberculous infection when, on the contrary, the hyperemia can be so applied that the skin temperature of the part under treatment is increased and the part assumes the appearance of an acute inflammation."

Since writing the above it has been the author's good fortune to visit Prof. Bier and see the hyperemia treatment as carried out in his clinic. The thing that impressed him most was the importance of exactness in technique. It is no exaggeration to say that hyperemia treatment is entirely a matter of technique. If the technique is correct the results are good; if bad, harm will be done.

The above description of method taken from Prof. Bier's own book gives a wrong impression of the manner in which he carries out the treatment now.

In many of the cases the color of the part does not vary markedly from the normal. The desired end is to bathe the part with a great amount of blood and yet not to stop the circulation. The part must be warm as it would be under such conditions with more flowing blood in the part. If the part becomes cold the purpose of the treatment is lost and harm may be done. Prof. Bier lays great stress on the two rules mentioned above and says the results are in proportion to the manner in which they are observed.

While the putting of an elastic bandage around a limb so as to cause a hyperemia of that limb seems like a very simple matter, yet to do it in a manner so as to produce the correct result is not simple. The amount of pressure to be used depends upon the individual case. It will vary according to the size of the limb, the amount of subcutaneous tissue or the muscular development. The physician who wishes to use this method of treatment should first know exactly what grade of hyperemia should be produced and then work until he gets it. Even Prof. Bier's own assistants, who have been using this method of cure for months, are often compelled to try several times before the desired condition is obtained.

Hyperemia in Joint Tuberculosis. The wrist, elbow and ankle joints are most suitable for treatment with hyperemia. The following are Bier's statistics of healing for these various joints:

Wrist,	88 per cent.
Elbow,	72.7 per cent.
Ankle,	61.5 per cent.

Not only tuberculosis of the joints, but that of the glands, skin, subcutaneous tissue and testicle have been treated successfully by Bier.

Hyperemia in Pulmonary Tuberculosis. Many attempts have been made to artificially produce hyperemia of the lungs. Bier is of the opinion that this should be a passive hyperemia, but the reason for his belief I have not been able to find. Jacoby (Münchner medizinische Wochenschrift, 1897, No. 8, u. 9) endeavored to produce hyperemia of the apex of the lung by placing the patient in such a position that the apex was the lowest part of the trunk and then placing over the apex a hot water bath. Bier has suggested that hyperemia could be produced by having the patient inhale deeply through the nose while it is being held partially shut by the fingers or some apparatus, and then exhale through the open mouth, and keep this up for some little time sustaining himself just at the point where the air hunger is endurable. While such a suggestion seems foolish and impractical yet it has recently been revived by Wasserman (Die Verwendung passiver

Hyperämie der Lunge bie Lungenschwindsucht. Zeitschrift für diät. und physik. Therapie., 8. Bd., 11. Heft). The trouble with this measure, aside from its impracticability is that, if it does produce a hyperemia, it must only be of the mucous membrane of the air passages and it would seem that the greater force would be exerted upon the mucous membranes of the larger air passages, while tuberculosis affects more particularly the parenchyma of the lung and the disease is situated near the finer divisions of the air spaces. If, however, such a result is desirable, it can be much more easily produced by the use of the pneumatic cabinet. By placing the patient in the cabinet and producing a lowered pressure about him, pressure will be removed from the blood vessels in the mucous membrane of the air passages and a dilatation resulting in a hyperemia will ensue.

Hyperemia Caused by Reflected Sunlight.

I have succeeded in demonstrating to my own satisfaction that a congestion is produced by directing the concentrated rays of the sun upon the chest by the use of large mirrors (three and one-half feet in diameter) in which the heat is cut off by blue glass. Whether this is due as some believe to the action of the blue and violet rays, which are reflected, or to the heat rays which are not screened out by the blue glass, I am unable to determine. However, after the use of these reflected rays for a half hour or more, there is a marked increase in the signs of congestion, as shown by the stethoscope. When the patient is first put under this treatment he experiences an increase in the amount of coughing which also suggests an increased congestion. This disappears, however, after the patient has become accustomed to the treatment.

Hyperemia Caused by the Use of Tuberculin.

Elsewhere, I have spoken of the manner in which tuberculin causes a hyperemia in the lung. A very small dose causes a hyperemia and a still larger one causes a congestion. This hyperemia is produced as a result of that action of tuberculin which causes a dilatation of the blood vessels in tuberculous tissue. I believe that this action of tuberculin is a very important one, although I have never seen reference to it in the literature. Tuberculin thus possesses the power to bring about the two most important conditions necessary to establish immunity in tuberculosis, viz., to stimulate the physiological processes of immunization so that more protective substances are formed, and to open up the blood vessels at the seat of the disease, and allow the blood to flood the centers of infection and apply the immunizing elements at the point where they will be most effective. Thus the hyperemia produced by tuberculin has a great advantage over that produced by other means in that it not only floods the area of infection with a greater amount of blood, but with a blood whose immunizing properties have been greatly increased. Of course there is no contraindication to the use of other measures for the production of immunity at the same time that hyperemia is being used; in fact, such measures are indicated, and will hasten recovery. This point has been established in connection with the treatment of lupus. Many cases treated by Finsen light alone do not get well; also many treated by tuberculin alone fail of a cure, but when these measures are combined the result is much better. Many fail to respond to Finsen light, which is doubtless indebted very largely to its hyperemia producing power for its result, because the content of the blood in protective substances is too low to be of value when the diseased area is flooded with it. Wright has shown that the opsonic power of the blood is usually low in these cases that fail to respond to Finsen light. He has also shown that often the opsonic index may be raised to normal and yet the patient fail to respond, owing to the fact that the immunizing elements fail to come in contact with the germs. Only when the protective substances have been increased and when these substances have been brought into direct contact with the bacilli do we have ideal conditions for the cure of the disease. Wright found that some of his lupus cases that failed to respond to an increase of the immunizing elements in the blood, as shown by increasing the opsonic content of the blood, made satisfactory improvement when he increased the flow of blood to the part by the use of hot sand poultices. These results are a most convincing demonstration of the value of tuberculin and hyperemia combined.

Hyperemia from Position.

It has been my observation that patients who suffer from a more or less general distribution of tuberculosis throughout both the front and back of the lungs, show a much more rapid advance toward recovery posteriorly. The back portion of the lung will heal out much more rapidly than the front. It is probable that the congestion caused by positions assumed by the patient may have something to do with this. While tuberculous patients spend a great portion of the time lying on their sides, yet their position affords an opportunity for the blood to gravitate posteriorly.

CHAPTER XVII.

THE SANATORIUM TREATMENT OF TUBERCULOSIS.

The sanatorium is the agency through which the open-air hygienic, dietetic. and scientific treatment of tuberculosis can be carried out to best advantage, While it might seem that treatment in a sanatorium should not differ from that on the outside, yet, in practice, it differs very materially. While it is possible to obtain excellent results outside of sanatoria, yet, it is impossible to have that same absolute control over a patient and all his actions, that close feeling of mutual interest and co-operation between patient and physician, and that cheerful helpfulness which comes from the association of many who are making the same sacrifices, struggling toward the same end and constantly finding themselves and their associates making steady advances toward recovery. The psychic effect of a sanatorium is one that can not be measured.

Sanatorium Depends on Its Head.

A sanatorium is simply the reflection of the man who is at the head of it, and whether it succeeds or fails depends upon him. The sanatorium treatment of tuberculosis requires of a medical director certain important qualifications. He should first of all understand the disease which he is expected to treat, and all things being equal the better he understands it, the better will be his results. Next and not of less importance he must be possessed of patience. He must be sympathetic, yet firm. He must be optimistic, but his optimism must be bounded by reason. He must be endowed with qualities of leadership, for he must not only lead his patients, but he must command an army of help. Sanatorium men are born, not made. It is useless to think that a sanatorium can be properly conducted by simply placing a physician, regardless of his qualifications and temperament, at the head of it. The head of a sanatorium should live at the institution so that he may come into intimate contact with his patients and so that he may be in touch with everything that goes on. The medical director of a sanatorium occupies much the same position as the captain of the ship. Harmony must be everywhere preserved; therefore, every department should be under his direction and personal supervision.

A word might be said regarding medical directors for state sanatoria. If it were possible, these institutions should not be controlled by politics. When it is remembered that their success depends upon the men at the head of them, it can readily be seen that one fit for such a position is fit to succeed anywhere. He is not, as a rule, looking for the place, but the place is looking for him. His appointment should depend on merit and not political power. Such a position should carry with it a good salary, for it demands a man capable of earning a good salary. Unless the board of directors of state institutions look well to this point they will be disappointed in the results obtained.

Buildings. While I shall not discuss fully the character of buildings which are applicable to the treatment of tuberculosis, yet I wish to mention a few important points which should not be overlooked in construction.

First of all, the requirements of different localities differ. What suits California might not and, most probably, would not suit for the Middle West or New England. Although different climatic conditions must be regarded, yet, certain considerations hold good everywhere. Buildings should be so constructed as to allow the maximum of sunshine and fresh air to enter them; especially should this apply to patients' rooms. The best ventilation is a cross ventilation, and to make it most perfect the outside windows with their transoms should extend to the ceiling so that there is left no dead air space where air can stagnate. The rooms for patients are best ventilated and best suited to the purpose of treatment if they are arranged on one side of a corridor only, for this allows a through ventilation, there being fresh air on both sides of the room (see Fig. 36). This makes construction more expensive, but it makes all rooms equally favored.

Another point in construction is to have everything plain, so as to offer as little chance as possible for the collection of dust and dirt, and to facilitate in cleaning.

Pavilion and Cottage Systems. Sanatoria are built on one of two general plans; the pavilion, consisting of one or several large buildings containing patients' rooms, or the cottage plan, consisting of many small buildings containing rooms for one or more patients. Both systems have their adherents. Both have their advantages and both have their disadvantages. The pavilion system offers better control of the patients and facilitates administration. Better service can be given for less cost. In this system, if accidents, such as hemorrhage or death, occur, it can be more easily concealed from the other patients than it can in the cottage system, where everyone can see what is going on. The cottage system does not invite the patients to congregate in parties so much as the pavilion system and, if the cottage contains a single room only, it offers the best opportunity for the entrance of sunlight and air. I have had an opportunity to study the advantages of both systems, for we have both in our institution. It is the opinion of both my associate and myself that, when all things are considered, the pavilion system is to be preferred.

In speaking of the pavilion system, it is necessary to divorce our idea from

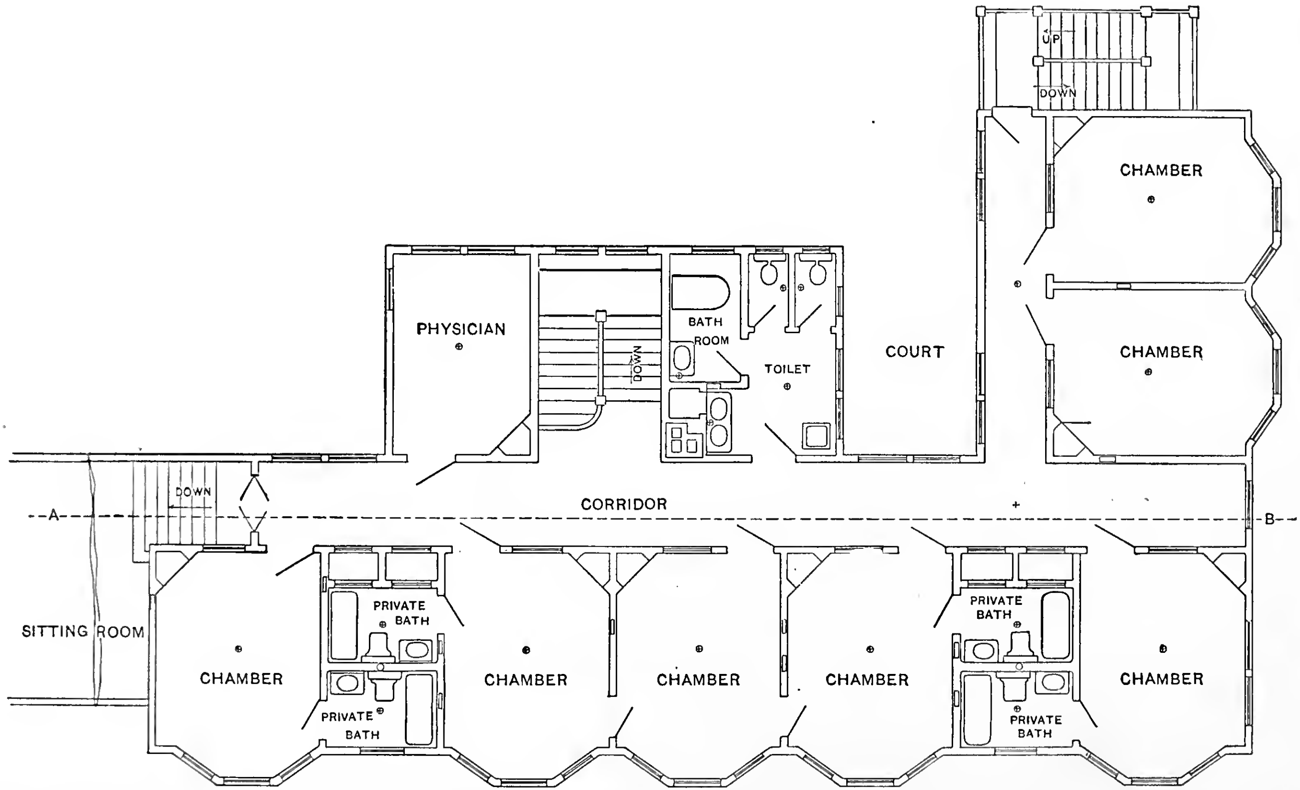


Fig. 36.—Floor plan of a portion of the Pottenger Sanatorium, showing arrangement of rooms on one side of corridor whereby cross ventilation is obtained through doors and transoms opening into the corridor. All corners are round. All patient's rooms have bay window frontage.

that of wards. While a pavilion may contain wards, it does not do so necessarily, and as used here, it refers to buildings with many rooms in contradistinction to cottages with one or a few rooms.

An Improved Bungalow.

There have been many tents, tent houses and bungalows designed for the use of tuberculous patients. Some of them are good and some of them worse than useless. I shall offer a description of the Pottenger Sanatorium Bungalow (Figs. 37 and 38) which we have found well adapted to the needs of our work here in California.

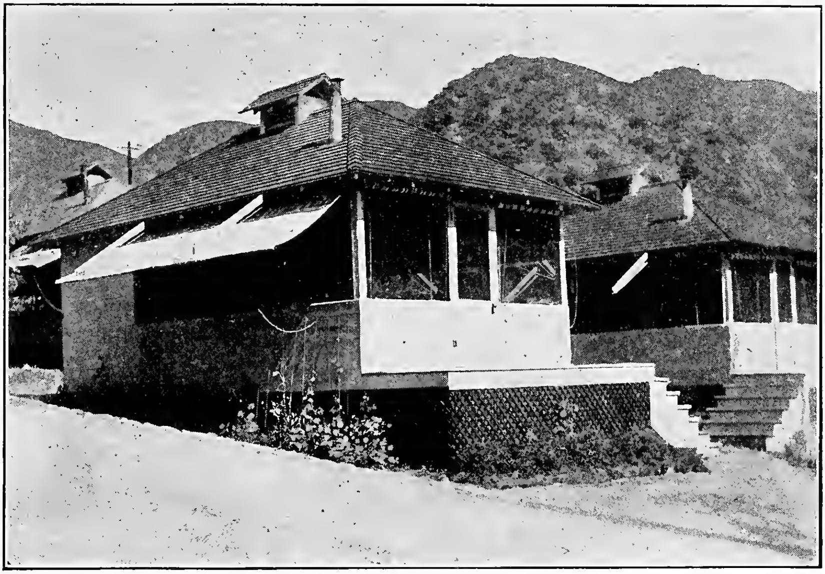


FIG. 37.—Pottenger Sanatorium Bungalow. Curtains are so arranged that they may be operated from within the bungalow. They can either be drawn out as an awning or rolled up to any desired height.

I believe it can also be used to advantage wherever such accommodations are needed.

It combines the ideas of utility, simplicity, and comfort. The bungalow consists of three parts, a sleeping room which measures twelve by fourteen feet; a dressing room, six by twelve feet, containing all the conveniences of a modern bathroom, including a wardrobe and trunk room adjoining; and a front porch measuring six by twelve feet. The sleeping room is open on three sides from a wainscoting, which extends two and one-half feet from the floor, to the roof which is seven feet from the floor. For privacy and as a protection in case of rain or wind the sides are supplied with a curtain of canvas which is fastened to a plate ten inches below the roof, leaving the space above this for ventilation when the curtains are lowered. All openings are covered with wire screening. The curtains are so arranged that they may be raised or lowered to any distance or they may be drawn out at any angle and used as an awning. They are secured by ropes so that in case of wind they will not flap. All movements of the curtains are controlled by ropes and pulleys from the inside of the tent. If the curtains are rolled up, there is a flood of air, light, and sunshine which enters without hindrance. If it is raining, the curtains may be drawn out as awnings, and yet not obstruct the free circulation of air. The dressing room in each bungalow is closed in, affording privacy. These bungalows may be built to face any direction, although facing south affords the patient the greatest opportunity for sunshine.

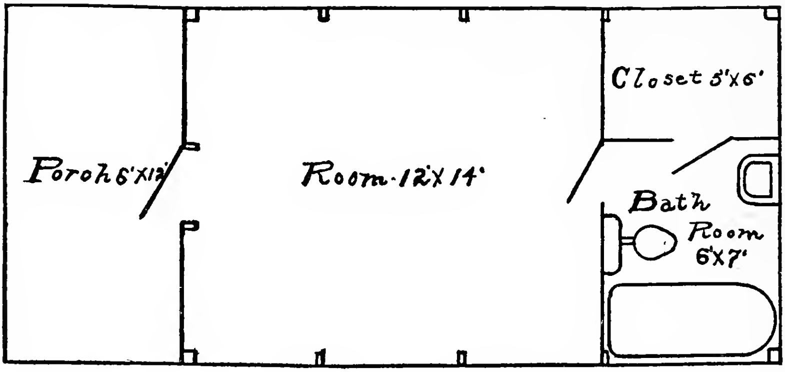


FIG. 38.—Floor plan of Pottenger Sanatorium Bungalow.

If there is a prevailing wind, the closed end with the dressing room should be placed on the windward side, thus affording greater protection. The roof is shingled and has a ventilator in the center which allows free circulation of air, thus making the bungalows comfortable during the hot weather in summer. They can be provided with small stoves for heating, when this is necessary, and it is a simple matter to wire them for electric lighting and call bells. Aside from its use in sanatoria, this bungalow answers well where convenient, comfortable quarters are wanted for a patient at his own home.

Choice of Patients for a Sanatorium.

We very often have patients tell us that they are not yet sick enough to come to a sanatorium. Most unfortunately, physicians often tell their patients this same thing. This comes from a misconception of the nature of such an institution. A sanatorium is a place to cure tuberculosis and no time is too early to begin a cure after the diagnosis is made.

While the fact that pulmonary tuberculosis is a very curable disease, the most curable of all chronic maladies, should be branded upon the minds of the medical fraternity, and while this blessed hope should be speedily made known to the world at large, it should be accompanied by an equally important truth, that the most curable stage is the early stage, before serious harm has been done to the lung and before the general vitality of the patient has been undermined.

In recent years it has been demonstrated to the profession that an early diagnosis, followed by immediate operation, will cure nearly all cases of appendicitis, and today professional opinion endorses this so strongly that a man almost fears to treat a case in any other manner. It now remains to demonstrate the same curability of tuberculosis. The evidence is at hand. The facts are obtainable, but they have not been impressed upon the profession.

Skillful treatment of tuberculosis in the incipient stage will show a mortality almost as low as early operative treatment of appendicitis. Even where breaking down has begun and bacilli appear in the sputum, and a large area of lung tissue is involved (usually so-called first stage), most sanatoria secure happy results in at least 65 per cent of cases. When we consider that the earliest cases rarely go to our institutions, we must call this an excellent showing.

If a man should fall overboard into a stream, would those who saw him fall delay taking steps for his rescue, thinking that he was not in sufficient danger to warrant it, and would they think it wise to wait until he has become exhausted and gone down beneath the waves before rendering him assistance? The man with a tuberculous infection no matter how slight, has fallen into the stream, and there is never a time, after this has been discovered, when it is too early for him to place himself under the best possible conditions for bringing about a cure.

The first question to be decided when tuberculosis has been discovered, is, can the patient be cured? If it is decided that he can, or that he has a fighting chance, the next questions are, what will give him the best chances of cure and how can this result be attained in the shortest time? Time is a very important factor to be taken into consideration in computing the cost of cure. There is no doubt but that a patient can attain a cure more surely and more quickly in a properly conducted sanatorium than he can outside. Although the first cost may be greater, in the end it proves to be the cheaper. Tuberculosis when neglected is such a fatal disease, that those who can afford to do so, should not fail to give themselves the benefit of the best chances of cure. They should seek a sanatorium at the first discovery of the trouble. Of course, those who can not afford sanatorium treatment, must do the best they can outside until such time as public or private charity furnishes endowed institutions for them. Because they can not go to a sanatorium, however, does not signify that they can not get well, but it means that they must struggle to master their disease against odds.

The most suitable cases for sanatorium treatment, as well as for treatment on the outside, are early cases. The earlier the case is discovered the better are the chances of cure. In public institutions where the greatest good to the greatest number must be considered, as a rule, only early cases are taken; but in private institutions, where our duty to the individual receives more consideration, many advanced cases must be admitted.

There is a common belief on the part of some sanatorium men that a sanatorium is only for early cases. This is a mistaken view. True, in those cases, the best record can be made for the institution, and more patients can be offered help in a given time; but is this all that is to be considered? Is a man who has advanced tuberculosis to be denied the right to the best treatment, simply because of greater involvement and lessened chances of recovery? Would it not be more sensible to give him the best opportunity possible? Do physicians refuse to give the best chance for life to patients suffering from other diseases simply because they are advanced and the chances of cure not so good? Few men realize what can be done for patients suffering from advanced tuberculosis when given the best chance of cure in a well conducted sanatorium. While the work is harder for both patient and physician the prize is greater and worthy of the effort.

My experience in the sanatorium treatment of tuberculosis has been largely among advanced cases. More than half of the patients examined are rejected because of the fact that in our opinion they have only a few weeks or months, at most, to live. Nothwithstanding this, we admit many bad cases and usually have about 30 per cent of the patients in bed because of high temperature. In spite of this fact about 50 per cent of all advanced cases who remain in the institution more than two months have had an arrestment of the disease. About 10 per cent secure a healed lesion and some of the others eventually go on to this happy result. The lives of nearly all of these advanced cases can be prolonged and many of those in whom an arrestment is secured will live for years and lead active, useful lives, even without a cure.

Usually those unfortunates who are suffering from advanced tuberculosis are allowed to go on, no attempt at curing them being made. They are kept as comfortable as possible but are allowed to go on to certain death. This is a cruel wrong. Many of these lives can be saved if we will but offer them the opportunity of the best treatment that can be secured. A patient suffering from chronic tuberculosis, even with considerable destruction of lung tissue, if he has a strong heart and good digestion, providing his constitution is not seriously undermined, deserves a chance for his life and will have more than even chances for an arrestment, if given the best that a sanatorium affords.

If denied this opportunity, he will go on to almost certain death within a comparatively short time. Even patients with hectic fever must not be denied a chance for life, for many times this condition yields to intelligent, rational measures.

While we plead for these advanced cases, yet we would not minimize the difficulties encountered in the handling of them. The man who will treat such cases must be an all around physician, for he will meet every complication imaginable. His patience must be unbounded and his optimism coextensive with it. He must be frank and tell his patient that the struggle will be a hard one and long drawn out, and impress upon him that patience, perseverance, and an unbounded faith in the final outcome will do much to aid in his recovery.

Difficulty of Treating Advanced Cases.

A properly conducted sanatorium offers the best chance of a favorable result to advanced cases and, through its agency, many may be restored to usefulness. The advanced case can be treated at home only under the greatest difficulties and with much less promise of success. To repeat what I have said elsewhere, these patients are not suffering from tuberculosis only, but more especially, from the results of tuberculosis. Many, if not all of them suffer more or less from mixed infection. Fibroid changes, necrosis, and in some instances calcification occur in the diseased areas. From the blocking up of the blood vessels in the lung there is a damming back of the blood with more or less passive congestion of the internal viscera; the heart has an extra burden thrown upon it, and its muscle, weakened by the strain, often becomes damaged. Cavities form in the lung, contraction occurs. That part of the lung which is not affected hypertrophies, and later becomes emphysematous, thus adding more burden to the heart, the general system is poisoned by toxins, wasting occurs, and all of the organs suffer more or less. This gives us the picture of consumption. This is what we are trying to relieve when we attempt the treatment of advanced cases of tuberculosis. Tuberculosis is a disease, consumption, a condition resulting from the disease. When we have done all we can for such cases we have done little enough; and yet, to many of these, the careful guidance and intelligent treatment of the patient as well as the disease, as it can be carried out in an institution, will offer an arrestment of the process with a prolongation of life; and to some it will even offer an opportunitv for the attainment of a healed process.

What Complications are a Barrier to Treatment?

What complications are a barrier to treatment? The answer to this question must vary according to circumstances. In public and charitable institutions we would bar many patients who would be eligible to treatment in private sanatoria, because in these institutions we must bear in mind the idea of the greatest good to the greatest number. Public institutions can not afford to fill their beds or any considerable portion of their beds with patients who will require six or eight months in order to obtain a favorable result when there are so many waiting for entrance who could obtain equally favorable results in from three to six months. Then, those who manage public and charitable institutions find it best to confine their efforts as much as is possible to early cases, and, where advanced cases are admitted, they must be such as offer a reasonable hope of rapid improvement. All tuberculous complications, as a rule, bar entrance, and serious disturbance on the part of the circulatory or digestive system or the presence of fever make the patients unsuitable.

This discrimination on entrance against such complications does not mean that they are necessarily fatal but only that they increase the time and cost of cure to such an extent that it is not thought expedient to admit those suffering from them. Tuberculous laryngitis, especially if it is in the early stages of infiltration, is not a barrier, providing our patients are given the benefit of tuberculin treatment. Tuberculosis of the bones, joints and glands, and even tuberculosis of the kidney and bladder yield to proper treatment. The writer has seen many cases of tuberculous laryngitis heal, also tuberculosis of the tonsil, nasal septum, pharynx and two cases of probable tuberculosis of the intestines. Tuberculosis of the lymphatic glands, in my experience, has never come to operation. When such complications are present the time of treatment is usually prolonged but, if money consideration does not hamper, such patients should be given a chance for life.

Length of Treatment. The length of time necessary to obtain an apparent cure or arrestment in tuberculosis or to determine that such a favorable result can not be attained is a question which must always be considered when determining what course to pursue. A patient in the early stages of tuberculosis will on an average secure an apparent cure or arrestment in from four to six months, while those in an advanced condition require from six months to one or two years or even longer. It is important that physicians understand this, for it is not at all uncommon for patients to be referred to a sanatorium with the assurance from their family physician that a few weeks or one or two months will restore them to health. This often causes no end of disappointment. It would be much better for the home physician to explain to the patient the nature of the trouble and inspire him with the hopefulness of modern methods of treatment, and yet not minimize too much the difficulties connected with it. It must also be remembered that many patients who secure an improvement in a few months might secure an arrestment in only a little longer time; and many who secure an arrestment might, by a little more time, secure an apparent cure.

Why a Sanatorium is Superior to the Home or an Open Resort.

All physicians are not yet convinced of the superiority of sanatorium treatment over treatment in the home or in an open health resort. There is also a prevalent idea that a considerable proportion of people are so constituted that they can not undergo sanatorium treatment. It is needless to say that such opinions are usually due to lack of experience. No one will question the superiority of a hospital for the treatment of acute or general diseases either medical or surgical, nor will physicians allow the opinion of the patients to have much weight when it comes to deciding what is to be done in a serious case. Tuberculosis is always serious and the best treatment is none too good. The advantages of a sanatorium over the home or open resort for the treatment of tuberculosis are as great as those of a well-appointed operating room in a hospital over a room in a private home. The belief that patients can not undergo the sanatorium treatment is a figment of the imagination. If a patient can not endure the life of a sanatorium he has little chance of cure outside.

The first great advantage in the sanatorium treatment of tuberculosis is that the patients are removed from the pernicious influences which surround them in their homes. It has been well said that tuberculous patients do not die but kill themselves; and I would add, or are killed by their friends. The life of the tuberculous patient is a constant unconscious repetition of Beecher's prayer: "O, Lord, defend me from my friends."

A tuberculous individual, although he does not always recognize the fact, is ill. He cannot and must not do the things that a well person does. If he associates with well people, he is compelled to do many unwise and harmful things, he is forced to entertain and be entertained, when he should be resting; he is led into vices and excesses, he is tempted to attend parties, theaters, and not infrequently dances, he is constantly tempted to eat indigestible food, he is ever receiving gratuitous advice, contrary to the doctor's orders, from some would-be-wise individual who thinks he knows far more of the needs of the tuberculous individual than the attending physician.

He should carry out a regime which is wholly at variance with the usual unhygienic rules of living. He should harden himself against cold by remaining in it while people in general are accustomed to warm rooms. He should have fresh air in order to stimulate his digestion, aid assimilation and tone up the various organs of the body, while those with whom he is compelled to associate are in the habit, as a rule, of living in rooms poorly ventilated. He may be willing to follow out the instructions of the physician with reference to the open-air life, but he will be compelled to do it in most instances not only without the co-operation of his associates, but often in the face of their opposition. Few people in apparent health will make the supposed sacrifices that are necessary in order to be with a tuberculous patient and to offer him

15

the best chances of cure; consequently the patient is compelled while living with private families to neglect many measures which will aid in a cure, and do many things which will retard progress.

The patient at home or in an open resort is near business and social life, yet he cannot enter them. The temptation is great and the denial much harder than when he is entirely away. He has a constant taste without the full enjoyment.

The next great advantage which makes sanatorium treatment superior to that of the home or open resort is the close personal contact of the patient and physician. In a disease like tuberculosis, where life or death depend on such little things, it is necessary for the physician to have absolute control over the patient. This necessity is emphasized by the fact that during much of the time these patients do not feel ill, and during this time when they feel well they are apt to do things that they should not do and jeopardize their recovery. On the other hand, there are many things that these patients should do which they will neglect unless the physician has some method of knowing whether or not they are done. Nothing stimulates obedience so much as frequent contact with the medical director.

It might be argued that these patients should be told what to do, and if they do not do this, they alone are responsible; but such argument would play havoc with results in the treatment of tuberculosis; for, here, the success of treatment depends upon keeping up the interest and hope of the patient through many seasons of discouragement, when even the bravest hearted waver. There is a little tendency to overstep rules in us all, and we often see this in tuberculous patients. They will often deliberately plan to take advantage of their physician and disregard his advice on matters which mean very much to their recovery. I have known them to pride themselves on doing something against his advice and without his knowledge. This is not done with any intentional disrespect, either, for patients having a reverence for their physician which almost equals worship, will do it.

The frequent visits and encouragement of the medical director at times when things are not going smoothly, when the disease is advancing, when complications are present or when progress toward recovery seems to be slow, gives the patient a strong arm upon which to lean and often tides him over the period of discouragement and starts him on with renewed zeal towards recovery. There are many times when the words of comfort and encouragement of the medical director are about all that stand between life and death to the patient. Under the stimulation of his visits I have seen such patients restored to useful lives. To patients who are not so ill, this close association gives an opportunity for encouragement that could not be offered in any home or open resort.

The opportunity of having complications seen when they first arise and of having measures taken for their immediate correction, and the fact that they have someone at hand to meet all emergencies, gives patients an assurance and feeling of safety that adds much to their chances of recovery.

The third great advantage of a well-conducted and well arranged sanatorium over the home or open resort is that here everything is especially fitted for the treatment of the disease. The rooms are constructed on hygienic principles, so that they may be flooded with light (especially sunlight); the dietary is arranged to suit the special needs of the patients; special measures of treatment are carried out to the best advantage because of the direct supervision of the physician; assistants and nurses are always at hand to aid in carrying out directions; and disinfection of rooms and table-ware and destruction of sputum and other bacillus-laden discharges are done with extreme care. This insures to the tuberculous patient the greatest security and at the same time the best opportunity of cure.

Air of Hopefulness Pervades Sanatoria.

There is a mistaken idea on the part of some individuals regarding the general air of a sanatorium. Many think that these institutions are places of gloom and sadness. Nothing could be farther from the truth. In sanatoria, it must be remembered that all patients who appear to be ill are in bed. The contra-indications for exercise are such that all who have fever, or those who are extremely emaciated, those who suffer from rapid heart or dyspnea and those who have complications are confined to their beds; consequently only the stronger are allowed to be up and around. Therefore, even in an institution where advanced cases are cared for there is nothing seen to mar the hopefulness of the place. Even most of those patients who are compelled to remain in bed are usually cheerful and happy.

When patients arrive at a sanatorium and are put upon the hygienic regime, as a rule, they begin to improve at once. At first they gain in weight. They see others are doing the same. They gradually see their symptoms abating and note that this change has come to others who have been there longer. A new hope awakens in their hearts and a firm belief in the possibility of cure takes hold upon them. Soon they see patients who were confined to their beds gradually getting better and stronger and venturing out to meals and then for walks. They are more convinced than ever of the hopefulness of their own condition. They see others apparently cured and this spurs them on to make their best efforts to secure a similar result.

Then there is that feeling of mutual interest. Patients will help each other. They will bring words of cheer, and conceal things that might discourage. They feel that they are bound together by special ties. They have the same disease, they are struggling for the same end and they are compelled to make the same sacrifices. This mutual concern for one another makes it easier to bear the disappointments which the disease has produced. They see that their loss is not so great but that some one else has suffered as much. They can endure the separation from home because of the strength supplied by their association with others as brave. They can better deprive themselves of harmful things that they have been accustomed to have, and restrain themselves from doing harmful things that they have been accustomed to do, and submit to things which increase their chances for recovery, though distasteful, because they have the moral support of all those who are about them.

The sanatorium then is the place where all those measures which aid in bringing about a cure in tuberculosis can be applied most easily and most successfully and where the tuberculous patient can live under the best circumstances pertaining to a cure.

CHAPTER XVIII.

CLIMATE AS A FACTOR IN THE TREATMENT OF TUBERCULOSIS.

Climate Always Important.

Climate is an important factor in both health and disease. Human beings are influenced very much by the climate in which they live. The northern races are hardier, not because of blood, but because of environment. The southern races are slower, and less energetic because climatic conditions make them so. The more rigorous climates of the north make greater demands upon the physiological processes of the body and consequently require a hardier race, while a less resistant race can live in the warmer areas of the earth. Not only heat and cold, but humidity, the amount of sunshine, winds and sudden changes are factors which affect the human race. Climatic conditions have much to do with spreading or checking the spread of infections.

Climate more Important to the Sick than to the Well.

It can readily be seen that a rigorous, changeable climate must necessarily make much greater demands upon an individual than a warm, equable climate. Since, when a patient is ill, all demands are apt to be exaggerated and harder to meet, it can also readily be seen that climatic conditions must have more or less influence in the treatment of disease.

No Specific Climate for Tuberculosis.

Formerly advice was given upon the subject of climate in the treatment of tuberculosis as though it had specific action. People were led to believe that if they could only get to the Rocky Mountains or the deserts of the Southwest or to California in America, or to the Alps or the Riviera in Europe that they would be cured. Patients were led to undertake long journeys regardless of their physical condition in the belief that it was necessary in order to be cured of their disease. Today, some physicians still foolishly advise patients far advanced in the disease to undertake long journeys in the search for health; yet, those who are treating the most cases of tuberculosis do not make any claim for there being anything specific to be derived from climatic treatment. This does not signify, however, that there is no benefit to be derived from climatic treatment, any more than the non-belief in there being any specific drug for tuberculosis signifies that no benefit can be derived from the careful use of drugs.

Good Use of Bad Climate Better than Bad Use of Good Climate.

While the most favorable climatic conditions are not necessary to the cure of tuberculosis, yet it stands to reason that if a patient can take advantage of a suitable climate, he will of necessity derive some benefit from it. Of course all are not able to take advantage of such changes. Both physical condition and pecuniary circumstances must be taken into account when a change is considered. It is useless to send a patient away from home and friends with the expectation of his deriving benefit from the change unless he has sufficient means to enable him to take care of himself properly. Patients who should not work at home should not work in health resorts, and this applies to all tuberculous patients; so, unless they have the means to support themselves comfortably at a health resort, where living is usually high, they will do best to remain at home.

It seems to me that climatic advantages in the treatment of tuberculosis may be well summed up in this statement: that is the best climate for the treatment of an individual patient (the climatic treatment the same as other forms of treatment being an individual matter) where he can have the most intelligent guidance, the most favorable surroundings and the best climatic conditions consistent with his pecuniary circumstances. This means that many patients of small means, to whom a change of climate would be a serious financial embarrassment, have better opportunities of cure by remaining under intelligent guidance at home than they would by stinting themselves and endeavoring to economize in a better climate. It means that the great mass of individuals suffering from tuberculosis are better off at home than they would be were they removed to some other more favored climate. And, yet, it also means, what many of our earnest advocates of home treatment are forgetting, that if an individual can take advantage of a favorable climate well suited to his resisting power and his disease, all things else being equal, he stands a much greater chance of regaining health.

If I were afflicted with tuberculosis, I would rather be treated in an intelligent manner in the most unfavorable climate than undertake to regain health alone in the best climate on earth. However, I believe my chances of cure would be materially increased, if, combined with intelligent treatment, favorable climatic conditions were also present.

Important Considerations in Choice of Climates.

Granting that a patient can advantageously seek suitable climatic conditions under which to be treated for tuberculosis, what considerations should determine the choice of such a climate? In the first place, if he be suffering from tuberculosis in the early stage, he has a wide range from which to choose. He would have good opportunities for cure in any favorable climate and doubtless could get well even in an unfavorable one. If, on the other hand, the disease be advanced, or if complications be present, these conditions must all be taken into consideration. Above all else, however, aside from the nature and extent of the disease and the complications present, the strength and reactive power of the patient must determine the final choice of the climate to be adopted.

Primary Effect of Climatic Treatment.

The primary effect of climatic treatment is upon metabolism. That climate is best suited to a given patient where tissue change is carried on to the best advantage. A robust individual will stand a rigorous climate while one with weakened constitution will find the demands made upon him by it to be too great for his good. Huggard, in his most excellent work on climatology (A Handbook of Climatic Treatment, London, 1906, page 461) says: "In regard to climate therapeutically, the most fundamental point is its effect on tissue change; and its action on tissue change depends on its heat abstracting powers. Now, the heat abstracting qualities depend, not on temperature alone, but on temperature in combination with the humidity of the air, relative and absolute, and the amount of wind."

A cold climate, then, with much wind makes the greatest demands upon the system for heat; a warm, humid climate with absence of wind should make the least. A dry, warm climate can not be equable because the air, containing little moisture, does not retain heat well, and as soon as the sun has ceased to shine the rapidly cooling air causes a feeling of cold. This accounts for the wide diurnal range in temperature which is noted wherever the air is dry, and gives the stimulating properties to warm dry climates. This makes the difference between a warm dry and a warm humid climate.

Climate must be Suited to the Reactive Powers of the Patient.

From these considerations it is patent that by the use of the various climatic conditions mentioned above we produce very different results. We can soothe, or we can produce various degrees of stimulation even to the point of irritation. It therefore behooves the physician who is prescribing climate for a tuberculous patient to exercise his judgment. He must take into consideration the physiological action of the climate which he is recommending and the power of the patient to meet the demands made upon him by such a climate. If a high altitude or a cold climate is being considered the patient must be in such a condition that he can respond to a demand for a high rate of tissue change. He should belong to the hardier type of man, with good circulatory, digestive and assimilative power. If he does not belong to this type, the proposed change is more apt to do harm than good. The most good can come from climatic change only by suiting the patient to the climate in such a manner that he may maintain his nutrition at the highest possible point. If a weakened patient be sent to a climate which makes extraordinary demands upon him, to meet the increased tissue waste, he will not do as well as he would in a less rigorous climate; for he is compelled to spend much energy in tissue repair that should be applied to fighting his disease. Where there is doubt, it is always best to choose a less stimulating climate.

Climatic Conditions of Nearby Places Differ.

The peculiarities of the individual location are very important, These are influenced by mountain ranges and canons, the direction of the prevailing wind currents, proximity to bodies of water, amount of sunshine, character of the soil, and many other factors. This should be understood by those who send patients away from home. Serious mistakes are often made by not understanding this fact. Patients are sent from the East to Southern California. They think the change so agreeable compared with the more rigorous climates from which they have come, that they consider any place is good enough for them; so they are apt to choose that place which suits their fancy and where they prefer to live, or where they think they can have the most pleasure. This takes many of them to the beaches, and it is not an uncommon spectacle to see tuberculous patients who left eastern homes in order to procure the benefits of the climate of Southern California, subjecting their forces of repair to the enormous strain which is produced by surf bathing. Oftentimes untold harm is done before the patient sees a physician and is advised to desist from this sport and move to the foothills.

Here in Southern California (I use this for illustration because I am acquainted with the facts, although the same holds good elsewhere) climate differs very materially often in so slight a distance as a few miles or even a fraction of a mile. In the foothills within thirty miles of the coast we have a moderately dry, fairly stimulating climate, while that nearer the coast is more humid and, owing to the strong sea breeze, demands greater resisting power on the part of the patient. Further inland, at a distance of seventy-five miles, it is much warmer in the daytime, the air is dryer and the winds much more stimulating, and often very trying on nervous patients. Like the mountain climate, the nights are always cool, giving the stimulating effect of the wide diurnal range, and even the heat of summer is very moderate, owing to the dryness of the air. The thermometer range usually varies with the distance from the ocean, and the humidity likewise; so, as we travel inland, the temperature increases and at the same time the humidity decreases, thus making even the hottest sections of the interior, such as Indio where a heat of 120 degrees is often experienced quite endurable, a fact scarcely conceivable to those who inhabit the eastern sections of our country where sunstrokes occur at a temperature under 100 degrees. In these hottest sections, sunstrokes are unknown.

The variety of climate within a short distance here in Southern California can be well illustrated by the fact that it is possible to take a cold plunge in the ocean in the morning, eat lunch in the foothills and take dinner on the top of the mountains at an elevation of 5000 feet.

While, perhaps, the differences here in Southern California may be greater than in most places within a like compass, yet the point I wish to make is that in order to make the best use of climate it must be prescribed with the same care as other remedies.

High Altitude Thought to Confer Immunity.

For many years it was thought that high altitude was essential to the cure of tuberculosis, and patients were sent to the high mountains regardless of their fitness for enduring the demands of such a change.

The popularity of high altitude was due largely to the writings of Dr. Archibald Smith (Practical Observations on the Diseases of Peru, Edinburgh Medical and Surgical Journal, 1840, Vol. LIV, pages 5–13) who brought the matter before the medical world in many widely read contributions. He stated that in the Peruvian Andes, immunity from tuberculosis was commonly observed at an elevation of between 7500 and 8500 feet. This same apparent immunity from tuberculosis was noticed by observers in the Alps and the Rocky Mountains. The natural conclusion was that it must be due to the altitude, for tuberculosis was rife in the cities of the lowlands quite near.

Immunity not Peculiar to Altitude.

Further observations, however, have shown that this immunity to tuberculosis is not peculiar to altitude, for the same immunity is enjoyed by other places. F. Parke Weber (A System of Physiological Therapeutics, Solis Cohen, Vol. IV) states, that in the Steppes of Tartary in the Russian and Chinese Empire there is almost no pulmonary tuberculosis. These Steppes vary from below sea-level to a considerable altitude. In the great deserts of the Southwestern portion of the United States, tuberculosis is unknown except as it has been brought in by strangers. It is a fact that in the American Desert the same as in the Steppes of Tartary those portions below sea-level enjoy the same freedom from tuberculosis as do the parts with greater elevation.

Not High Altitude but Certain Conditions Accompanying it Cause this Apparent Immunity.

These facts force us to the conclusion, then, that it is not the altitude but something that accompanies altitude that has afforded this seeming immunity. If we were to analyze briefly the points of similarity in the various regions, embracing as they do places of all degrees of altitude from several hundred feet below the sea-level to many thousands of feet elevation, we observe four things: first, they are all sparsely settled; second, they all have either a dry or moderately dry air; third, they all have an air comparatively free from bacterial life; and fourth, they have a great amount of sunshine.

These conditions are just the opposite from those which favor the spread of tuberculosis. Tuberculosis is a disease which thrives in thickly settled districts where an intimate association of the sick and well takes place, especially in overcrowded quarters. The danger is the greater the more favorable the conditions for the life of bacilli after they have been thrown out into the atmosphere. Thus, moisture and warmth with lack of sunshine favor the preservation of bacteria, while dry air, either warm or cold, with an abundance of sunshine tends to their destruction. We believe, then, that these are the factors which make certain climates apparently immune to tuberculosis, and not the fact of their elevation above or below sea-level.

It is fortunate that these favorable conditions may be found at all altitudes, for it gives us a greater opportunity for suiting climatic conditions to the individual needs of the patient. If high altitudes were an essential in the treatment of tuberculosis, its advantages would necessarily be denied to many, because there is a great majority of tuberculous patients who are absolutely unfit for life at high altitude, and can not live there without doing themselves harm; and there is even a much greater number who can be treated to much better advantage in medium and low altitudes than in higher altitudes.

Sunlight Important in the Treatment of Tuberculosis.

It has long been observed that sunlight has a very important influence on the physiological activity of both plant and animal life. The lower forms of organisms, the bacteria, are quickly killed by it. Thus the bacterial content of the air of those localities where there is a great amount of sunshine is much lower than where there is less sunshine. Not only sunshine but diffused light, which is indirect sunshine, will also destroy bacteria, but it requires a longer time. In as much as tuberculosis is a bacterial disease, and in as much as there is always associated with the tubercle bacillus many other bacteria which have a very deleterious effect on the patient, the beneficial effect of light, and especially of direct sunlight, can readily be understood as a means of destroying bacteria, preventing re-infection with tubercle bacilli and secondary infection with other micro-organisms. There is no doubt but that much benefit to the tuberculous is derived from this antibacterial action of sunlight in those regions of the earth where a maximum of sunshine abounds, and this condition is a very important one in choosing a climate for the treatment of this disease.

The effect of light on higher life, including man, is that of a quickening of all the vital processes. The blood is enriched, cell activity is stimulated and the function of the various organs is improved. Blood absorbs light to a very high degree, as was demonstrated by Finsen who directed a blue pencil of light on to the ear after placing a piece of sensitized paper behind it. After five minutes no change on the paper was noted. The ear was then compressed between two glass plates driving the blood out of it, and penetration was almost immediate. Quincke (Pflueger's Archives, 1894, Vol. LVII, page 134) has shown that hemoglobin gives off its oxygen more quickly in light than in the dark, hence light increases the processes of oxidation in the body. Marti (Vehr. d. Congr. f. innere. Med., 1897) by means of experiments on rats showed that deprivation of light lessens the number of red corpuscles and also, though to less extent, the amount of hemoglobin, while strong, continuous light increases both the erythrocytes and the hemoglobin.

Aside from these direct effects the cheering, buoyant effect of sunshine is very marked and counts much in favor of the patient by keeping him content and happy, and inviting him to live an outdoor life. Therefore, we must conclude that sunlight is an important element in a climate suited to the treatment of tuberculosis.

Relative Merits of High and Low Altitudes in Tuberculosis.

It must be borne in mind, when choosing a plaçe with a suitable climate for a patient who wishes to recover from tuberculosis, that he must necessarily make this place his home for several months; and, if his disease is advanced, he must extend his stay to many months. Consequently we must look well before we advise.

Mountain climates at high altitude are stimulating. The call for tissue change is enormous, and must be met by a strong organism. A patient who is suitable for high altitude treatment should be naturally strong, should have an abundance of red corpuscles to meet the conditions necessary for tissue change, should have a strong heart, a respiratory system not too much impaired, and should possess a well-balanced nervous system. On the other hand, patients who are naturally weak or who are weakened by disease, who have a deficiency of blood, weak hearts, severely impaired lungs and unstable nervous systems, are not suitable for high altitude treatment. The young and strong are better suited to high altitude treatment, than those in the declining years of life. The latter should be treated at low altitude.

As a rule, when the relative merits of high and low altitude are discussed, high altitude is compared with thickly populated areas at low altitude where the humidity is great, instead of areas where similar conditions except as to elevation obtain. This comparison is unfair and gives a false impression.

If we compare the effects of high altitude such as we find it in the Rocky Mountains and the Alps, with low dry altitudes such as we find in the deserts and foothills of the great Southwest, including parts of California, Nevada, Arizona, New Mexico and Texas, the comparison is about as follows:

High Altitude.	Low Altitude.
1. Sparse population.	1. Sparse population.
2. Pure air relatively free from bacterial contamination.	2. Pure air relatively free from bacterial contamination.
3. Great amount of sunshine.	3. Maximum amount of sunshine.
4. Wind usually strong and cold, especially in winter.	4. Wind usually gentle.
5. Temperature cold in winter, delightful in summer, with change of seasons; nights cool.	5. Temperature bracing in winter, warm days in summer; nights cool.
6. Great demand for tissue change.	6. Moderate demand for tissue change.
7. Atmospheric pressure low, calling for increased respiratory and cardiac activity.	7. Atmospheric pressure high, calling for no extra respiratory and cardiac activity.
8. Increase in red corpuscles—may be either physiological to meet decrease of oxygen in air and increased tissue change or due to increased sunlight and other stimulating agencies. Whatever the cause may be it would seem to be of no material advantage and unnecessary to the individual, except while living at high altitude, for the corpuscles return to normal soon after returning to low altitude again.	8. Increase of red corpuscles also noted, probably due to sunlight and other agencies which improve general tone.

From this comparison it will be seen that high altitude has a very stimulating climate and a rarefied atmosphere, which does not pertain to the lower level, but, in as much as it calls for an enormous tissue change, patients who go there must have strong constitutions and well functionating organs; and, in as much as the rarefied atmosphere calls for extra work upon the part of the heart and lungs, it is questionable whether or not it is the best place for patients with diseased lungs.

The following arguments are relevant to the discussion on the relative merits of high and low altitude in the treatment of tuberculosis.

High Altitude Treatment Contrary to the Principle of Rest in Inflammations.

1. Rest is an important factor in the healing of inflammations. This is a well-recognized principle of treatment in all other forms of tuberculosis. When the joints or bones are affected, movements are absolutely prohibited. The accepted treatment of these conditions is immobilization, and for this purpose plaster casts are used. The lungs unfortunately are organs that can not be spared. They must carry on their function of aerating the blood. Every minute from sixteen to twenty respiratory excursions must be made even at low altitude. At high altitude, at first, both the depth and frequency of respirations are increased, the former remaining permanently so. Also the number of heart beats per minute is increased. This is made necessary on account of the decreased amount of oxygen. The effect of

high altitude upon the pulse, respiration and vital capacity is shown in the following table (Huggard, Climatology, page 111):

INFLUENCE OF NORMAL AND OF DIMINISHED ATMOSPHERIC PRESSURE ON VON VIVENOT AND FELLOW-WORKERS.

Name of Subject.	Vital Capacity.		Respiration.		Pulse.	
	In Normal Air.	In Air at 434 mm. Pressure. (=4470 meters above sea-level.)	In Normal Air.	In Air at 434 mm. Pressure.	In Normal Air.	In Air at 434 mm. Pressure.
	ccm.	ccm.				
Lange	3942	3448 (494)	15	21	73	82
Mittermaier	4237	3843 (394)	7.5	9.5	78	80
M. de G.	....	......	17	21	61	75
Von Vivenot	....	......	14 or 15	18	80	105

Thus we see that instead of following the customary and accepted plan of treating inflammations in general, and tuberculosis of other organs in particular, we are making an exception in this case and increasing the exercise of the diseased lungs when we treat them by high altitude. Not only is this increased work thrown upon the lungs, but the heart which is already overburdened in tuberculosis is subjected to an extra strain. Unless there are factors in altitude *per se* which overbalance the harm that may be done in this way, factors which can not be obtained in lower levels, we must conclude that high altitude treatment is not indicated, in fact, is contraindicated in the treatment of tuberculosis.

Parts Adjacent to Heart Heal Slowly.

2. The effect of increased movement upon the diseased lungs is shown by the slowness of healing in those parts of the lungs, especially of the left, which lie adjacent to and are kept in constant motion by the action of the heart.

I have found that tuberculous infiltrations of the left lung lying adjacent to the heart are very slow in healing, and, if the lower portions of the lung are involved anteriorly I consider the chances of cure much better when the involvement is on the right side.

This observation, if it is correct—and I feel sure that I have made it in too many instances to account for it as a coincidence or accident—speaks in terms which are unmistakable in favor of rest as against exercise for the infiltrated lung.

Tuberculosis Common in Athletes.

3. According to my experience tuberculosis is extraordinarily common among athletes. We are somewhat at a loss to know how to explain this unless it is due to an overdevelopment followed by a retrograde process with a resultant lowered resistance.

Athletes have an overdeveloped muscular system. The heart muscle is firmer and larger than normal, and the lungs are increased in size. The entire organism is tuned to an abnormal condition, to endure more than ordinary strain. Not satisfied with being able to do as much as the normal man, the athlete subjects himself to more or less of a constant overstrain. His respiratory and circulatory systems arise to the occasion for a time and meet the extra demand; but they do it to their own detriment.

When he leaves his training, and settles down to the usual habits of life, he often finds himself incapacitated. He has heart, lungs, and muscular system suited to great exertion and he does not need them. The result is a retrograde process. The muscles become flabby, the heart likewise, and the lungs which have been overdeveloped in order to meet the greater demands of oxidation, must also share in this retrogression. The result is an injury to the tissues and a lowered resistance.

Unless this observation be wrong and this explanation improbable, it points to the fact that it is better for a patient to be treated at low altitude, at least, if he expects to live at low altitude after recovery, since the effect of high altitude is to throw more work upon the heart and lungs, thus causing an increased development on their part if they are able to respond to the demand. In coming from a high to a low altitude, there must be a readjustment on the part of the organs of respiration and circulation to meet the changed conditions. This is accompanied by a retrograde process, during which time the patient is more liable to relapse than if he had remained at the high altitude.

High Altitude Calls for Strong Reactive Powers.

4. The next observation which I would make, bearing upon high altitude treatment is that, owing to increased tissue change, an extra demand is made upon the organism; and, unless the patient can meet this, he will suffer harm rather than obtain good. A strong constitution, with good circulatory, digestive, muscular and nervous systems, and with good blood, as mentioned before, is necessary for the best results in high altitude treatment. Then, too, young people are better suited to it than older ones. Thus it can be seen that the benefits of high altitude are precluded from most of the great mass of tuberculous patients as we find them. The effect of high altitude on the heart is to increase the number of its beats per minute. When a healthy individual becomes acclimated to high altitude the pulse-rate during rest, becomes practically identical with the pulse-rate at sea-level; upon exertion, however, its rate is increased beyond proportion. The following data is taken from

Name.	Pulse. Zermatt. Rest.	Pulse. Breithorn. Rest.	Pulse. Breithorn. Motion.	Vital Capacity. Zermatt.	Vital Capacity. Breithorn.	Observations.
Interbinnen, 10 years old.	84	120	132	1200	1250	Neither dyspnea nor palpitation, 4.30 p. m.
Frau Sahli, 20 + years old.	96	106	140	2650	2510	Slight dyspnea, palpitation, slight cyanosis.
Frau Kronecker, 30 + years old.	85	100	136	2500	2550	Standing on plateau, pulse 112, after 20 steps, pulse 136.
Professor Sahli, 40 + years old.	94	106	144	3500	2750	Palpitation, dyspnea, slight cardiac murmur, lying on Breithorn, p. 100.
Professor Kronecker, 50 + years old.	64	80	120	2625	2200	When walking, palpitation and dyspnea, slight palpitation after 35 strokes of axe at intervals of one second, p. 108.
Pern (peasant in Zermatt), 73 years old, not a climber.	70	80	120	1900	1500	Standing, p. 100, after 70 strokes with pick, p. 120, some dyspnea, palpitation after 20 steps upward.
Herr Asher, 30 + years old.	74	112	120	2340	1960	In Zermatt after 2 decilitres of Dôle, p. 84.
Herr Bartel (attendant in Physiological Institute, Berne).	94	120	160	3800	3250	Mountain sickness, dizziness, no palpitation, can photograph with difficulty.
Guide Pern, 30 years old.	..	100	140	....	....	Slight palpitation and dyspnea after 20 steps.
Guide Kronick, 37 years old.	..	108	120	....	....	After 20 steps transient dyspnea.
Carrie Pinder, 24 years old.	..	108	140	....	....	After 20 steps palpitation, but no dyspnea.

a table arranged by Huggard (Handbook of Climatic Treatment, 1906). It shows the result of altitude upon the heart, during both rest and exercise. These observations were taken by Prof. Kronecker of Berne in 1894. Observations were first taken at Zermatt at an elevation of 1600 meters. Then the party was taken to Breithorn at an elevation of 3750 meters. In order to eliminate the factors of exertion and fatigue some members of the party were carried.

These observations lead me to the following conclusions: first, high altitude treatment of tuberculosis is in direct antagonism with the well-founded and generally accepted principle of rest in tuberculosis; second, patients who are treated at a high altitude are at a disadvantage if they undertake to live at a low altitude afterwards; third, high altitude makes such great demands upon the system owing to increased tissue change that many tuberculous patients are unable to meet the requirements.

Wherein Lies the Value of Climatic Treatment?

Wherein lies the value of climatic treatment? To answer this question we must keep several factors in mind. In discussing the effects of open-air treatment, I showed that we can accomplish two things by putting our patients in the open air, first, increase the state of nutrition, and second, supply the organism with air relatively free from bacteria.

Now if these are the effects of open-air treatment, we can readily see that a climate, which is properly suited to the individual, possessing dry air with low bacterial content, must have a distinct advantage over one possessing damp air with high bacterial content, which at best is only to be endured but not recommended. The effect of dry air with a maximum of sunshine seems to be very beneficial in cases of mixed infection, both as a curative and as a prophylactic. This also exerts a favorable influence on tuberculous patients with severe bronchitis and profuse expectoration. In climates with a variable humidity, if several dry days follow in succession, there is always a marked decrease in the amount of expectoration. The explanation of this is very simple. When air is exhaled it is saturated with moisture. If it is saturated when inhaled, of course, it can not carry off as much moisture from the lungs as it could if its humidity were low. The dryer the air the greater the amount of moisture required from the air passages to saturate it.

Humid climates, as a rule are more or less unsatisfactory in the treatment of tuberculosis. If they are cold and humid, they are as a rule variable and productive of catarrhal conditions. If they are warm and humid, they are enervating and the patient suffers from digestive and assimilative disturbances. If they are cold and dry they are too rigorous for any but the strongest.

It would seem then that the best climate for tuberculous patients is one with air relatively dry, of low bacterial content, with plenty of sunshine and with the elements of temperature, variability, wind and altitude suited to the individual patient, which invites him to spend the greater portion of his time in the open air without discomfort.

Ozone was formerly thought to be an important factor in climate for the treatment of tuberculosis. The air of the mountains, that of the sea, and air in the neighborhood of pine forests was thought to have especially beneficial qualities. We now know that ozone can be entirely disregarded in choosing a climate, as it has no specific effect.

While neither climatic change nor favorable climatic conditions are essentials in the treatment of tuberculosis, yet they are factors of great importance, for if they had no other effect it can not be gainsaid that a well-suited, favorable climate renders the adoption of the open-air treatment of tuberculosis much easier, and in this very important way adds its mite to the cure of the disease.

CHAPTER XIX.

THE COMPLICATIONS OF PULMONARY TUBERCULOSIS AND THEIR TREATMENT.

TUBERCULOUS LARYNGITIS.

Frequency. The importance of tuberculosis of the larynx can be best appreciated after a careful study of the larynx in patients suffering from advanced tuberculosis or after making careful post-mortem examinations of this organ in tuberculous subjects. Such a course will show that this complication is present in more than 50 per cent of cases; and, according to some observers, even in as many as 60 or 70 per cent ("The Treatment of Tuberculous Laryngitis with Culture Products, with Observations upon the Action of Specific Inoculations in the Treatment of Tuberculosis." American Journal of the Medical Sciences. December, 1906).

Diagnosis. Since this complication is so common, it behooves those who are treating tuberculosis to make routine examinations of the throat. This is especially important since early tuberculous laryngitis offers excellent chances of cure while the far advanced disease is, as a rule, hopeless.

Tuberculous laryngitis begins as an infiltration which may remain as such for months and months or which may soon break down and form an ulcer. At first there are few if any symptoms recognizable. While under ordinary circumstances, if these infiltrations were to appear in a larynx which was previously healthy, they would perhaps cause an uneasiness or a feeling of fullness; yet, when they appear in a larynx which is constantly irritated by coughing, as is usually the case in tuberculosis, any symptoms of this character might be unnoticed. Sometimes an irritation or feeling of fullness is noticed; sometimes a slight hoarseness is observed; sometimes the voice tires more readily than common; and at other times shooting pains are present.

The diagnosis, however, must rest on a careful examination of the larynx. Its accuracy will depend on the experience of the observer. The physician who frequently sees these cases will rarely be mistaken. The disease is perhaps always secondary to tuberculosis elsewhere in the body and rarely occurs unless the lungs are affected. While it must be borne in mind that a tuberculous patient is subject to all forms of non-tuberculous throat trouble, yet repeated examinations by a laryngologist who is accustomed to examine throats of tuberculous patients, will rarely fail to differentiate tuberculous from non-tuberculous involvements.

Any portion of the larynx may be the seat of tuberculosis; the cords, the interarytenoid space, the arytenoids themselves, the ventricles or the epiglottis. The appearance of these early lesions is that of a slight thickening of the mucous membrane with very often a velvety appearance. We should no more require the presence of tumefactions or ulcerations in order to make a diagnosis of tuberculous laryngitis than we would require cavities and other advanced signs to diagnose pulmonary tuberculosis. Early diagnosis is as important here as it is in tuberculosis of the pulmonary form.

When there is doubt as to the nature of the laryngeal lesion, the matter may be easily settled by the tuberculin test.

Prognosis. The prognosis in tuberculous laryngitis depends very much upon the earliness of diagnosis and the methods of treatment employed. The prognosis depends very much upon whether or not tuberculin is intelligently used in treatment. Where it is so used the prognosis does not differ far from the prognosis in pulmonary tuberculosis when an equally early diagnosis has been made. A very large per cent of early cases and even a fair per cent of those which are far advanced, including some with ulceration, can get well. In my own experience, out of 42 cases of tuberculous laryngitis found in patients who remained at the sanatorium for more than two months, 30, or 71.4 per cent were apparently cured.

Treatment. The treatment of tuberculous laryngitis corresponds in principle to that of tuberculosis elsewhere in the body.

Rest is a very important measure. The use of the larynx should be limited. The patient should not be allowed to do any unnecessary talking, and where it causes irritation, it is better that he converse in a whisper. No singing or shouting or straining of the voice of any kind should be indulged in. A cold compress, as described in Chapter XIV, applied to the throat is of great benefit in the treatment of this complication. It relieves the cough somewhat and makes the throat feel more comfortable.

Local applications to the upper air passages are valuable in proportion to their power of reducing catarrhal conditions and relieving cough. It is well to give close attention to nasal respiration. While I would have some hesitancy in operating upon a patient while he was expectorating bacilli, yet I would advise palliative measures, to keep nasal respiration free and easy; for mouth-breathing is injurious to the larynx. Slightly stimulating applications, such as protargol 5 to 10 per cent made to the larynx after it has been cleansed with an alkaline spray seems to be about as valuable as any measure that I have found. This should be followed by some protective oily spray which may contain such ingredients as menthol, or eucalyptus. When ulcerations are present, especially if they are painful, they may be dusted with orthoform used in a powder blower. When cough is an aggravating factor, one-twelfth grain of heroin added to the orthoform acts well.

I have never found it necessary to use lactic acid or any other harsh measure in the treatment of this affection. Mild and gentle measures have proven eminently satisfactory to both the patient and myself.

Focusing the sun's rays upon the parts by means of two mirrors after the plan of Sorgo (Ueber die Behandlung der Kehlkopftuberkulose mit Sonnenlicht nebst einem Vorschlag zür Behandlung derselben mit kunstlichen Lichte, Wien. klin. Woch., 1905, vol. XVIII, No. 4) or using the violet rays, seems to aid healing perhaps by causing a hyperemia of the part and thus bringing more defensive bodies in contact with the bacilli.

The most important remedy in the treatment of this complication is tuberculin. The action of the remedy can be accurately controlled by the local reaction produced in the larynx. The dosage should be governed entirely by the local findings. That amount of tuberculin should be administered which is necessary to cause a slight stimulation of the local process. This will show as a slight hyperemia. When this has been produced, the dose should not be repeated until the hyperemia has disappeared, nor should it be increased until this amount fails to produce reaction. Where the larynx is affected it should always be made the index for dosage.

The effect of tuberculin here is the same as elsewhere (see Chapter XV). It increases the amount of protective substances found in the blood through its stimulation of the physiological machinery of immunization. Its stimulating effect also causes a local congestion about the tuberculous foci and thus hastens healing by bringing the protective bodies of the blood to bear upon the tubercle bacilli in greater amounts than is usual in these conditions. This same action has a tendency to prevent the bacilli from spreading to new foci.

By these simple means of treatment tuberculous laryngitis may be removed from the list of fatal diseases and placed among the more hopeful.

TUBERCULOSIS OF THE INTESTINES.

Frequency. Tuberculosis of the intestines is much more common than is generally supposed. In 1226 cases (Schroeder und Blumenfeld, Therapie der Lungenschwindsucht, page 721) Heinze found tubercular ulcerations 630 times. Fenwick and Dodwell found the intestines involved 500 times in 883 sections made on persons dying of tuberculosis, and Eisenhart found intestinal involvement 566 times in sections on 1000 tuberculous subjects. Baumgarten even goes so far as to say that practically every individual suffering from advanced tuberculosis has some involvement of the intestinal tract. Whether we accept Baumgarten's opinion or not we must recognize the fact that tuberculosis of the intestinal tract is very common in individuals suffering from advanced tuberculosis, and we should bear this in mind in dealing with the intestinal symptoms of these cases.

Site of Ulceration. Ulcerations may be found in various parts of the alimentary canal, but they occur most commonly in the lower part of the ileum, about the head of the cecum and in the lower part of the colon and rectum.

Symptoms. The symptoms vary according to the extent and according to the seat of the focus. Nothnagel has pointed out that where the disease is confined to the region of the cecum, diarrhea may not be a troublesome symptom at all, but when the lower part of the colon and the rectum are involved, diarrhea is usually very marked. Oftentimes constipation is troublesome and again we have an alternation of diarrhea and constipation. Sometimes the lumen of the bowel is almost entirely occluded either through cicatricial contraction or through pressure from tuberculous masses in the peritoneum. The stools are often clay colored, and quite often of a very offensive odor. They may occasionally contain blood. This would not be expected to be of a bright color, however, unless the lesions were near the rectum. Pus will also be found occasionally and is a sure sign of ulceration.

Pain is not always present, but where the ulceration is extensive and the peritoneum involved then it is a common symptom. It may show as colicky pains when the bowels move or may only be elicited upon pressure.

Diagnosis. The diagnosis is not easy to make if we depend upon symptoms alone; and, in as much as the process is nearly always secondary to tuberculosis elsewhere in the body, the tuberculin test is not of great value unless it shows by the local reaction, causing pain and perhaps an increase in diarrhea, as I have seen in some instances. I am inclined to believe that tuberculosis of the intestines causes a depression in temperature which manifests itself by the morning measurement being unusually low.

It has been my observation that, when one suffering from tuberculosis begins to have two or three mushy stools a day, part of them coming at night, the cause is most likely of tuberculous origin.

The finding of bacilli in the stools is important, but it is very difficult to be sure whether or not they are from sputum which has been swallowed, yet we are justified in believing that if bacilli are frequently found in the feces of an intelligent patient, that they are most likely from foci in the intestinal tract. When the feces are to be examined the patient should be required to use special precautions against the swallowing of sputum.

Strassburger (Muench. med. Wochenschrift, No. 16, 1900) gives the following method of examining the stools for bacilli: "A small particle of fecal material is rubbed up with water and centrifugated for a very short time, in order to throw down the gross particles. The bacilli for the most part remain suspended in the fluid. The fluid is poured off and diluted with twice its volume of 96 per cent alcohol, which lowers the specific gravity to such an extent that the separation of the bacilli by further centrifugation is made quite easy. The sediment is stained in the usual way and examined for bacilli." Page (I. Diss. Heidelberg, 1902, p. 47) recommends the addition of equal parts of absolute alcohol and ether and reducing the specific gravity of the liquid to 0.7702 at 25 degrees Centigrade.

Treatment. When a diagnosis of intestinal tuberculosis has been made or when the diagnosis has not been definitely made but the condition has been suspected, it is well to look very carefully after the condition of the digestive tract. It is very important to keep the patient well nourished and at the same time to keep the bowels regular and to shield the intestinal wall as much as possible from irritation. To this end both constipation and diarrhea must be combated.

When constipation is present it should be combated by a suitable diet. It is preferable to combat this with fruits and fats rather than by coarse foods which have irritating particles that may injure the diseased mucous membrane.

Oil enemas are often of great value, and when persisted in will sometimes relieve most obstinate constipation. For this purpose, one to three ounces of olive oil may be injected high up into the colon at night, by means of a syringe and soft rubber catheter. This should be retained until the following morning, when, as a rule, an easy movement of the bowels will occur.

If laxatives are used they should be carefully chosen and employed with caution. They should not be too severe in their action, lest they might cause severe irritation and start up a stubborn diarrhea. Cascara sagrada answers the purpose very well.

When the patient is suffering from tubercular diarrhea, every care must be exerted to relieve him as soon as possible, remembering that nutrition must be maintained if a successful issue is to be had. The patient should be put to bed. The intestinal tract should be freed from all irritating particles. This is best done by a moderate dose of castor oil (one-half to three-fourths of an ounce) or magnesium sulphate (one-half ounce). The patient should at once be put upon a restricted, non-irritating diet, consisting at first perhaps of milk and lime water only, two parts of the former to one of the latter. It is rarely necessary to continue milk alone for more than twenty-four hours. Then milk toast, boiled rice, and the whites of eggs may be added, and later scraped meat, soft-boiled and poached eggs, tropon, mashed and baked potatoes may be cautiously tried. The diet should only be increased as the intestinal tract becomes tolerant. It will be necessary in many cases to eliminate fruits, fats, coarse vegetables and all laxative foods for some time.

If, after the administration of the initial dose of oil or magnesium, the bowels continue to be loose, I have obtained good results from a teaspoonful of a saturated solution of magnesium sulphate given in two ounces of water before breakfast or small doses (one dram) of caster oil taken at bed time.

At the same time I often administer bismuth subnitrate alone, or if necessary, in combination with deodorized tincture of opium (twenty grains to one dram of the former and five to ten drops of the latter) after every movement of the bowels.

When the diarrhea is intractable I use either very large doses of bismuth (one to two drams with opium as above every two to four hours) or the lead and opium pill or a mixture consisting of dilute acetic acid, ♏x, morphia, gr. i$\frac{1}{8}$–$\frac{1}{6}$ and acetate of lead, gr. i–ii.

It is also well to irrigate the colon with a warm normal salt solution or, as s recommended by Reed, an antiseptic solution such as carbolic acid (one part) and glycerine (eight parts) of which one dram may be used to one quart of water. Of this solution, one or two quarts may be injected every second day, normal salt solution being used on the alternate day. Cloths wrung out of hot water should be applied to the abdomen daily for a period of one or two hours. These should be changed every 20 minutes and should be well covered, preferably with flannel cloths, in order to retain the heat as long as possible.

Tuberculin and allied products should be used. I have seen two cases of well-marked tubercular involvement of the intestine apparently heal and a number of others improve under the combined hygienic, symptomatic and tuberculin treatment. We should not pronounce doom upon any one who shows symptoms of intestinal involvement, but we should do what we can to cure him, remembering that the post-mortem records show evidences of spontaneous healing, and our own experience with the cure of advanced cases of tuberculosis proves that they can sometimes be cured.

Where stenosis of the intestinal tract occurs, surgery must be resorted to. If the general condition of the patient is satisfactory, the results are somewhat encouraging. Cornet (Die Tuberkulose, Zweite Auflege, 1907) quotes statistics from Hofmeister who secured healing in 34 of 50 patients where he made a total resection on account of tuberculosis in the ileo-cecal region. Kocher was successful in 16 out of 18 patients operated upon and Körte was successful in all of 11 cases.

FISTULA IN ANO.

A small percentage of tuberculous patients suffer from fistula and I feel that a word about treatment should be said. When a patient with fistula presents himself, the physician or surgeon, before advising operation, would do well to examine the lungs of his patient. If tuberculosis is present, especially in an active form, and it frequently is, I would recommend that the effect of the operation upon the patient be considered carefully before it is advised. I have seen a number of patients whose decline in strength, accompanied by an advance in the tuberculous process in the lungs, dated from such an operation; and in quite a percentage of the cases, the result of the operation was not satisfactory. Unless the symptoms are such that an immediate operation is necessary, I believe that it is wise to let operation alone as long as possible.

I have seen many of these fistulas heal without any treatment whatever except local cleanliness, during a course of combined hygienic-open-air and tuberculin treatment.

TUBERCULOSIS OF THE LYMPHATIC GLANDS.

Frequency of Glandular Involvement.

The frequency of tuberculosis of the lymphatic glands is not generally realized. It is probable that a large majority of children have tuberculosis of the lymph glands, and it is further probable that these glandular foci are often the source whence come the bacilli which cause infection in other organs in later years.

From a careful study of this subject made by the author, see Appendix, Chapter I (A Study of Tuberculous Infection, New York Medical Journal, March 12, 1903), the following conclusions based upon statistics from a great number of observers have been taken:

1. Nearly all children show enlarged glands.

2. About three-fourths of the children who have chronically enlarged glands react to tuberculin and about three-fourths of such glands removed and subjected to microscopical examination prove to be tuberculous.

3. Practically all children who die of tuberculosis have enlarged glands, and the process in them seems to be far advanced, warranting the conclusion that they might have been the earliest foci of infection.

When we add to this the fact that a very large percentage of adults who suffer from tuberculosis show enlargement of the glands we are warranted in the statement that the glandular system is very commonly affected by tuberculosis.

Treatment of Tuberculous Glands in Children.

What should be our attitude toward these tuberculous glands in early life? Should we consider them serious and take steps toward their cure at this time or should we wait for further development of the disease? This is a very important question and one which can not be brushed aside by a simple answer. Probably we have not yet advanced sufficiently to demand that all children or all individuals who have enlarged glands wherein there is a suspicion of a tuberculous cause, should be subjected to the tuberculin test, yet I believe such a course is rational and demanded by common sense. Is it not just as important to treat tuberculosis when it affects the glands as when it affects other organs? It seems to me that the inference is warranted that the lymph glands are probably in nearly all instances the first seat of tuberculous infection. The germs are carried to the glands and there strained out of the circulating lymph. From this focus other areas in the body are infected. This would be an ideal seat of infection for treatment, owing to the fact that the foci are constantly bathed with lymph which renders it easy to bring the protective bodies in direct contact with the bacilli. Many clinicians (among them the writer) have shown that tuberculous glands can be healed by the use of tuberculin, so why wait for the disease to spread to other organs? It is possible that by diagnosing tuberculosis of the lymph glands and treating it intelligently we might prevent much of the disease of the pulmonary form.

Glands the Seat of Softening.

That form of tuberculosis of the glands which has received most attention is the form where they become acutely inflamed, enlarge, soften and show signs of suppuration. The best treatment for these is prophylactic. Treatment of these glands should be instituted as soon as they are found. With reference to glandular involvements we are disregarding early diagnosis and treating only consumption.

Treatment of Suppurating Glands.

After suppuration has shown itself in one or more of a chain of glands the usual method of treatment consists in surgical removal of as many of the enlarged glands as can be dissected out. This measure while often successful is very unsatisfactory, for it leaves the patient with other glands which are likewise diseased, and offers no assurance that these will not soon be in the same condition as the ones removed.

What I believe to be a much better method is to treat these patients the same as we would treat those suffering from tuberculosis elsewhere. I mean by this, to endeavor to bring about an immunity to the bacillus and its toxins, by the use of those measures which build up the nutrition of the organism and by the specific inoculation of tubercle vaccines. The advantage of this method is that the treatment is being directed not to one or two or a half dozen glands that may be involved but to all the tuberculous glands and all other foci of infection that may be found in the body of the host.

By this method of treating tuberculosis of the lymph glands I have never had a single case among my tuberculous patients where the glands softened and necessitated removal, although in many instances the glands were large and, in several instances, they were tender at the beginning of treatment. I have also treated several cases of enlarged, tender, tuberculous glands when the lungs were not affected, with the same uniformly favorable result. Wright (Medico-Chirurgical Transactions, Vol. 89) reports excellent results even in cases where suppuration has occurred. So confident is he of the value of the immunizing treatment, that he says: "Next, perhaps, to tubercular ulceration of the subcutaneous tissue, tubercular affections of the lymphatic glands furnish the clearest evidence of the efficacy of therapeutic inoculation of tubercle vaccine. This result, as reflection will show, is in accordance with what might have been expected *apriori* in view of the fact that the tubercle bacilli are here disposed right in the path of the lymph stream, which is passing through the gland to the blood. I do not myself doubt from what I have seen of the effect of inoculation on tuberculous glands that the extirpation of these by surgical methods as well as the purely climatic treatment of this affection are destined to give place to the therapeutic exploitation of tuberculin inoculations controlled by the determination of the opsonic index, and combined with hot sand poultices and rubefacients, or other measures which, like these, will produce an ampler lymph-flow in the whole territory—or may I call it 'watershed' or 'collecting basin'—whose lymph passes into the blood through the conduit of the infected gland."

From my personal experience I do not hesitate to say that tuberculosis of the lymph glands before softening has occurred is amenable to tuberculin treatment, and from Wright's experience we are warranted in the conclusion that even after softening has occurred, it is still a medical and not a surgical disease.

The time of treatment by inoculations is of course longer than that by surgical methods, but this is compensated for by the fact that, in operating, only those glands which have been removed have been treated, while by the inoculation method all the infected glands in the body have been treated and, if a favorable result has been attained, the possibility of a future extension of the disease has been largely removed.

PLEURISY.

Frequency. When we consider the intimate relationship of the pleura with the lung, we can not conceive of a patient suffering from pulmonary tuberculosis unless it is a lesion more or less central in its location without an accompanying pleurisy. Post-mortem records bear this out, for it is very seldom that a section is made upon a person who has been afflicted with pulmonary tuberculosis without finding evidence of pleural inflammation.

Varieties. These pleurisies show several varities. They may be dry inflammations, the surface being covered with plastic lymph; they may be accompanied by an exudate of serum or pus, or there may be a progressive obliteration of the pleural cavity due to adhesion of the two pleural surfaces.

Pleurisy does not always show itself at the principal focus of the infection. It is not at all uncommon to find the infiltration at the apex and the pleurisy at the base or the main infiltration in one lung and the pleurisy in the other. Serous pleurisy may be caused by an apical lesion, the fluid being poured out and gravitating to the lowest part. In instances where an effusion comes on without any previous warning, it may be due to a latent tubercular focus at the apex.

Symptoms. Dry pleurisies are the most common in tuberculosis. They usually manifest themselves by a sharp cutting pain on inspiration and cough and when severe may cause shortness of breath owing to nature's attempt at shielding the patient from the pain caused by the increased movement necessitated by deeper inspirations.

When the attack is of slight severity only, there may be no constitutional symptoms recognizable, but when more severe there is an elevation of temperature; it may be to 100 degrees or even 102 degrees Fahrenheit, with some indisposition and loss of appetite. It will be remembered, as mentioned on page 54 that pleurisy is one of the causes of continuous temperature in pulmonary tuberculosis.

Dry pleurisy is often treated for intercostal neuralgia. A point of some value in differentiation is the greater mobility of the lung in the latter, as described on page 71. Of course when the pleural rub is heard the diagnosis is plain.

Pleurisy with effusion usually begins with pain; this diminishes as the effusion takes place and may return after absorption has occurred. A rise of temperature is nearly always present, which in severe cases may reach 104 degrees Fahrenheit. The pulse becomes rapid. A chill is sometimes experienced at the outset. With effusion the constitutional symptoms are more severe. The patient feels tired, and in severe cases weak and ill. He loses his appetite and may suffer from constipation and headache. As the effusion increases in amount, shortness of breath comes on, due to compression of the lung.

On physical examination, if the effusion is small, it may be easily overlooked. If it is large, the intercostal spaces appear widened and bulging. On examination the vocal fremitus is decreased, the percussion note is dull or flat according to the amount of fluid. If the lung tissue is much compressed the note over it may be hyperresonant or even tympanitic according to the amount of relaxation present. The heart is usually displaced toward the side free from effusion. This can not be taken as a diagnostic sign, however, because as described on page 88 the heart suffers more or less displacement in tuberculous patients where contractions have occurred. On auscultation at the commencement of the attack, the pleural rub may be elicited, but this disappears and as the effusion is poured out the breath sounds grow more and more indistinct.

The diagnosis of pleural effusion is sometimes quite difficult when the underlying lung is the seat of infiltration, because then it is not easy to detect the change of position in the fluid as the patient changes his position. Auscultatory stroking is of great service in such cases, as the difference in the density of the effusion and infiltration makes a difference in their power of conducting sound. The paravertebral triangle of dulness (Figs. 39 and 40) (Grocco's sign) found on the side opposite the effusion is also of value when the lower lobe on the other side is not also the seat of infiltration. Thayer and Fabyan (The American Journal of the Medical Sciences, Jan., 1907) gives the following method for determining it: "After percussing out the limits of the supposed effusion one should mark out the lower limit of pulmonary resonance on the opposite side and then percuss downward directly over the spine, marking the point at which dullness (relative) begins. It will be found usually that this point corresponds fairly close with the beginning of relative dullness on the side of the effusion; that at all events it is a little higher than the beginning of flatness. One should then percuss downward along lines parallel to the spine and inward toward the spine along lines parallel to the lower limit of pulmonary resonance. In this manner it is usually easy to mark out, at the

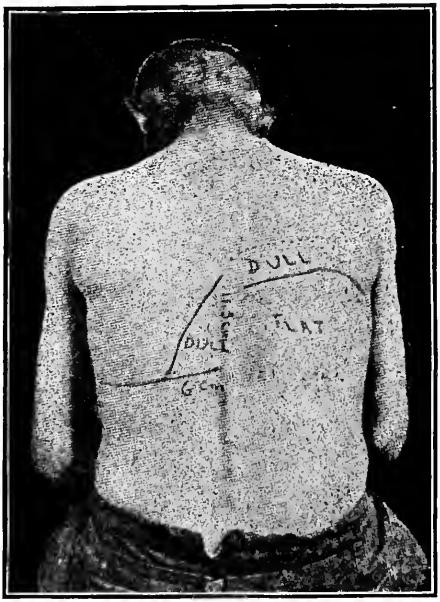


Fig. 39.—Showing paravertebral triangle of dulness on left. Hydrothorax on right side. (*Thayer* and *Fabyan*.)

inferior and mesial angle of the healthy side of the back, a triangle of dullness. The vertical side of this right-angled triangle, represented by the line of the spinous processes, reaches to a point somewhat higher than the upper limit of flatness on the affected side. The base, represented by the mesial part of the line marking the lower limit of the lung on the unaffected side, varies, according to the size of the effusion, from 2 c.m. to as much as 7 c.m. in extent. The third side of this dull area is represented by a line joining the extremities of these two lines. It has sometimes seemed to us, as has been noted by Rauchfuss, that this line showed a slight outward convexity."

Aside from these forms of pleurisy we now and then have pleurisies of both the dry variety and of the form with effusion which show neither pain nor temperature and, unless in the case of large effusion, no appreciable constitutional symptoms.

Physical Signs Remaining After Pleurisy.

Pleural inflammations leave physical signs in the chest which are often embarrassing to the examiner. Often they result in a thickening of the pleural layers, so that the respiratory note of the underlying lung can not be clearly made out. The resulting adhesions also afford signs which resemble rales and at times it is almost impossible (see page 77) to differentiate between these pleural sounds

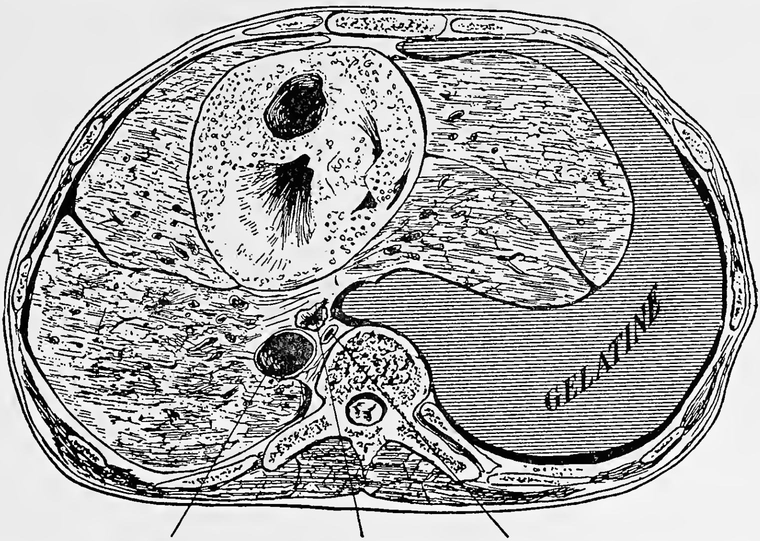


FIG. 40.—Cross section of chest with artificially produced right-sided hydrothorax, showing manner of pushing mediastinum over to left in production of paravertebral triangle of dulness. (*Badnel* and *Sicialiano.*)

and those which originate within the lung. These sounds appear as fine crepitations, medium rales, creakings or gratings.

Treatment of Pleurisies.

When pleurisy, either dry or with effusion, supervenes in a patient suffering from pulmonary tuberculosis, unless it be too slight to receive notice, the patient should be put to bed. He should be given as much food as is consistent with his digestive powers, and the bowels should be carefully regulated. For the pain, applications of hot compresses, frequently changed, and continued for from one to two hours at a time afford great comfort. Where the pain is not very severe the chest may be painted with iodine, or a fly blister may be used, and the chest may be bound tightly with a bandage. Great relief can be afforded by strapping the chest with adhesive plaster so as to limit the motion of the side. For such a purpose the straps should be about two inches wide and should start immediately across the sternum on the opposite side, be carried backward and downward across the ribs and end immediately beyond the median line. A second row should start posteriorly and pass forward and downward crossing the others and ending in the same manner. Where the cough and pain are very severe, Dover's powder or even morphia may be necessary; however, in my practice, these are rarely used, the more simple methods usually sufficing. If the cough is severe, and the pain is aggravated because of the cough, then I prefer to use codein.

There is a great difference of opinion as to the advisability of removing fluid from the pleura. Some excellent authorities operate very early, before the accumulation has caused any special symptoms, relying on its presence as being cause sufficient to warrant removal; others withhold operating until some urgent symptom such as embarrassment of respiration or circulation demand it, preferring to let the exudate absorb of its own accord if it will. It has always been my practice to wait and let nature care for the fluid unless removal has been especially indicated. Where removal is resorted to it seems best not to remove more than half of the fluid and it also seems best to wait for the removal until the end of the exudative stage, when the inflammatory symptoms have all disappeared. This fluid has been shown to be poor in specific protective particles so its absorption can not have any effect in artificially increasing the protective power of the blood; but, by its presence it causes an enforced rest of the lung, if it be on the diseased side, which, unless the pressure be so great as to cause harm in other directions, may be of some value in promoting healing. On the other hand, when the exudate is allowed to remain, fibrin is deposited on the pleural surfaces, and this organizes and acts as an embarrassment to the lung.

PNEUMOTHORAX.

Seriousness of Pneumothorax.

Pneumothorax is an uncommon complication of tuberculosis, yet one which will be met occasionally. The cause of it is an escape of air into the pleural cavity due to the rupture of a tuberculous focus. The seriousness of it depends very much upon the condition of the lung and pleura. If it occurs in a chest which is the seat of marked infiltration, where the lung is bound down by pleural adhesions, and the lung on the other side is in fairly good condition, the symptoms might be very slight, because much of the work of the diseased lung has already been thrown on the better lung, and besides the pleural adhesions may prevent the lung on the affected side from fully collapsing. If, on the other hand, the better lung should be involved in the pneumothorax or it should come on in an individual whose lungs were the seat of little trouble, compensation would be very difficult to establish and it is probable that the patient would succumb. Such patients often die within the first few hours of the attack.

Symptoms. Pneumothorax usually comes on suddenly with a sharp pain and dyspnea. If the collapse of the lung be sudden and extensive, the dyspnea becomes urgent within a very short time; if, on the other hand, the pleural cavity fills with air graduallly the dyspnea is progressive but not so urgent. In one of my cases which occurred in a lung which had been the seat of a pneumonia resulting in fibrosis, the only symptom that the patient noticed was a shortness of breath. The diagnosis was made on physical findings. In another the pleural cavity filled gradually. Pain was intense but the shortness of breath did not reach its climax until twenty-four hours after the onset.

The temperature may be either elevated or lowered or it may remain unchanged. The dyspnea, the bulging of the chest on the affected side, the displacement of the heart, the absence of breath sounds, and the sudden development of a tympanitic note over an area formerly affording a normal or impaired sound, are the physical signs which are found. Later, an effusion usually takes place and the phenomenon of splashing or succussion may be detected upon shaking the patient. The bell sound which is sometimes present is produced as follows: The stethoscope is placed either behind or in the axilla while a coin is laid flat on the chest in front and tapped by a second one. Ordinarily only a dull sound is heard, but when pneumothorax is present a clear bell sound is heard. It is not pathognomonic of pneumothorax, for it can occasionally be produced over cavities and an inflated stomach might give the same sign.

Treatment. At the onset the most urgent symptoms are shock, pain and nervousness. These must be met at once. Remedies which act quickly are necessary. The diffusible stimulants, such as ammonia, alcohol and ether, are of great service. Strychnia may be advantageously given combined with morphia to relieve the distress and support the respiratory function. The case must be treated symptomatically. If the intrapleural pressure becomes so great that dyspnea is urgent a paracentesis should be made. This allows the air to escape and affords relief to the respiration and circulation for the time. If it becomes urgent again a second or third paracentesis may be made, choosing a new place for each puncture. By this means the patient may be tided over the immediate crisis. If fluid appears the same considerations should guide us as though it were a case of pleural effusion.

MIXED INFECTION.

The subject of mixed infection in its relations to tuberculosis is one that is poorly understood; yet, it is one that must be understood before we can make great headway in our treatment of patients suffering from tuberculosis in the advanced form.

"Many bacteria besides the tubercle bacillus are found in tuberculous sputum. The various pus organisms are commonly present. That these various organisms are found in the sputum is not sufficient ground for associating them with the tuberculous process, for they may have come from the mouth, throat or other portions of the respiratory tract. To obviate this possibility of error, Pfeiffer suggested that the particles of sputum for examination be taken from the center of the mass of sputum. Kitasato even went further and washed the sputum mass in sterile water, before the sample for examination was taken.

"Other observers, as Petruschky, Fraenkel and Schroeder and Naegelsbach, examined the blood to see if it contained the organisms. These examinations usually proved to be negative. It is only rarely that the various organisms mentioned in connection with tuberculosis are found in the blood, and, when found, it is usually in the blood taken after death; and, it is highly probable that they passed into it during the hours immediately preceding death.

"Still other observers, Ortner, Sata, Schabad, Cornet and Kitasato, made cultures from the walls of cavities after the death of the patient. In some instances these cultures were taken almost immediately after death, to prove that the organisms were there during life and that they had not come from other parts of the air passages after the death of the patient.

"This method revealed about the same varieties of organisms as were found by the examination of the sputum. The pus organisms, especially streptococci, were most commonly found. Staphylococci, pneumococci and influenza bacilli were present less commonly. In some instances no other organisms than the tubercle bacillus were found.

"The important fact to be borne in mind in these observations is that these various organisms were found not only in the air passages and cavities present, but also in the lung tissue beyond; some, as Ortner, even noting them in the tissues which had not yet been invaded by the tubercle bacillus.

"Some idea of the frequency with which other organisms associate themselves with the tuberculous process may be gained from the following: Ortner found an organism which he named micrococcus-pneumoniæ, but which later proved to be a streptococcus in twenty-eight out of forty-two examinations. Pasquale found streptococci in the sputum every time in eighty-two cases. Schroeder and Mennes, in twenty-one cases of tuberculosis in all stages, made thirty examinations of sputum and found streptococci twenty-nine times staphylococci seventeen times and pneumococci fifteen times.

"The important question to decide is what part these various organisms, which are found in so large a percentage of the cases of advanced tuberculosis, play in the pathologic processes present." (Pottenger, "A Clinical Study of Mixed Infection in Tuberculosis." Report of International Congress on Tuberculosis, Paris, 1905. Journal American Medical Association, March 24, 1906.)

The work of Wright in connection with localized tuberculous lesions has thrown some light upon this question. He has found that by testing the opsonic index of patients suffering from localized tuberculous lesions that their indices indicate infection from other micro-organisms as well as the tubercle bacillus. He has shown also that inoculation with the appropriate vaccines made from a culture of the complicating micro-organism hastens healing very much. It seems to me that this offers us some hope that we may soon understand this condition better.

In the treatment of advanced cases of pulmonary tuberculosis we are often able to arrive at a result which is very satisfactory compared with the condition of the patient at the beginning of treatment. We can often secure a healing of all but a small focus, which keeps on secreting month after month. In such cases it seems probable that, if we could but combine with tuberculin the appropriate vaccine made from the culture of the associated micro-organisms, we might heal these lesions out entirely; but until we are able to cope with this condition more intelligently we must go on in the same unsatisfactory manner in which we have been going in the past.

I believe we are safe in assuming that mixed infection is a factor in all cases of tuberculosis which have passed beyond the early stage of the disease and arrived at the open stage. I do not mean by this that an open surface in the air passages is necessary for this association of other bacteria, for they should be as able to gain entrance to the tissues without an ulcerated surface as tubercle bacilli; but I mention this open stage as showing a disease which is somewhat advanced.

Mixed infection as usually understood consists of a complexity of symptoms, associated with a wide range of temperature (Fig. 9), and prostration more or less severe. In the early morning the temperature in mixed infection is usually low, 96.5° or 97°. It may be as low as 95°. A few hours after, the patient may or may not have a chill and then the temperature advances. It may go as high as 104° or even higher, although 102° or 103° is the usual maximum. If the early morning temperature is very low, or, if it is normal or above normal, the afternoon temperature is apt to be high; so, for a tuberculous patient, we welcome a morning temperature ranging from 97.5° to 98° as an indication for a good day. The fever is often associated with nervousness, headache and disturbance of the appetite and digestion; and sometimes intense burning of the palms of the hands and soles of the feet.

The method of treatment which has given best satisfaction in mixed infection, aside from attempts at specific medication, is that which is usually employed in the treatment of fever in tuberculosis.

The patient is put to bed in a well-ventilated room or in the open air and treated in a purely symptomatic and expectant manner. Unlike the method of treating ordinary acute fever we must remember that the patient may be

17

ill for weeks or months and that the maintenance of nutrition and preservation of strength are very important.

Chills. In order to make the patient as comfortable as possible we endeavor to prevent chills and reduce the temperature by rational methods. When the patient's tmeperature is low in the morning or when he is having chills we endeavor to prevent these by seeing that he is kept warm in the early morning. Hot drinks are given and if the patient finds it necessary to leave the bed for any purpose whatever, he is wrapped warmly and protected from the chill of the air. If he is accustomed to have chills, it is well to anticipate them by placing hot water bottles to his feet and giving him a hot drink of water or milk about one-half hour before the expected time of the chill.

Fever. The fever is combated by rest in bed in a well-ventilated apartment, hydrotherapy and very careful and painstaking attention to minute details. If the digestion is carefully looked after, the bowels properly regulated and all sources of worry and irritation removed, we have done much toward keeping the temperature as low as is consistent with the pathological process present.

The various coal tar products should not be used except very exceptionally, and then only in very small doses. The more experience one has in treating this condition the less value will he attribute to such remedies, and the less use will he find for them.

It is very necessary to know that lowering the temperature, in itself, is not curing the patient. It is not the fever that is at fault, but the cause of the fever. Treating the fever symptomatically is of value only as it refreshes and improves the general tone of the patient and enables him to endure his illness better. If this result is attained by the various coal tar products it is obtained at the expense of its depressing action upon the heart; and the physician must decide whether or not this is justifiable.

There is one measure that can usually be employed without any danger of harm whatever, and one that refreshes the patient at the same time, that is hydrotherapy. Whatever hydrotherapeutic measures are employed, should be carefully adapted to the condition and strength of the patient.

I have found sponging with tepid water, as described on page 157, to be the most useful application. This procedure should be tried whenever it is necessary to relieve the patient by the reduction of temperature. It relieves not only the temperature but the nervousness as well, and seems to enable the patient to better endure the effect of the toxins from which he is suffering.

Diet. Remembering that mixed infection may continue to cause fever and other severe symptoms for weeks and months we must endeavor to fortify our patients and prepare them for the heavy tax that such a process makes upon them. When left to their own inclinations during this time, patients usually eat very little and consequently lose weight rapidly; but, when correctly guided in their diet, they may pass through a siege of fever lasting several months and gain in weight.

The diet at such times should be abundant and should be carefully suited to the patient. I have found that it is not necessary to cut off solid food as is usually recommended in acute fevers; on the contrary, I believe such a course to be disadvantageous when the solids are well borne. At that time of the day when the temperature is low, the patient can usually take a solid meal to advantage. In the usual cases of mixed infection when the temperature is low in the morning, but begins to rise about noon, reaching its maximum during the afternoon and then beginning to decline by four or five o'clock, I usually give the patient a solid breakfast, consisting of fruit, some cereal if desired, steak, chops, soft boiled or poached eggs, baked potato, bread and butter and milk This will be digested by the time the temperature begins to rise. At lunch, when the temperature is on the rise, the patient is given milk or malted milk, and one or two raw eggs, with perhaps gelatin, junket or some light custard, if desired. At six in the evening a fairly full meal consisting of soup, roast meat, vegetables, some light dessert and milk is given. In this way the food is so suited to the condition of the patient that those varieties which require the greatest digestive energy are taken when the stomach is best able to care for them, and at other times such food is given as makes little demand upon the digestive powers. This also gives the patient the advantage of solid food. I am firmly convinced that solid food, if well borne, stimulates the appetite more than such articles as milk and eggs which we resort to so often.

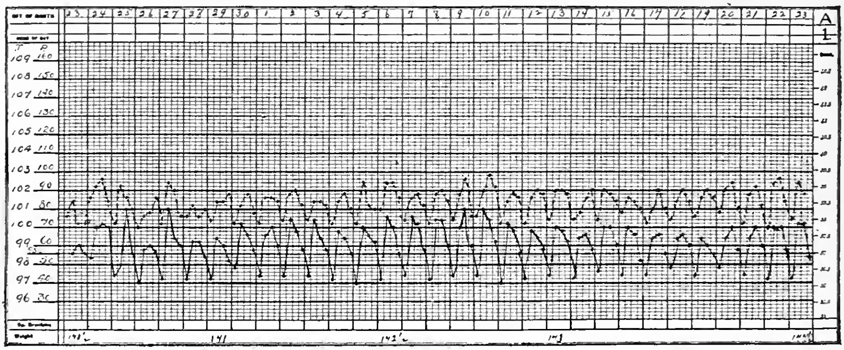
While we sometimes find it necessary to resort to a diet consisting almost entirely of milk and eggs, yet, where solid food can be well borne I believe it has many advantages. Where milk and eggs are almost wholly relied upon, not less than one and one-half quarts of milk and from three to six eggs should be consumed each day.

The digestive functions should be assisted when necessary. If digestion is carried on slowly, thirty grains of sodium chloride dissolved in a glass of hot water taken from one-half to one hour before meals will often prove very beneficial, or dilute hydrochloric acid may be used after meals. The commercial digestants, while theoretically of little value, seem to help at times. The bowels should be regulated. Calomel in small divided doses, followed by castor oil or magnesium sulphate is a great help occasionally. It is very essential not to allow the bowels to become constipated.

Serum Treatment of Mixed Infection.

Serum therapy has been used in mixed infection for several years. The principal serum that has been employed has been that made from the horse by inoculating him with virulent strains of streptococci. The writer has employed this serum in about one hundred cases, with encouraging results. While every patient who has been subjected to treatment has not responded, yet this is not discouraging; for such a result could not be expected when we consider that there are many strains of streptococci, and besides this the patient is often infected with other micro-organisms such as the staphylococcus and pneumococcus, as well as the streptococcus; and, is it

A



B

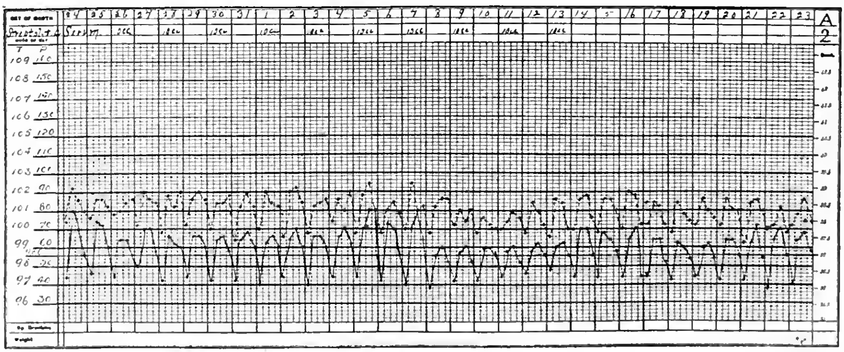


FIG. 41.—A and B. Chart illustrating beneficial action of streptolytic serum. Patient's temperature proved stubborn. At beginning of second month began use of streptolytic serum (Chart B), temperature favorably influenced.

not probable also that these patients suffer from the absorption of the products resulting from the decaying of tissue as well as from the toxins from other micro-organisms?

In my experience this serum has been of great value to many patients. Whether or not it acts, as Wright believes, as a vaccine instead of a passive immunizer, I do not know; but, in a certain number of instances, the complicating mixed infection has been cut short following its employment.

To understand mixed infection, we must divorce our minds from the usual idea of hectic fever, which might be called far advanced mixed infection. Mixed infection plays a role in fever of less degree and doubtless has its influence on the tuberculous process in many cases where no rise of temperature exists. I have been in the habit of using streptolytic serum in these cases of mild degree as well as in those of a severe nature. Figure 41 illustrates the temperature chart of such a case. The patient had not done well regardless of a month's careful management at the sanatorium. He was put on streptolytic serum, 20 cc. every other day taken by the mouth, and the result can be plainly seen on the chart. This patient continued to make satisfactory improvement and after a month's use of the serum had no further trouble with rise of temperature.

I do not doubt but that the true remedy for mixed infection will be obtained in a vaccine made from the cultures taken from the strain of the micro-organism found in each individual patient. The results which we have had so far in our endeavors to treat in this manner are very encouraging.

Convalescence From Mixed Infection. When the symptoms begin to abate and the patient feels brighter and stronger, great caution must be exercised. Haste at this time may make waste. If the process has been a severe one, the patient, tired of his long forced confinement, usually wishes to do things faster than good judgment would dictate. The patient should not be allowed to get up, as a rule, until the temperature has been normal for several days. The same care must be exercised as is usual in the case of a patient convalescing from acute fever. The nervous system is unstable, the heart is weak and irritable, the muscular system is flabby, and the patient is easily fatigued. Even the nervous excitement associated with the anticipation of getting up is often sufficient to raise the temperature one or more degrees; and, an overexertion may be associated with even a higher rise, which may continue for several days. The best rule to follow is to allow the patient to do only as much as he can do without fatigue. Then gradually he may extend the time to half an hour, then an hour, and I think it best to have the patient sit up for two or three hours before a walk of more than across the room is attempted.

The two points to guard against are fatigue and heart strain.

HEMOPTYSIS.

Frequency. Hemoptysis is a very common complication of tuberculosis. It is present according to West (Diseases of Organs of Respiration, Vol. II, page 467) in about 75 per cent of tuberculous subjects, although it becomes an urgent symptom in only about 25 per cent.

Its relationship to early diagnosis I have discussed previously, but it is well to repeat that there is only one excuse for not giving a patient who suffers from an early hemoptysis the benefit of an early diagnosis and early treatment, and that is a failure on his part to consult a physician. "Throat hemorrhage" has become almost obsolete, "stomach hemorrhage" is extremely rare, but "pulmonary hemorrhage" has gained in importance because we now know that nearly all hemorrhages formerly attributed to other causes are due to a bleeding from some part within the lung.

Cause of Hemoptysis.

Hemoptysis is nearly always due to a tuberculous process. The amount of blood may be very small and due to an extravasation in an area of tuberculous congestion; but, if the amount be at all large, it is more likely due to an opening in some vessel. Hemoptyses of the former variety are not attended by immediate danger; but we have no way of differentiating them from those produced by a small opening in a vessel. Very often we have a slight staining of the sputum preceding a copious hemorrhage (see Chapter XIII), soa ll hemoptyses should be treated seriously until we definitely decide that the loss of blood does not come from an open vessel.

The larger hemoptyses come from eroded vessels or from the bursting of aneurismal dilatations of vessels in cavities. The aneurisms are due in part to the fact that the tissue has been destroyed around the vessel, thus removing the natural support of its walls. The inflammatory condition which results from the tuberculous process usually obliterates the vessels and saves the patient from this danger; but, occasionally, this fails to occur when such patients are liable to severe hemorrhages.

Hemoptysis Epidemic.

It has been my observation that hemoptyses very often appear in epidemic form. When large numbers of tuberculous patients are treated together, every now and then, several patients will suffer from hemoptysis at the same time. At our sanatorium we have long periods, at times, without an occurrence of hemoptysis; then, suddenly, several will occur at or about the same time. I have noticed also that when they are prevalent in the institution, they also occur in the town; and have also noted the coincidence between the frequency here and in the City of Los Angeles. The blood pressure of the patients at these times, when we have measured it, has been high. This points to their being some general cause, probably associated with the prevailing meteorological conditions, which produce hemoptysis.

Treatment of Hemoptysis.

Perhaps no complication from which the tuberculous patient suffers, is so atrociously mistreated as hemoptysis. It is nearly always overtreated. Many foolish things are done. Many things that are positively harmful are done and the things that are indicated are left undone. The results that have been attained in spite of this misdirected enthusiasm furnish unmistakable proof of the beneficence of nature and point the way to much better results when the treatment is carried out along rational lines.

To appreciate the indications for treatment, it is necessary to understand the conditions present. The circulatory system may be likened to a system of elastic tubes filled with fluid and connected with a central pump (the heart). Every portion of this elastic tube system is dependent upon the tension of every other portion. These tubes are able to withstand a wide degree of variation in pressure; but, let them become defective in any portion, then, an increase in the pressure might cause a rupture. In tuberculosis the walls of these elastic tubes (the blood vessels) are the seat of tubercles, which soften and break down, thus weakening them. At such a time there is great danger of a rupture. It may come about either by the destructive process breaking through the wall or by an increase in the tension of the tubes causing the fluid in the tubes to exert greater force against their walls. This increased tension may be brought about either by an increase in the force of the pump (the heart) or by an increased tension on the part of the elastic tubes (the blood vessels).

With this understanding we can comprehend the treatment of hemoptysis, which is simply a rupture somewhere in the system of elastic tubings.

Where any considerable loss of blood occurs the hemoptysis is due to a break in the wall of a vessel. The sensible thing to do in order to check bleeding is to keep the tension within the vessels low, by either decreasing the force of the heart (the pump), or, by decreasing the tension of the vessels (elastic tubes).

There are several factors which enter into the lowering of blood pressure. The first that I would mention is rest. This influences the heart particularly. Exercise increases blood pressure, while rest lowers it. Therefore the first indication in the treatment of hemoptysis is to put the patient to bed, in the recumbent position. Mental excitement also increases blood pressure, therefore it is very important to allay all nervousness that may come through fright.

It is not enough to put the patient to bed, but, if the hemoptysis is at all serious, absolute rest must be enjoined. The patient should not be allowed to leave the bed for any purpose, nor should he be allowed to change his position, or move his legs or arms until further danger of bleeding has been removed. The nervousness can often be allayed by a few words of assurance from the physician or attendant. The patient can be told that very few people die of hemorrhage. It has been my experience that fewer patients have severe hemorrhages in institutions than on the outside, and I do not doubt but that the assurance which comes from the physician, who is always at hand, is an important factor in preventing severe bleeding. Where the nervousness can be allayed in this manner, and the patient can be closely watched, I think it is much better to withhold such remedies as morphia unless they should be required for other purposes.

Aside from removing those things which raise the pressure, we can also employ remedies which lower pressure. Of these, the vasodilators are always to be thought of because of their rapid action. Nitroglycerine, amylnitrite and sodium nitrite are of special value. If a hypodermic tablet of 1/100 grain of nitroglycerine be placed on the tongue of the patient, the blood pressure will be lowered almost instantly. (Fig. 42.) The same may be accomplished by the inhalation of amylnitrite. The effect of both of these prepara-

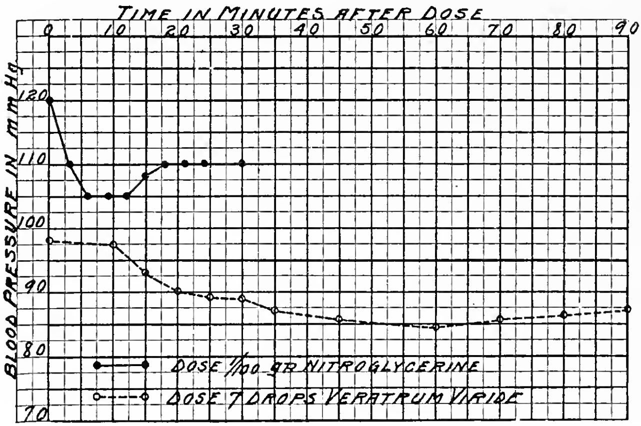


FIG. 42.—Chart showing comparative action of nitroglycerine and veratrum viride in lowering blood pressure, and suggesting their use in the treatment of hemorrhage.

tions is evanescent. Nitrite of soda is more permanent, the effect lasting for an hour or more. Norwood's tincture of veratrum viride or aconite are also excellent remedies to keep down the blood pressure. I am accustomed to using the nitroglycerine 1/100 gr. tablet dissolved on the tongue at once when called to see a patient suffering from hemoptysis, and then ordering three to seven drops of Norwood's tincture of veratrum viride to be used every three hours or as is necessary to keep the blood pressure low as shown by the sphygmomanometer. Figure 42 illustrates the manner in which nitroglycerine and veratrum supplement each other, the former acting at once but passing off after a few minutes, the latter acting slowly but keeping up its action for a longer time. By frequently testing the blood pressure, it may be kept low; and the clot which forms in the ruptured artery may have an opportunity to organize and close the opening. It has been suggested that the most rational plan to adopt is to put on the sphygmomanometer at once when called to see the patient, note the height of the blood pressure at the time the bleeding ceases, and, then, keep it below that point. We must not lose sight of the fact, however, that bleeding may continue in spite of low blood pressure, owing to an extension of the necrotic process in the vessel wall.

Another factor in checking hemoptysis is the clot which forms in the rupture of the vessel. Blood has a tendency to clot as soon as it leaves the vessels or when it comes in contact with a roughened body. Fortunately the edges of the opening in the vessel wall are more or less uneven and thus offer a favorable opportunity for clotting and also offer more or less resistance to the forcing out of the clot when it has formed. If the blood has its normal coagulability, a clot forms readily, if it does not, then bleeding may continue.

The entire burden of the treatment of hemorrhage which follows a ruptured vessel is to retain the clot within the opening until it can organize and close the opening in the vessel wall. Every measure so far mentioned has been for that purpose. The blood pressure must be kept low in order to prevent the increased tension from forcing the clot from the opening.

If the coagulability of the blood should be low, then it might be well to administer calcium chloride in doses of five grains every two or three hours for two or three days. Gelatine is also advisable, and I am in the habit of using it in the dietary of all hemorrhage patients. The great difficulty with these remedies is that they are of slow action and consequently of no value in an emergency. If a patient's blood lacked coagulating power and there was a large opening in a vessel wall, the chances are that the patient would die before these remedies would act; but if the emergency was not to great, then they might be of some value. Fortunately the coagulating power is rarely at fault.

Cough is often a factor in dislodging the clot and if it is severe, it needs attention. In treating the cough in hemoptysis, however, great caution must be exercised. A certain amount of coughing is necessary in order to remove the blood which collects in the air passages, and yet it should not be allowed to imperil the patient by removing the clot. For the purpose of quieting the cough when it is deemed advisable, I am in the habit of employing codein. If the patient is very restless and nervous, however, I substitute morphia.

I think great harm is often done by the indiscriminate use of morphia. Many practitioners make it a routine practice to administer a hypodermic of morphia in all cases of hemorrhage; and then, for fear that the bleeding may continue, they repeat the drug at regular intervals for some hours. This treatment sometimes results in blunting the sensibility of the nerve endings in the bronchi, causing the blood and secretions to be retained, thus favoring pneumonia. Morphia also checks the secretions and prevents elimination.

My rule is never to use morphia in the treatment of hemoptysis when I can avoid it. Ergot and the preparations made from the suprarenal glands are contraindicated in the treatment of hemoptysis due to an opening in a vessel wall. The use of astringents such as tannic and gallic acid are useless.

The patient should be put upon a cold diet, consisting of such articles as milk, eggs, tropon, gelatine and custard. The bowels should be kept open. A saline laxative is valuable for this purpose because by its abstracting water from the tissues it lowers blood pressure.

There is another type of hemoptysis, which seems to be due to a congestion in the lung rather than an opening in a vessel wall. While, as a rule, there is only a small amount of blood lost, yet sometimes it amounts to several mouthfuls and may persist for several days.

I do not know any definite method of differentiating between these two varieties of hemoptysis, yet they call for different methods of treatment. When there is doubt, however, it is better to treat the case as though it were an opening in a vessel; but, if we can be sure that the blood is the result of congestion, then it would be better to use remedies which stimulate the circulation, such as strychnia, digitalis and the products of the suprarenal glands.

TUBERCULOSIS OF THE GENITO-URINARY TRACT.

Doubtless tuberculous nodules exist in portions of the genito-urinary tract oftener than we have been wont to believe, yet active tuberculous disease in these organs has not been so very common. The kidney, the bladder, the testicles and ovaries may all be the seat of tuberculosis.

The usual treatment for tuberculous testicles and ovaries and quite commonly, though not so generally for tuberculous kidneys, is removal, while tuberculosis of the bladder, as a rule, baffles all scientific skill.

It is a source of great satisfaction from the standpoint of the scientist as well as from that of the patient to record the excellent work done by Wright in treating these lesions. His work shows that these localized tuberculous lesions are to be treated medically and not surgically. The following case illustrates the condition and method (Wright, on the "General Principles of the Therapeutic Value of Bacterial Vaccines as Applied to the Treatment of Tuberculous Infection." Medico-Chirurgical Transactions, Vol. 89):

"The patient is a young woman of very good physique. She came under treatment first in January, 1905, with a history of tubercular cystitis and tubercular disease of the kidney dating back two years. One of her kidneys had been removed and there was evidence of the involvement of the other kidney. The urine contained pus in considerable amount and in association with this many tubercle bacilli and several varieties of contaminating bacteria, among others proteus. The patient's tuberculo-opsonic index was tested on two occasions before the inoculation treatment was initiated. On the first occasion it stood at 0.75, on the second occasion at 0.35. An improvement in the patient's symptoms set in practically immediately after the first inoculation undertaken with 1/800 milligramme. The tuberculo-opsonic power rose on the day after inoculation to 1.7, and continued at this height or near this point for the next six days. An inoculation undertaken on this day with 1/400 milligramme brought down the opsonic power of the blood. In association with this the patient complained of more pain. After the inoculations had been continued for about six months, when the tubercle bacilli had disappeared from the urine, and when, as a result of the inoculation of a proteus vaccine, the proteus also had disappeared, the patient felt so well that she mooted the question of engagement and marriage. Since then she has suffered a relapse, developing an acute cystitis. This attack, which was apparently associated with a reappearance of the proteus in the urine, is now subsiding."

What can be done for the kidney and bladder can also doubtless be done for the ovary and testicle. I have had the happy experience of seeing an apparent healing in a case of tuberculosis of the ovary.

The history of the case is as follows: Two years before the patient reported for treatment, she had had one ovary removed. Upon examination it proved to be tuberculous. The other ovary, at the time of the operation, showed signs of disease and the surgeon ventured the opinion that it would sooner or later have to be removed. The patient was opposed to this radical course so one ovary was left. Before coming to us the ovary had become enlarged and tender and was giving the patient quite a good deal of trouble. While we promised her nothing, she insisted on being treated. After a long treatment with tubercle vaccines extending over about one year the ovary decreased in size, became firm and was no longer tender. It is bound down by adhesions, due to the inflammatory condition about it, but otherwise it seems to be free from disease. After the patient had been away from treatment about three months she returned and we gave her large doses of tuberculin without causing any tenderness or general reaction.

These experiences make us most hopeful of future results in this field of therapy, and show us that there are few if any tuberculous lesions that are entirely hopeless.

TUBERCULOUS MENINGITIS.

Tuberculous meningitis is rarely a complication of pulmonary tuberculosis in the adult, but it is found more frequently in children between the second and seventh years. The child usually shows symptoms of failing health for some time. This may extend over a period of three or four weeks. This can readily be understood if we bear in mind that tubercles form slowly at times, and not infrequently remain stationary in their growth for prolonged periods. The child loses its appetite, becomes peevish, irritable, does not care to play, loses weight, sleeps poorly and may cry out during sleep. After this prodromal stage the symptoms become more pronounced. Headache, vomiting and fever appear. The headache may be either intermittent or constant. It sometimes becomes so severe that the child will utter a peculiar scream which is characteristic of this disease. The temperature is elevated, the respiration regular and the pulse slow. The child shows rapid emaciation and usually lapses into a somnolent condition. Sometimes convulsions appear.

When meningitis occurs as a complication of pulmonary tuberculosis, the symptoms are not far different. The patient becomes nervous and irritable, loses appetite, sleeps poorly (insomnia may be marked), complains of headache which is often intense, usually shows a dilatation of the pupil and may become delirious or even maniacal. The temperature is elevated. Before death the patient may become stuporous.

The treatment of these cases is purely symptomatic. The bowels should be kept open, and the headache should be relieved. An ice cap is often of value, bromides are helpful, but phenacetin or morphia will usually be necessary in order to allay the intense pain. If intracranial pressure gets too high, as it often does with children, lumbar punctures may be resorted to.

SYPHILIS.

Syphilis is a factor that must often be dealt with in tuberculous patients. When we remember how common syphilis is and then take into consideration the effect of this disease not only on the one who acquires it but on those of succeeding generations, and then recall all of the masked forms that it assumes, we are ready to appreciate that syphilis may be quite a factor as a predisposing and complicating condition in tuberculosis. I have been convinced of this fact for some time, and have seen that antisyphilitic treatment is often of great value in helping to cure tuberculosis. Spengler (Deutsch. med. Woch., 1906, No. 15) has given this matter much thought and is firmly convinced of its importance.

Fresh syphilis is a very serious complication. Patients who have these two diseases at the same time usually do badly. In all such cases mercury and iodine should be used. Mercurial ointment is perhaps as efficacious as any preparation. The Italian school use hypodermic injections of sublimate deep into the gluteal muscles. When mercury is used the amount should depend greatly upon the condition of the patient. One who is strong could have large amounts and more frequent applications than one in a weakened condition. If a small amount of sulphur is administered each day, it helps to prevent mercurialism.

The effect of inherited syphilis is well known to all physicians, although as yet its importance does not seem to be grasped by those who are treating tuberculosis. My attention was called to the effect of masked syphilis early in my career as a practicing physician. A boy ten years old was brought to me for treatment. He was under weight, puny, never strong like other boys, yet not what could be called ill. He had been treated by many physicians with tonics of various kinds to no effect and was considered to be "a weak boy" without any apparent cause. I could get no signs of syphilis. History was negative. Father and mother both denied ever having syphilis. On inquiry I derived the information that the father had been a seaman in his early years. I decided to give the boy a new tonic consisting of iodide of potassium. A wonderful transformation was wrought in the child.

No less remarkable results have I seen in tuberculosis where in spite of the best of treatment, both hygienic and specific, the disease failed to yield, but healed when iodine was added to the therapy. One of the most convincing illustrations occurred in the practice of one of my colleagues. The patient had a widespread disease of both lungs with altered breathing, and many rales, which had lasted for fourteen years. The patient expectorated more than three ounces of sputum per day which contained bacilli. After repeated treatments by excellent physicians, and an intelligent treatment by tubercle vaccine, he failed to get well until iodine was added to the treatment, when in the course of two or three weeks the sputum almost entirely disappeared. After this treatment the patient went on to a cure.

In those cases when the disease is widespread and yet the patient feels well and appears well a syphilitic factor should be expected, especially an inherited syphilis. Spengler has described a certain type of respiratory murmur which he believes to be characteristic of inherited syphilis. It is found most pronounced in the middle lobe anteriorly and lower lobes posteriorly. This peculiar murmur is similar to what is heard when one holds his head under water.

Whenever inherited syphilis is thought to be a factor in tuberculosis, iodine, either in the form of the tincture, ten to twenty drops twice a day well diluted in milk after meals, or some of the albumenate preparations or the iodides of sodium and potassium should be employed internally, or inunctions of some suitable preparation such as iodol or iothion should be made.

PREGNANCY.

The phthisiotherapist is often confronted by pregnancy as a complication in tuberculosis, and the question arises what shall he do in such cases? When a woman suffering from tuberculosis becomes pregnant, if the disease is quiescent and the patient in good physical condition, no harm may result to her and she may give birth to a strong healthy child. If she is relieved of the care of the child, and the drain which would come through lactation, she may make an uninterrupted convalescence and not be harmed by the pregnancy. On the other hand, there is always grave danger that the quiescent focus may be lighted up and that the woman may become the victim of an active tuberculosis.

If a woman who is suffering from active tuberculosis becomes pregnant, the case is quite different. The disease may at once begin to show signs of greater activity. It may take on the character of an acute process, and the patient go down to death within a very short time. On the other hand, the patient may appear better for a time. She may have an apparent arrestment of the symptoms while she is carrying the child. Hope is assured that the pregnancy has cured her tuberculosis. In either case, however, after delivery the disease is prone to light up anew, and the patient go on to quick and certain death.

Pregnancy must always be looked upon as a serious complication in tuberculosis. When a woman has been apparently cured of tuberculosis, several years should elapse before she becomes pregnant. A woman with an arrestment of the disease can not become pregnant without running great risk of starting up the disease anew, even although the arrestment is of several years, standing. A woman with active symptoms of tuberculosis, should she become pregnant, has chances greatly against her. She can only look forward to the probability of an increased activity of the disease.

This being true it is the duty of physicians to tell their tuberculous women of the dangers which accompany pregnancy. I believe it is humane and just to instruct them how to prevent conception.

As to what is the right plan to adopt when pregnancy has occurred, there is room for a just difference of opinion. Recognizing the great danger to the mother, some most conscientious physicians advocate emptying the uterus at once upon the discovery of the condition. Others, to whom we can ascribe no greater degree of conscientiousness, deny the right to sacrifice the life of an innocent unborn babe to that of the mother. If we admit that the physician has the right to consider the life of the mother in preference to the life of a fecundated ovum, and grant that he is justly entrusted with the right to interfere in the interests of the mother when in his judgment her life is imperiled, then we must take a middle ground on this subject; and, while we would not advise emptying the uterus in every tuberculous woman who becomes pregnant, we would say that it should always be considered, and a line of action should be determined upon only after the pros and cons have been most carefully considered.

CHAPTER XX

TREATMENT OF SYMPTOMS.

COUGH.

Perhaps the symptom which will most often cause individuals suffering from pulmonary tuberculosis to seek medical aid is cough. Cough is a necessary accompaniment of the disease. It shows itself early and continues to the end. There is no necessity, however, of cough assuming as great proportions as it usually does. When patients are properly controlled, cough sinks into insignificance compared with it as found in those who live improperly.

The first treatment of cough consists in instructing the patient to resist all inclination to cough which is not necessary for the expulsion of secretion. There is a common belief that if there is mucus present it should be coughed at until expelled. This is a wrong idea. The patient should spare himself every cough that he possibly can, for cough, by irritation, increases the tendency to cough, and by increasing secretion increases the necessity for cough.

Effect of Cough.

Cough produces an injurious effect in several different ways: First, by its explosive action it injures the tender fibrils of new tissue which are thrown out during the process of healing and by this irritation causes the formation of more scar tissue than would otherwise be formed. Where it is continued for a long time, it also causes a dilatation of the air vesicles resulting in an emphysematous condition with its train of injurious effects.

Second, if the cough is severe, it wearies and exhausts the patient and prevents sleep and often causes a rise of temperature.

Third, it often interferes with nutrition by causing the patient to vomit as soon as food has been eaten.

When the patient understands the necessity of controlling cough it is surprising to find how little of it is really necessary. The will power is one of the most potent remedies to be employed against it.

Cause of Cough Key to Treatment.

Cough is due to a number of different causes, such as the disease process in the lung or pleura or inflammatory conditions in the upper air passages; but, the excessive cough, as we find it, is due in a large measure to overexertion and bad habits of living. It is much more pronounced in patients who live in badly ventilated apartments and who overexercise than in those who live in the open air and do not overexert. Where excessive, especially if it is irritating and unproductive, it will quite often show marked improvement when the patient is required to rest in bed. This kind of a cough is often relieved by the use of the wet jacket as described on page 162. When it does not yield to these simple measures, it may be found necessary to resort occasionally to the use of some sedative such as codein or heroin. Personally, I rarely resort to these remedies, and when necessary, codein is given the preference because of its more favorable action on the digestive system. The derivatives of opium are the only ones that are reliable, and their action upon the digestive function debars them from a very general use. Many men are entirely too free with the use of cough medicines. Better management of the case, together with the confidence of the patient, makes most cough remedies superfluous.

Sometimes cough is due to an attempt to expel secretion from a cavity or to an excessive bronchial secretion. In such cases alkaline hot drinks (15 grains of bicarbonate of soda in a glass of hot water) often proves beneficial. Inhalations of tar, benzoin and creosote are also of some value in these cases, and if creosote does not disagree with the patient, its administration in doses of ten drops (Beechwood creosote) after meals will often have a salutary effect in the latter class of cases. When creosote is administered it should not be given in capsules, for when they dissolve, the liquid escapes and exerts a severe action upon the mucosa of the stomach. To avoid this the desired dose should be put into a conveniently sized bottle, for example one holding four ounces, which should then be filled with water (some prefer it quite warm) and thoroughly shaken so as to break up the creosote drops into very fine globules. When thus administered it can not injure the mucous membrane of the stomach.

Oftentimes cough comes on as soon as food has been eaten, the patient coughing until he vomits. This condition will sometimes yield to hot alkaline drinks taken fifteen minutes before meals. Sometimes a post-nasal catarrh is the exciting cause in these cases, when relief may be afforded by post-nasal applications of a 10 per cent solution of protargol, or a solution of iodine in glycerine. Five to ten grains of oxalate of cerium twenty minutes before eating sometimes has a beneficial effect, but when the vomiting becomes serious by causing loss of weight, as I have occasionally seen it, and when it does not yield to the simple measures, codein or heroin one hour before the meal should be used.

Care of the upper air passages will keep down a great deal of unnecessary coughing, and while I do not believe in persistent, uncalled for spraying and treating of the naso-pharyngeal and laryngeal mucous membranes, yet I am convinced that the services of a skilled rhinologist and laryngologist will add much to the comfort and well being of patients suffering from tuberculosis.

In elderly persons the red iodide of mercury in small doses (1/50 of a grain) three or four times a day often acts splendidly; especially if the cough is due to the presence of atheroma. When the cough is due to laryngeal irritation, measures described on page 243 should be employed.

NIGHT OR SLEEP SWEATS.

Cause of Night or Sleep Sweats.

Night sweats occur some time during the course of nearly all cases of tuberculosis. They may be so mild as to cause only a slight moistening of the skin or they may be so severe as to wet the night clothing and bedding.

The cause of these sweats is not known, although it is generally believed that they are of toxic origin. They apparently follow a general relaxation of the tone of the skin, and quite often occur after a rise of temperature has subsided. Following the high temperature of advanced tuberculosis sweats are often profuse, although they may be absent. In early tuberculosis their connection with a rise of temperature is not so evident because they may occur when the patient is having a normal temperature or a rise of only a fraction of a degree. It is possible that the tendency to sweating is an individual characteristic, due to the fact that some people are more susceptible than others to the action of toxins.

Like cough, night sweats are more pronounced when patients live under improper surroundings. Many patients who have been suffering from severe sweats lose them as soon as their lives are properly ordered. In my sanatorium experience I have rarely been called upon to prescribe for them, for they usually disappear when the patient is placed under a hygienic regime. It is generally believed that patients treated with tuberculin are less subject to night sweats than those who are not.

Night sweats are found in other diseases than tuberculosis. They commonly appear when an individual is debilitated from any cause whatsoever; so, they assume diagnostic importance only when considered in relation to other symptoms.

Treatment.

Night sweats can usually be relieved by properly regulating the patient's life. The effect of the open-air life is to improve nutrition and nerve tone. In this improvement the skin participates to a high degree. As the patient's general condition improves and his skin becomes healthier, sweats usually lessen. Hydrotherapeutic measures are valuable because of their tonic action on the skin. The morning cold sponge has much to do with checking night sweats.

When they persist in spite of the usual hygienic measures, I am often able to control them by having the patient rubbed off with a solution of equal parts of vinegar and water immediately before retiring. Sometimes plain cold water will suffice. The action of this is due probably to its effect in contracting the relaxed condition of the skin which is present when the patient sleeps.

Sometimes, in spite of these simple measures, sweating will continue. This is most likely to be the case when the disease is far advanced and the patient is suffering from mixed infection, or when the process is running a rapid course. There is no harm in the sweat itself. There is a popular idea, which is shared by many physicians, as well as laymen, that these sweats are very weakening. It is not the sweating, but the cause of the sweating that is weakening. The greatest harm that usually comes from the sweating is in the discomfort to the patient. Occasionally it is followed by a chill, to avoid which, a patient subjected to sweating should keep at his bedside a towel with which he may dry himself if sweating should occur; and, he should also have a change of night clothes in the bed or under the pillow, where they will be kept warm, to be put on in case a change should be necessary.

When the sweats are profuse, atropine $\frac{1}{100}$ to $\frac{1}{60}$ of a grain given at bedtime, may dry the secretion and prevent the sweating. Agaracin may be tried and will sometimes prove beneficial. As a rule, however, if the simple methods above will not suffice, too much must not be expected from drugs.

FEVER.

In every case of tuberculosis a rise of temperature is present some time during its course. This does not require special measures of treatment, however, unless the rise exceeds 100 degrees. While this measure is arbitrary yet experience shows it to be about the point above which the temperture may not go without producing some anxiety. The temperature of uncomplicated pulmonary tuberculosis, except in acute forms, rarely goes above 101 degrees and usually remains below 100 degrees. When this limit is exceeded, we must suspect that the tuberculous areas have taken on an acute inflammatory condition resulting in a pneumonitis of greater or lesser severity or that some complication in the nature of a mixed infection, or on the part of the pleura or the digestive system, or an acute miliary condition has arisen.

No matter what the cause of such a temperature, the patient should be treated as a fever patient. Experience in treating these cases will teach that even fever cases can not be treated by routine measures; and, while we make 100 degrees the usual limit, yet in many instances it is advisable to treat as fever cases those who have a lower limit. Strict individualization after a thorough understanding of the patient is necessary to successful treatment.

Fever patients should remain in bed. It is scarcely necessary to say that they should be placed in the open air and subjected to all the restrictions which make up the usual hygienic regime, for this statement applies to all cases of tuberculosis. An appropriate diet is also indispensable, and does much toward lessening the fever.

Rest, in the treatment of these patients, is indicated because exercise causes an increased absorption of toxins, thus increasing one of the principal causes of an increased temperature, and also because the patient's powers of resistance are better when the patient is at rest. If the temperature is due to a congestion in the lung, exertion also raises the temperature by increasing this congestion. The medical attendant should promptly order the patient to bed when a rise of temperature comes. To think that it may lower in a few days of its own accord without rest usually results in a loss of time.

The effect of placing these patients in the open air, especially when they have been in the habit of living with inadequate ventilation, is often very marked. There need be no fear on the part of either physician or friends in adopting the open-air treatment for these patients. While this statement should not be taken as warranting unnecessary and foolish exposure, yet a patient may be taken from a warm, overheated, poorly ventilated room and placed in a cool, well-ventilated room even in rigorous climates, without danger, if proper precautions such as those mentioned in Chapter XI are observed.

Fever must not be treated with drugs for they can not be counted on to remove the cause. Not the fever but the cause of the fever must be treated. The pneumonic condition, the pleurisy, the mixed infection and the complications on the part of the gastro-intestinal tract must be the recipients of our therapeutic energies.

The slight rise of temperature due to the tuberculous process which does not exceed 101 degrees is best combated by a combination of the open-air, dietetic, hygienic and tuberculin treatment. It is not an uncommon experience to find a rise in temperature of this kind, which has persisted for some time, yield in a short period to injections of minute doses of tuberculin. This seems unreasonable, for it is generally believed that the fever is due to the system's being surcharged with toxins from the tubercle bacillus; and, it would seem that to inject more toxins would be only adding fuel to the fire. That such injections act beneficially I have been able to prove for the past three years. Repeatedly have I seen such temperatures yield to this treatment when they had refused to yield until the tuberculin was given. Wright offers us an explanation of this action. He says that not infrequently the machinery of immunization fails to work to its full capacity in spite of the fact that toxins from the invading bacteria are being poured out into the blood stream. At such times vaccines injected into the tissue may stimulate the formation of protective bodies where those circulating in the blood have failed. Whether or not we accept this as the explanation, the fact remains, that these temperatures can often be successfully lowered by the use of minute doses of tuberculin.

In order to avoid repetition, I will refer my readers for further discussion of treatment of fever to the sections which deal with the various complications which cause it.

PAIN.

Pain is a very common accompaniment of tuberculosis. It is due usually to one of two causes, either a pleurisy or a muscular soreness from coughing. The former is the more common cause. The tuberculous area in the lung is not accompanied by pain unless the process is near the pleura; but when it is so situated there is nearly always more or less pain. Occasionally, however, we will find an extensive involvement of the pleura and yet the patient deny having experienced any pain at all.

These pleural pains may be very slight or they may be severe; they may be acute or they may be dull. When there is an acute process present the pain is usually of a stabbing character, catching the patient as he coughs or takes a deep breath. Old pleural adhesions are often the seat of pain which comes on with certain changes in the weather. The weather conditions which favor these pains seem to be about the same as those which cause pain in rheumatic joints. When a cavity is forming near the surface of the lung the patient often experiences a dull ache. Aside from these pains due to acute or subacute conditions affecting the pleura there are others which accompany contraction of the lungs. As the lung contracts it pulls on the old pleural adhesions and often makes the patient feel very uncomfortable. Sometimes the patient complains of an aching and again a feeling of pressure as though he were placed in a vice. Many of the acute pleural pains are treated as intercostal neuralgias and many of them as myalgias. It seems far fetched to pass beyond the pleura in order to ascribe the origin of these pains to the intercostal nerves and muscles.

The treatment of pain of pleural origin depends on whether or not it is acute. No matter what its character, the application of tincture of iodine may be of some value; in fact, for the less severe pains it is the only measure necessary. If very acute a blister may be employed, but this interferes with strapping which is the measure that offers the greatest relief in such cases. Either dry or moist heat applied in the form of hot water bottles or hot wet packs is of great value. If the pain is a muscular soreness from excessive coughing it will quickly disappear when the cough is relieved, although the application of moist or dry heat may hasten its disappearance.

INSOMNIA.

Tuberculous patients often suffer from insomnia. It may be due to many causes the same as it is in non-tuberculous subjects. When it persists it is well to think of an increased gastric acidity. If due to this it may be relieved by a large dose (one-half to one dram) of bicarbonate of soda: but this should be used only temporarily until the condition is corrected. It is not well to start these patients to using hypnotics, for it is quite easy for them to learn to depend upon them. Simple measures, such as a light supper where digestion is poor, or a hot drink of milk in some cases where the brain seems too active, or a cold abdominal compress (Neptune's girdle) may do just as well as sleeping powders, and are certainly to be preferred.

When drugs must be resorted to, chloralamid, twenty to thirty grains, sulphonal, ten to thirty grains, or trional ten to thirty grains may be used. It will often be found that the smaller doses do just as well as the larger ones.

Aside from this insomnia, which we find in all stages of the disease, there is a terminal insomnia which often comes on when the patient is approaching death. It may appear some little time before the end, but it usually becomes most distressing at the last. It is difficult to relieve, sometimes resisting large nightly doses of hypnotics. When it has once made its appearance it usually lasts until the death of the patient.

DYSPNEA.

Dyspnea may be due to mechanical obstruction of the respiratory surface in the lung, upward pressure from the abdomen, irritation of the respiratory center by toxins, pleurisy, pneumothorax, nervousness or complications on the part of the heart.

That due to mechanical obstruction comes on as the disease spreads and involves large areas of lung tissue. It may be due either to infiltrations, fibrosis, the destruction of tissue as is found where large cavities are present, or to complicating catarrhal conditions and emphysema. The most common cause of dyspnea resulting from increased abdominal pressure is that due to gas resulting from fermentation in the stomach and bowel. The early dyspnea in tuberculosis is perhaps of toxic origin; so is the one coming on in acute miliary tuberculosis, and the one accompanying mixed infection, at least in part, due to this cause. Pleurisy may cause dyspnea by the pressure of the effusion or by the pain caused by the respiratory excursion. Pneumothorax causes most alarming dyspnea by pressure, and perhaps also by stimulation of the respiratory centers by CO_2. Dyspnea of cardiac origin is often found as the disease extends and the heart becomes more and more enfeebled. Nervous dyspnea is used to designate a form of unknown cause.

The treatment of dyspnea calls for rest as the measure of prime importance. When the dyspnea is marked the patient should remain in bed. When due to mechanical causes, the relief of dyspnea must come through the removal of these obstructions. Many persons suffering from advanced tuberculosis who are quite short of breath obtain relief as healing takes place, or as an associated catarrhal condition of the air passages clears away. Oftentimes that form of dyspnea due to widespread fibrosis improves very much through healing out of areas of more recent involvement, thus increasing the respiratory area. I have seen this symptom improve very much after a short period of combined sanatorium and tuberculin treatment, when the areas which were the seat of recent involvement began to heal out.

When the shortness of breath is due to intraabdominal pressure from gas, a proper diet should be prescribed and other appropriate measures should be directed toward relieving the accompanying indigestion. When pleurisy and pneumothorax are the cause, these complications must be treated as directed in Chapter XIX.

The early toxic dyspnea yields quickly to the general treatment for tuberculosis, while that due to mixed infection yields only when this complication improves or disappears, and that of acute miliary tuberculosis lasts until the death of the patient.

When the embarrassment is of cardiac origin, rest, together with suitable aids to the circulatory system such as strychnia and nitroglycerine, seems to act well. This also is of value when there is much fibrosis present in the lung.

Nervous dyspnea yields to suggestion; if it does not, mild sedatives may be used.

When dyspnea is very urgent it may call for codein, heroin or morphia. These remedies will prove more efficacious in severe dyspnea than any others which I have tried, yet they should be used only in the rarest instances. They should not be considered at all in dyspnea of a mild grade nor when they must be used for a prolonged period, unless it be to make the last days of life comfortable.

SYMPTOMS ON THE PART OF THE GASTRO-INTESTINAL TRACT.

The importance of keeping the gastro-intestinal tract in a healthy condition in tuberculosis can not be overestimated. The difficulties in the way are many, and will often tax the skill of the physician and the patience of the patient. While I am not willing to accept the statement, which is so commonly made, that the cure of tuberculosis is a matter of nutrition, yet I am willing to recognize the fact that a healthy condition on the part of the gastro-intestinal tract is of the greatest importance to the patient who wishes to make a fight for the recovery of health. The cure of tuberculosis comes about through the establishment of immunity on the part of the organism to the tubercle bacillus and its toxins; and, while patients can accomplish this in spite of gastro-intestinal complications, yet it is but reasonable to suppose that a strong, well-nourished individual will be more likely to be able to secure an immunity than one who is poorly nourished, for we should expect the body tissues of the former to be more responsive to the stimulation of the toxins in the production of defensive bodies than those of the latter. Attention to the gastro-intestinal tract, then, while not everything, is very important.

In the treatment of symptoms on the part of the digestive apparatus, proper diet and correct methods of eating should take the place of drugs as far as is possible. The diet should be carefully suited to the digestive condition. The patient should be trained to eat slowly and chew thoroughly. He should have his meals at regular intervals and at the same hours each day. This is most important in order to maintain the best digestive results. For suggestions as to the method of handling the various complications on the part of the digestive system I will refer my readers to Chapter XII.

CHAPTER XXI.

THE RELATIONSHIP BETWEEN THE PHYSICIAN AND THE PATIENT.

Candor Between Physician and Patient Necessary.

The relationship between the physician and the patient suffering from chronic pulmonary tuberculosis must be one of unusual candor, confidence and trust. Tuberculosis is a disease which heals slowly, consequently this relationship is one that must necessarily extend over a long period of time. At best, it will exist for several months and often extends over several years.

This relationship should be instituted upon the very first visit of the patient. It should be assumed that, when a patient consults a physician, he comes to learn the truth. There is due the patient from the physician a diagnosis, a prognosis, and the outline of a rational treatment; on the other hand, there is due the physician from the patient confidence and a willingness to obey instructions.

Contrary to what should be, the relationship between physician and patient often begins as one of deception, the patient furnishing misleading information and the physician either failing to find the nature of the trouble or misinforming the patient if he does.

Great Responsibility on Physicians.

Whoever would treat tuberculosis, or whoever would be treated for it, should be conversant with these three facts: first, tuberculosis is a communicable disease; second, it is a preventable disease, and, third, it is a curable disease. It should also be known that the earlier the disease is detected the less danger there is of its being communicated to others, providing the proper precautions are taken, and the greater the opportunity of its cure, providing the proper remedial measures are instituted.

There is a great responsibility upon the physician who is consulted by a patient suffering from tuberculosis; for, upon his advice depends very largely the course pursued by the patient. It is necessary for the physician to know both the hopeful and the hopeless side of tuberculosis. He should know that, when the disease is discovered early and treated in an intelligent manner, it is the most curable of all chronic diseases. He should also know that when it is discovered late or when discovered early but allowed to go on, it is one of the most fatal of all diseases. The curability depends upon the ability of the physician to recognize and properly manage the disease, and the candor with which he deals with the patient on the one hand, and upon the time when the patient seeks advice and his confidence in and willingness to obey the physician, on the other. On the candor of the physician depend not only the patient's chances of recovery but also the health and lives of those with whom he associates. Tuberculosis being a cummunicable and preventable disease, every person afflicted with tuberculosis should know it. Undoubtedly the medical profession must assume much of the responsibility for the high death rate that exists today among tuberculous patients, and must also assume responsibility for the new infections which occur because of the failure to establish a diagnosis and to inform the patient of the true nature of his trouble.

The Patient Must Know that He Has Tuberculosis.

When tuberculosis was thought to be an incurable disease, and believed to be transmitted by heredity instead of being infectious, there was not that urgent demand for candor that there is today. At that time it was not a very joyful thing to tell a patient that he had consumption, for he understood by that that his days were numbered; but today conditions have changed, the patient can be told that he has tuberculosis, the most curable of all chronic diseases, and furthermore, he must be told that in order to afford himself the best chances of cure and in order to prevent his immediate friends from becoming infected he must know the truth about his disease.

Deceptive Terms not Permissible.

Modern medicine has no place for the old deceptive expressions of "threatened tuberculosis," "weak lungs," "sore spot on the lung," "throat trouble," "bronchial trouble," "bronchitis," "asthma," "liver trouble," "stomach trouble," "stomach cough" and "malaria" which have been used so long by the medical profession to quiet the patients' fears and lull them into the grasp of certain but unsuspected death. Such deception carries with it unnecessary death, and would not be tolerated in dealing with other serious conditions. Imagine a physician telling his patient with appendicitis that he has "cramps" or "colic!" Imagine what his surgeon friends would say! Yet many of these surgeons who would condemn their brother physicians for calling appendicitis "cramps" are informing their tuberculous patients that they have "weak lungs," "throat trouble" and other equally deceptive conditions. It is not sparing the patient to withhold from him the diagnosis of early tuberculosis and allow him to progress to a hopeless condition. The physician, therefore, should insist on telling his patient the nature of his trouble, and the patient should demand the truth from the physician.

There is a hesitancy on the part of many physicians in regard to telling their patients that they have tuberculosis. The physician often fears his diagnosis. He does not seem to have confidence in his findings. While all men have not had the requisite training cr the practical experience to enable them to make a physical examination of the chest sufficiently thorough to definitely decide whether or not an incipient tuberculosis is present, they should all be able to recognize the symptoms of early tuberculosis and to take the temperature of the patient, and if there are suspicions of early tuberculosis they should give or have some one give the tuberculin test, or if the disease is sufficiently advanced for expectoration to be present, no matter how slight its amount, they should either examine it or have it examined for tubercle bacilli. In these early cases, the best interests of the patient demand a diagnosis, and if the attending physician can not establish one, he should call a consultant, the same as is done in other diseases when there is doubt. When the diagnosis has been established, then there are absolutely no grounds for secrecy or deception. The best interests of both the patient and his associates demand that the truth be known.

The Patient Should be Told in a Humane Manner.

The feelings of the patient should always be spared as much as is possible, and he should be apprised of his condition in a humane manner. If he has not suspected the nature of his illness he will be somewhat surprised and doubtless somewhat depressed. If he has suspected it he will nearly always be relieved at knowing the truth; for, rightly or wrongly people place great confidence in their physician, and when they know that he knows what is the matter with them, they feel that the way is open to recovery; but if they think that he does not know, they feel helpless.

When I make a diagnosis of tuberculosis I make it a rule to always tell my patients. I have had anxious parents and brothers and sisters implore me not to do so, but with a few moments' reasoning I have nearly always convinced them of the wisdom of such a course. The most difficult positions in which I have been placed in this regard have been due to instructions from the patient's physician. Very often a patient comes to my office bearing a letter from his home physician in which the well-meaning medical adviser requests me to make a thorough examination of the patient, but implores me not to inform the patient as to the nature of the trouble. Such requests I am bound to respect, because the patient is not my own, but at the same time it prevents me from talking intelligently with the patient and giving him the advice which he should have.

When a patient is informed that he has tuberculosis he should at the same time be told that it is a curable disease. He should furthermore be told that if he wishes to afford himself the best opportunity of cure, it is necessary for him to know the nature of the disease, otherwise he will do things that he should not do and omit doing things that he should do. It is also necessary for him to know in order that he may take precautions against reinfecting himself and infecting his immediate friends who associate intimately with him. He should also know that when he has so conducted himself as to prevent scattering infection among his friends and associates, he has also taken the precautions which are necessary in order to prevent reinfecting himself. He should also be assured that if he takes proper precautions he is a perfectly safe companion with whom to associate. When a patient has been informed that he has tuberculosis, he is no worse than he was before he knew it; on the contrary he is better, for he can now take intelligent steps toward getting well.

Co-operation of Patient and Physician Necessary. In order to obtain satisfactory results in treating disease, it is necessary to have the co-operation of the patient, and especially is this true in treating such a chronic disease as tuberculosis, where the patient, though feeling well a good part of the time, must be kept interested in treatment for months. It is all but impossible to secure this co-operation unless the patient knows why it is required. It must seem strange to a patient to be asked to rest, remain out of doors, divorce himself from his business, and follow out other instructions which are usually given to the tuberculous, when he has no definite idea why he is doing it. How can a physician give a satisfactory explanation of the slowness with which the patient improves if he has told him that it is only "throat trouble?" How can he satisfy his scientific spirit by explaining every exacerbation as being due to "la grippe," "bronchitis" and "asthma?" Is it any wonder that patients so treated become discouraged and usually go down to death? Is it any wonder that physicians who treat their cases in this manner have little faith in the curability of tuberculosis? We could not expect such a policy of deception to inspire sufficient confidence to tide over crises of discouragement. What is of equal or even greater importance is that such a course deprives the well of that protection which is due them which comes from the patient following out proper rules of living and attending carefully to his personal hygiene, seeing that all bacillus-bearing discharges are carefully destroyed, and minimizing all chances of conveying infection.

If this relationship of candor and confidence between the physician and patient is entered upon at the beginning of their relations it will be one of the strongest assets of their association. It gives the patient confidence which will support him through many trials and discouragements, and it assures the physician of a co-operation that will spur him on to his best endeavors.

Tuberculosis is a many sided disease. It affects all the leading systems of the body; the respiratory, the circulatory, the digestive and nervous systems being especially influenced, and yet, with it all, the patient, for the most part, does not feel ill. He has many symptoms which cause him discomfort and inconvenience, which will come to the physician's notice. The manner in which these symptoms are dealt with depends very much on the nature of the physician as well as upon the nature of the patient.

The man who treats tuberculosis, should possess a comprehensive understanding of the disease, and should also be conversant with the psychology of the tuberculous patient. These two qualifications are indispensable to him if he wishes to secure any measure of success.

Intelligent Patients, Best Patients.

No two physicians can deal with their patients exactly alike, and no physician will treat all his patients in exactly the same way. Personally, I obtain best results by making my patients intelligent on the subject of tuberculosis. I endeavor to explain to them the nature of the disease, something of its course, the difficulties in the way of cure, the complications, the aids to cure, and what they can do to help, always impressing upon them that the result depends very largely upon themselves. This instruction is done either by conversation as I meet the patient in the office or by lectures as I carry it out at the Sanatorium. These occasional lectures have been most helpful to the patients and have had a remarkable influence in encouraging them and spurring them on to an intelligent co-operation. I do not fear an intelligent patient, but I have had the most difficulty with those who have preconceived ideas and who are not susceptible to new light. I make it a rule not to ask my patients to do anything for which I can not give them a reason. My reason may be wrong, but if it sounds plausible it helps to secure co-operation. It removes that barrier of mystery which has so long separated the physician and patient, and brings them close together.

Mutual Interest of Physician and Patient.

Tuberculous patients must be under the guidance of the physician for months and often years. This continuous association brings about a feeling of interest and nearness, which aids in the production of favorable results. I do not believe it is possible for a physician to procure as good results in the treatment of tuberculous patients by holding himself aloof from them and treating them coldly, as by entering into their lives, taking keen interest in their welfare and showing them that he is endowed with the milk of human kindness. Such a physician is honored for his knowledge and revered for his character. He commands confidence on the part of his patient, not only because the patient thinks it offers him the best opportunity of cure but also because his own personality demands it.

Tuberculous Patients Need Physician's Guidance.

There is a common misconception to the effect that there is no treatment for tuberculosis. This comes from the teaching that there is no drug which has a specific action. Physicians very often, when they discover the disease, tell their patients that nothing can be done for them, but that they must be cured by getting out in the air. This attitude is wrong. The physician can do much for the tuberculous patient, in fact he can do as much for him as he can for almost any other kind of patient. The tuberculous patient is not one to be neglected if favorable results are desired. I have heard physicians say that the tuberculous patient needs nothing but an occasional examination and advice. Such teaching is pernicious. The tuberculous patient is one who should be in close touch with his medical adviser. I believe that the virtue in many so-called tuberculous cures which require frequent visits of the patient to the physician lies in this close association. These patients have doubts and fears besides the usual symptoms and complications. They must have someone with whom to consult. If they do not see their physician they will tell their troubles to their neighbors and the result is misconception and meddlesome advice.

Patients Need Mental Support of their Physician.

These patients do not need so much medicine, but they do need to have their physician tell them that this and that symptom will amount to nothing, that it is just what must be expected and that they need not worry over it. I have often seen fear and discouragement, as well as painful symptoms, disappear by simply explaining to the patient that there was nothing seriously wrong. The effect of suggestion is marvelous, and its legitimate use keeps the patients happy and contented. It is better to use it than to undertake to suit a drug to every ache and pain. The physician who employs suggestion in this manner, however, must not be blinded to conditions which may exist that call for careful consideration. While a joke or a jolly may make a patient forget his trouble and raise him out of despondency, yet there is a time to be serious. It is just as great a mistake to treat everything by suggestion as to treat everything by drugs. A happy combination of suggestion, drugs and physical remedies, employed in an intelligent manner, will bring best results.

The patient should always maintain confidence in his physician, but, if, for any reason, he should lose this, for the sake of both himself and his physician, he should choose a new one. Not only should he have confidence in his physician but he should give to him obedience. To be cured of tuberculosis, the patient must do many things that he does not want to do and omit doing many things that he does want to do. He must deprive himself of some things which he has been in the habit of enjoying, and perhaps he may be compelled to do some things which he objects to doing; but he must remember the prize of regained health which lies before him. A few months of what seems to be deprivations may result in a renewed lease on life. It requires determination and character to get well of tuberculosis. A contented, happy disposition is also a valuable characteristic, while a discontented, faultfinding disposition will often deprive its possessor of excellent chances of cure.

A candid understanding, a mutual confidence, a reciprocal interest, a thorough co-operation and a well-directed intelligence on the part of patient and physician, will help to make many of the problems relative to the treatment of tuberculosis much simpler and the results of treatment much better.

CHAPTER XXII.

RESULTS AND PERMANENCY OF RESULTS IN PULMONARY TUBERCULOSIS.

A few years ago there was no organized effort to treat tuberculosis. There was no systematized method of treatment for the disease; in fact, no one thought it curable. It was recognized in its advanced stages only and was always considered hopeless. From time immemorial tuberculosis has been known and always considered a fatal disease.

The Beginning of Systematic Treatment of Tuberculosis.

It is no wonder that Brehmer was considered insane when, in the middle of the past century, he declared that tuberculosis was curable. He adduced as evidence to prove his assertion the results of post-mortem findings; but could not convince his unwilling confreres. So positive was he of his conviction that he started a sanatorium at Goerbersdorf, which is known by his name, and began the treatment of tuberculosis. This institution was founded in 1859 and was the first successful attempt at the systematic treatment of this disease. While we must give Bodington credit for the first attempt at adopting the fresh air treatment of tuberculosis, yet it will be recalled that his experiment failed. His patients were driven from him and the institution was turned into an asylum for the insane. Bodington's confreres undoubtedly thought this a very appropriate ending of such a project and would gladly have seen its founder an inmate.

Tuberculosis was made the subject of much study during the past century. Among the great minds that were turned toward solving the various problems connected with it, may be mentioned Bayle, Louis, Laennec, Virchow, Villemin and Koch. At the beginning of the century very little was actually known of tuberculosis, but before the sixth decade had passed, the relationship between the tubercle and tuberculosis had been established, the disease had been proven by the experiments of Villemin to be transmissible, and Brehmer had pronounced it curable and had succeeded in making his opinion good.

Effect of Koch's Discovery.

The scientific world was, therefore, somewhat prepared for the announcement made by Koch on the 24th of March, 1882 ("Die Aetiologie der Tuberkulose," Berlin. klinische Wochenschrift, No. 15, 1882) that the cause of tuberculosis was the tubercle bacillus. This discovery, however, revolutionized the opinion of the world regarding this disease, and by so doing really made it easier to carry out revolutionary ideas regarding its prevention and cure.

This discovery of Koch's is further reaching in its effect upon the world than is generally believed, for it has given us the key to preventive measures, it has stimulated early diagnosis and thus brought the disease under treatment at a favorable time; it has shown the necessity of hygienic living on the part of the afflicted, and it has opened up the way for the rational treatment of the disease.

While Brehmer maintained that tuberculosis is curable, Koch put into his hands the means by which it can be diagnosed early, when it is most curable. Modern refinements of diagnosis by means of which we are enabled to detect the very early changes in tuberculosis are dependent, first, upon Koch's discovery of the tubercle bacillus and then upon his later discovery of the diagnostic value of the tuberculin test.

Ideas of Treatment Grow Slowly.

In spite of the great amount of study which was directed toward tuberculosis, and in spite of the work that Brehmer was doing, the idea of treatment in tuberculosis grew slowly. The sanatorium at Falkenstein, which was so ably directed by Brehmer's pupil, Dettweiler, was founded in the seventies. At long intervals new institutions arose until finally the sanatorium treatment of this disease began to take serious hold on the scientific world. Not much credence, however, was given to the curability of tuberculosis until the past fifteen years—one might almost say until the past ten years. During this time sufficient evidence has been amassed to prove beyond cavil that tuberculosis is a curable disease, one which will yield to systematic, intelligent treatment. This conviction has now possessed the entire world and everywhere the treatment of tuberculosis is being prosecuted with vigor.

American Pioneers in Phthisio-therapy.

It is a source of great pride to this country to have produced several of the pioneers in the treatment of this dread disease. The first private sanatorium in the United States was established by Dr. J. W. Gleitzmann, in 1875. Trudeau, driven into what at the time seemed exile, went to the Adirondacks and in 1884 established the first sanatorium for the treatment of the tuberculous poor on the western continent. The Adirondack Cottage Sanitarium today stands as the agency through which hundreds of citizens have been restored to health, and is a fitting and perpetual monument to its founder. Bowditch soon took up the great work and founded the Sharon Sanatorium near Boston. Otis, Knight, Whittaker, von Ruck, Flick, Solly and others soon followed.

Tuberculosis Yields Readily to Treatment.

While there is still much doubt in the minds of many people as to the curability of tuberculosis, this doubt is due to a lack of acquaintanceship with facts, or a willful disregard of them.

When we have considered the matter carefully in the light of the results that have been obtained, we must conclude that tuberculosis when intelligently treated is not such a dreadfully hopeless disease after all. It offers about the same hope of cure as do other serious diseases and yields even better results than any other chronic disease.

Improvement can be obtained in nearly all patients suffering from pulmonary tuberculosis unless they be *in extremis* when the proper treatment is instituted. Nearly all incipient cases and quite a large percentage of those farther advanced can be relieved of all active symptoms, so that they may be able to live for years and lead lives of usefulness.

The result obtained in the treatment of tuberculosis depends:

First, Upon the earliness of the diagnosis.

Secondly, Upon the intelligence of the treatment and the promptness with which it is instituted.

Thirdly, Upon the ability and willingness of the patient to carry out instructions.

Cure Depends upon Earliness of Diagnosis.

Under the most favorable circumstances the results of treatment are very encouraging, the lesion can be healed in nearly all instances, and the result can be accomplished in a comparatively short time. Of course this statement implies a diagnosis in the incipient stage, the prompt adoption and the faithful prosecution of rational treatment. If circumstances are less favorable, that is, if the diagnosis is not made so early, or, if made early, time is wasted in adopting and carrying out a suitable therapy, then the result will be correspondingly unsatisfactory.

The relationship of early diagnosis to a favorable result is well shown by statistics from institutions wherein patients of all stages are treated. From these results we may conclude, as mentioned at the beginning of the chapter on Diagnosis of Early Tuberculosis, that if medical men would expend but a fraction of the energy in learning to diagnose tuberculosis early that a few scientists are expending in endeavoring to discover a "cure" for it, we would be able to say that the cure for tuberculosis is already at hand.

I have arranged in Tables I and II the results of treatment from several American sanatoria. These reports prove the assertion that tuberculosis is a curable disease and show more plainly than any argument that I can make the necessity of early diagnosis and immediate treatment.

Many individuals, both among the medical profession and the laity, fail to realize the importance of early treatment of tuberculosis. If the expression "do it now" can be applied anywhere, it can not be applied with more meaning than when it refers to the treatment of tuberculosis when an early diagnosis has been made.

Table II shows what delay means. Whereas of 1896 early cases, 1188 or 70 per cent were apparently cured, of 2138 moderately advanced only 538, or 25.1 per cent were apparently cured, and of 1062 far advanced only 136

TABLE I.

Institution.	No. Patients.	Stage. I Incipient.	Stage. II Advanced.	Stage. III Far advanced	Results. Apparently cured. No.	Apparently cured. Per cent.	Arrested. No.	Arrested. Per cent.	Improved. No.	Improved. Per cent.	Unimproved. No.	Unimproved. Per cent.	Dead or not accounted for. No.	Dead or not accounted for. Per cent.
Adirondack Cottage Sanitarium, 1893–1902.	1487	366	....	....	245	67	83	23	29	8	8	2	...	.....
			788	....	90	12	338	43	261	34	78	10	...	.....
				343	...	....	51	15	116	34	152	44	49	3
1904–1905.	311	123	....	....	57	46.3	56	45.5	8	6.5	2	1.6	...	.....
			188	....	17	9	123	63	26	13.8	15	8	2	.....
Rutland Sanatorium,* 1901–1904.	1732	897	....	....	633	70.5	...	.....	237	26.4	27	.03	...	.....
			653	....	160	23	...	.....	417	63.8	76	11.6	...	.....
				182	17	.09	...	.....	140	77	25	1.5	...	.....
Loomis Sanatorium, 1903–4–5.	231	92	....	....	54	58.7	23	30.4	9	1	...	.....	...	.....
			81	....	14	17.3	20	24.7	33	40.7	14	18	...	.....
				53	...	....	5	8.62	18	31	21	36.21	14	24.14
Sharon Sanatorium,* 1903 and 1905.	80	46	....	....	38	82.6	...	.....	8	17.4	...	.....	...	.....
			34	....	7	20.6	...	.....	19	56	8	23.5	...	.....
Winyah Sanitarium, 1901–1906.	863	141	....	....	132	93.6	6	4.3	3	2.1	....	.....	...	.....
			367	....	227	61.9	96	26.2	41	11.2	3	.9	...	.....
				355	108	30.3	86	24.2	75	21.1	86	24.2	...	.....
Pottenger Sanatorium.	192	31	....	....	29	93.5	2	6.5	...	...	...	.....	...	.....
			37	....	23	62.2	11	29.7	1	2.7	2	5.4	...	.....
				124	11	8.9	50	40.3	40	32.2	23	18.6	...	.....
	4896	1696	2148	1062	1862		960		1440		538			

* Apparently cured and arrested not segregated, hence I counted them as apparently cured in above table.

TABLE II.

Number of Patients.			Apparently Cured.		Arrested.		Improved.		Unimproved.		Died.	
I Incipient.	II Advanced.	III Far advanced.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.
1696	....	....	1188	70.	175	10.3	294	17.3	37	2.2	2	.1
	2138	....	538	25.1	593	27.8	798	37.3	196	9.2	13	.6
		1062	136	12.8	192	18.	389	36.6	307	28.9	38	3.6
1696	2138	1062	1862		960		1481		540		53	

or 12.8 per cent were apparently cured. Thus the opportunity for cure in early cases is nearly three times as great as it is in those moderately advanced, and nearly six times as great as in those far advanced.

Never a Time too Early to Begin Treatment.

In the face of such statistics how can a physician inform his patient that he is not yet sick enough to go to a sanatorium or to take treatment for his disease? If one is going to take treatment for tuberculosis, "do it now." Let him do it while his chances of recovery are 70 per cent instead of waiting until they are reduced to 25 or 12 per cent. In the face of such statistics how can physicians continue to tell their patients that they are only suffering from "throat trouble," or "bronchial trouble?" They must realize that by so doing they are trifling with human lives and rapidly reducing the chances of cure for their patients.

Cure of Tuberculosis an Investment.

While in the United States we aim at obtaining a clinical cure of tuberculosis, in many of the sanatoria of Germany they aim at an economic cure. The treatment of tuberculosis has been taken up as a business proposition by the insurance societies of Germany. These organizations find that it is a remunerative investment to maintain institutions for the treatment of the insured who develop tuberculosis. If a member of these insurance societies develops tuberculosis, the company sends him to a sanatorium for three months' treatment, provided, in the judgment of the examining physician, he can be restored to such a degree of health as to be able to work for two more years. They find that it is much cheaper to pay for the treatment of the patient than to pay the insurance benefit. This is a worthy example for state governments to follow. State sanatoria, divorced from politics, and properly conducted are a good investment for any state.

TABLE III.

RESULTS AND PERMANENCY OF RESULTS OBTAINED BY THE GERMAN IMPERIAL INSURANCE SOCIETIES

	At the end of time of treatment of every 100 persons treated.					Of Every 100 Treated and Traced.														
	The following percentage had regained their working capacity in the year:					Of those treated in 1898 the following were in full working capacity:					Of those treated in 1899 the following were in full working capacity:				Of those treated in 1900 the following were in full working capacity:			Of those treated in 1901 the following were in full working capacity:		Of those treated in 1902 the following were in full working capacity:
	1898	1899	1900	1901	1902	1898	1899	1900	1901	1902	1899	1900	1901	1902	1900	1901	1902	1901	1902	1902
Men and women......	74	74	72	77	78	68	45	38	33	31	67	48	40	35	66	49	41	71	55	74
Men alone............	74	74	72	77	77	67	44	37	31	28	67	48	39	33	66	48	40	70	54	73
Women alone.........	73	73	72	77	80	69	49	43	39	38	67	51	44	40	67	52	46	72	60	77

The statistics of the Imperial Insurance Company show that 12,187 tuberculous men and 4302 tuberculous women were treated at the expense of the Invalid Insurance Companies in 1902. Of this number, eliminating those who interrupted treatment within two weeks, 81 per cent were restored to full earning capacity; including them, the percentage was 78.

Table III (Der Stand der Tuberkulose Bekämpfung im Frühjahr, 1905) shows the results which were obtained during the years 1898–1902, also the permanency of such results.

The Prusso-Hessian Railway Company has also assumed responsibility for the treatment of its employes, and during the year 1904 furnished treatment to 716. These patients were treated on the average 73.5 days, which all must recognize as a very short time, too short for best results—yet the results are most excellent as shown in Table IV.

This table shows also the permanency of results obtained from 1898–1904. Of course all patients so treated must, of necessity, be early cases in order to obtain results in so short a time.

Treatment Greatly Prolongs Life.

While we are often disappointed in the results of treatment, yet both physician and patient have much ground for congratulation; for, even where a cure can not be obtained, the patient's life can be prolonged. Reiche ("Die Dauererfolge der Heilstätten behandlung Lungenschwindsüchter," Münch. med. Woch., No. 33, 1902) followed the after history of 683 patients who were denied admission to the sanatoria of the Hanseatic Insurance Company, mostly on account of the process being too far advanced, and compared the length of life with those who were treated in the sanatoria. In the untreated cases the length of life from the first symptoms of the disease until death was forty-three months. In those treated in the sanatoria, however, "six to seven years after the first cure 52.7 per cent still remain fully capable of work."

Results of Treatment Compared with Results in Other Diseases.

The treatment of tuberculosis makes an excellent showing also when compared with the treatment of other chronic diseases. The statistics of the Imperial Insurance Company (Amtliche Nachrichten der Reichsversicherungsamtes, 1902: Statistik der Heilbehandlung, 1, Beiheft.) furnish excellent opportunity for comparison. Statistics are at hand of over 100,000 insured, who were treated for chronic diseases during the years 1897–1900. A favorable result was obtained in from 68 to 77 per cent of the cases of pulmonary tuberculosis, and in from 69 to 74 per cent of other diseases. In the second year the condition was satisfactory in 44 to 50 per cent of the tuberculous cases, and also in 44 to 50 per cent of the other cases. In the third year the satisfactory result had declined to 30 to 41 per cent in the tuberculous cases and to 39 to 43 per cent in other cases. In the fourth year, that of tuberculosis was from 30 to 34 per cent and that of other diseases

TABLE IV.

A PROOF OF PERMANENCY OF RESULTS IN PULMONARY TUBERCULOSIS AS OBTAINED BY THE PRUSSO-HESSIAN RAILWAY COMPANY.

Year of Treatment.	Number Treated.	After Treatment There Were Still in Full Working Capacity:						
		In the 1st year.	In the 2d year.	In the 3d year.	In the 4th year.	In the 5th year.	In the 6th year.	In the 7th year.
1898	217	172=792.6%	137=63.13%	118=54.38%	98=45.16%	95=43.78%	87=40.09%	81=37.33%
1899	354	296=83.62%	258=72.88%	216=61.02%	194=54.80%	176=49.75%	160=45.2%	
1900	429	365=84.11%	309=72.03%	273=63.64%	246=57.34%	230=53.61%		
1901	532	449=84.40%	383=71.99%	336=63.16%	310=58.27%			
1902	540	467=86.48%	409=75.74%	360=66.67%				
1903	632	521=82.44%	431=68.20%					
1904	716	585=81.70%						

36 to 41 per cent. In the fifth year, that of tuberculosis was 27 per cent, and that of other diseases was 34 per cent.

Thus the results of treatment of tuberculosis are about as favorable as those of other chronic diseases. It must also be remembered that the main aim of the State Insurance Company's treatment has been what is called an "economic cure." The patients were not treated until clinically cured, but only until they were restored to their earning power. Had a clinical cure been obtained in as many of these cases as was possible, there is no doubt but that the showing would have been much better, and more favorable to tuberculosis than to the other diseases.

Sanatorium and Hospital Results Compared.

A comparison of the results of treatment as carried out in sanatoria and in ordinary hospitals is interesting because it throws light upon the question of the relative value of treatment by exact methods, under the best circumstances, and treatment by inexact methods but still under good circumstances. Reiche ("Zur Kritik der Erfolge der Heilstättenbehandlung Lungenschwindsüchtiger," Zeitschrift f. Tuberkulose, Bd. II, S. 405) compares the number of patients living after a period of four years who were treated in sanatoria and in the General Hospital at Hamburg with the following results:

TABLE V.

After four years there were still alive of those treated in:

	Sanatoria. Per cent.	Hospitals. Per cent.
1895	80.	28.
1896	85.9	38.
1897	92.6	55.1
1898	91.4	77.5

Permanency of Results.

Not only is it of value to secure a given result but it is equally important that this result be permanent. The question of the permanency of results, therefore, is one of the most important connected with the treatment of tuberculosis. Patients are always anxious to know whether or not they are likely to break down again after they have secured a favorable result.

Many valuable statistics have been collected with reference to this point. Bowditch and Dunham give the following summary, Table VI ("Six Years' Experience at the Massachusetts State Sanatorium for Tuberculosis," Report of National Association for Study and Prevention of Tuberculosis, 1905) of the condition of 539 patients who were discharged from Rutland with their disease arrested:

TABLE VI.

SUBSEQUENT HISTORY OF PATIENTS ON DR. BOWDITCH'S SERVICE UP TO MAY 1, 1905 (RUTLAND).

	Year of Discharge.						
	1899	1900	1901	1902	1903	1904	Total.
Number of patients discharged with "disease arrested,".......	35	56	85	90	132	141	539
Number of patients now in good health and working,...........	18	39	60	65	105	113	400
Number of patients who have not replied to letters lately,........	2	9	3	8	10	17	50
Number of patients who can not be traced, ...	4	1	2	1	1	0	9
Number of patients in whom symptoms have returned,......	2	2	9	8	4	11	36
Died,*........................	9	5	11	8	12	0	45
Patients left sanatorium "improved," but now reached condition of "arrest,"...........	9	5	14	7	15	13	63

Table VII shows the permanency of results obtained at the Adirondack Cottage Sanatorium in fifteen hundred cases which had been discharged from two to eighteen years.

Table VIII represents the permanency of results obtained at the Winyah Sanitarium (Karl von Ruck and Silvio von Ruck, "A Clinical Study of Two Hundred and Ninety-three Cases of Pulmonary Tuberculosis Treated at the Winyah Sanitarium in 1905-1906").

In 1905 I reported on the after-history of 27 cases which had been discharged from two to six years, (Pottenger "The Permanency of Results in Pulmonary Tuberculosis—The After-history of 27 Cases Treated by the Combined Hygienic, Dietetic, Open-air and Tuberculin Treatment," Therapeutic Gazette, 1905). While the number is small yet the results are very encouraging to those who are suffering from tuberculosis. It is now four years since the last one was discharged.

Of these, 12 were in the first stage, and were all apparently cured and remain well today.

*Four have died from causes other than tuberculosis.

TABLE VII.

ANALYSIS OF FIFTEEN HUNDRED CASES DISCHARGED FROM TWO TO EIGHTEEN YEARS AGO.

Condition. On Admission.	Condition. On Discharge.	Number.	Percentage.	Condition in 1902. Well.	Per cent.	Arrested.	Per cent.	Relapsed.	Per cent.	Chronic.	Per cent.	Dead.	Per cent.	Untraced.	Per cent.
Incipient	Ap. cured	245	67	131	53	4	2	11	4	2	1	22	9	75	31
	Disease arrested	83	23	30	36	7	8	3	3	4	5	16	20	23	28
	Disease improved	29	8	9	31	2	7	0	0	0	0	10	34	8	28
	Disease unimproved	8	2	0	0	0	0	0	0	0	0	6	75	2	25
	Stayed less than one week	1	0	0	0	0	0	0	0	1	100	0	0	0	0
	Total	366	..	170	46	13	4	14	4	7	2	54	15	108	29
Advanced	Ap. cured	90	12	54	60	1	1	4	4	1	1	9	10	21	24
	Disease arrested	338	43	80	24	43	13	20	6	18	5	106	31	71	21
	Disease improved	261	34	16	6	7	3	3	1	17	7	118	45	100	38
	Disease unimproved	78	10	1	1	0	0	0	0	3	4	52	67	22	28
	Died at sanitarium	10	1	0	0	0	0	0	0	0	0	10	100	0	0
	Stayed less than one week	1	0	0	0	0	0	0	0	0	0	0	0	1	100
	Total	778	..	151	19	51	6	27	4	39	5	295	38	215	28
Far advanced	Disease arrested	51	15	2	4	1	2	2	4	3	6	29	57	14	27
	Disease improved	116	34	1	1	4	4	1	1	6	5	69	59	35	30
	Disease unimproved	152	44	3	2	0	0	0	0	0	0	98	64	51	34
	Died at sanitarium	24	7	0	0	0	0	0	0	0	0	24	100	0	0
	Total	343	..	6	2	5	1	3	1	9	3	220	64	100	29
	Doubtful cases	2	0	2	100	0	0	0	0	0	0	0	0	0	0
	Incomplete records	11	0	0	0	0	0	0	0	0	0	0	0	11	100
	Grand total	1500	..	329	22	69	5	44	3	55	4	569	37	434	29

TABLE VIII.

FINAL RESULTS IN 602 CASES OF PULMONARY TUBERCULOSIS DISCHARGED 2 TO 10 YEARS AGO.

Stages.	Years in which patients were discharged.	No. originally reported.	Failed to improve under treatment.	Recovered or improved under treatment.	Total No. traced.	Reported as Cured.				Are in good health.	Reported Greatly Improved.				Are in good health.	Reported Improved.				Are in good health.	Permanent Results in				
						Were traced.	Have died.	Are living.	Have relapsed.		Were traced.	Have died.	Are living.	Have relapsed.		Were traced.	Have died.	Are living.	Have relapsed.		Cases reported as recovered.	Cases reported as greatly improved.	Cases reported as improved.	Total number.	Per cent.
Early. Class A	1897 1898	20	0	20	14	14	2	12	0	12	0	0	0	0	0	0	0	0	0	0	12	0	0	12	85.7
	1899 1900	53	0	53	37	34	0	34	0	34	2	0	2	0	2	1	0	1	0	1	34	2	1	37	100.
	1901 1902	53	0	53	43	40	3	37	2	35	2	0	2	0	2	1	0	1	0	1	35	2	1	38	88.4
	1903 1904	45	0	45	45	44	1	43	4	39	0	0	0	0	0	1	0	1	0	1	39	0	1	40	88.9
	Totals..	171	0	171	139	132	6	126	6	120	4	0	4	0	4	3	0	3	0	3	120	4	3	127	91.4
Middle. Class B	1897 1898	37	0	37	24	19	2	17	3	14	4	0	4	1	3	1	0	1	0	1	14	3	1	18	75.2
	1899 1900	80	0	80	62	42	6	36	2	34	16	3	13	1	12	4	2	2	0	2	34	12	2	48	77.4
	1901 1902	139	0	139	102	60	5	55	4	51	28	3	25	4	21	14	4	10	1	9	51	21	9	81	79.4
	1903 1904	94	0	94	77	65	2	63	3	60	7	0	7	1	6	5	4	1	1	0	60	6	0	66	85.7
	Totals..	350	0	350	265	186	15	171	12	159	55	6	49	7	42	24	10	14	2	12	159	42	12	213	80.4
Advanced. Class C.	1897 1898	21	2	19	13	2	1	1	0	1	6	3	3	1	2	5	4	1	0	1	1	2	1	4	30.8
	1899 1900	92	29	63	46	14	4	10	2	8	18	7	11	5	6	14	12	2	1	1	8	6	1	15	30.6
	1901 1902	117	29	88	70	36	10	26	7	19	18	8	10	4	6	16	12	4	3	1	19	6	1	26	37.1
	1903 1904	122	36	86	69	30	10	20	7	13	20	4	16	4	12	19	14	5	1	4	13	12	4	29	42.0
	Totals..	352	96	256	198	82	25	57	16	41	62	22	40	14	26	54	42	12	5	7	41	26	7	74	37.4
All Stages.	Summary .	873	96	777	602	400	46	354	34	320	121	28	93	21	72	81	52	20	7	22	320	72	22	414	68.8

Eight were in the second stage. Six were apparently cured and remain well today. Two were unimproved and died.

Seven were in the third stage. Two were discharged as arrested and are living today, although one has recently had a failure in health owing to hard work and long hours. The five who were discharged as improved are all dead. The fact that all who were only improved died, should not discourage any one, for the term of treatment was over five months in only two cases.

Premature Interruption of Treatment Prevents Favorable Results.

The permanency of results depends very much upon the condition of the patient at the time of discharge. Tuberculosis is a disease which heals slowly, and the cure can not be hurried beyond a certain point. Patients are apt to become impatient over the long time that is required and for one cause or another stop treatment, thus depriving themselves of the best results. This is always a mistake, although in many instances it is unavoidable. Patients should be taught that the last few months of treatment, when they seem and feel well and when changes in the lung are not so apparent to them, are the most important ones from the standpoint of permanency of results. There is a tendency to shorten the term of treatment in tuberculosis. This is a great mistake, even in early cases. An early case should be treated from four to six months. By giving the requisite time more cures will result and they will remain more permanent.

When it is possible to obtain a cure, treatment should not be considered ended until this result has been attained. In some instances a second or third course of treatment may succeed where previous courses have failed. Petruschky ("Kriterien und Kontrolle der Heilung bei Lungentuberkulose," Koch's Festschrift, 1903) recommends what he calls his "etappen methode;" that is subjecting tuberculous patients to several courses of treatment with periods of rest intervening. By this method he has been able to secure excellent results. In the 10 years from 1893 to 1903 he treated 112 patients with this method, with the following results:

Of the 112, 58 were far advanced cases and 54 early cases.

Of the 58 advanced cases, 60 per cent died and 45 per cent were cured.

Of the 54 early cases, most of whom came from families with tuberculous history, none died, and 54, the entire number, were cured.

What is a Cure?

In this connection it is well to consider what may be called a cure. There is no doubt that this is one of our most difficult questions to decide. The mistake is often made of thinking a patient is cured simply because he has regained his weight and ceased coughing and expectorating, or ceased expectorating bacillus-bearing sputum. A moment's thought will show the error of this opinion, for patients may regain their weight and still have active tuberculosis, and they may have infiltrations in the lungs for long periods of time without bacilli appearing in the sputum. The absence of bacilli may simply mean a closed process. Many patients who are called cured are not cured at all, their processes having simply become quiescent. While the absence of all symptoms is very valuable, and when taken in connection with signs of a healed process on auscultation, may afford strong presumptive evidence of cure, yet this is not absolute. The only real reliable test whether or not the patient is cured is the tuberculin test. If the patient, at the end of treatment, has lost all symptoms and physical signs and fails to react to 10 milligrammes of tuberculin, we are then safe in calling him cured. In patients who have been treated by preparations made from the tubercle bacillus this test is not reliable, for one preparation will afford a certain immunity to the others. In such cases the test should be given six months after the completion of treatment when the absence of reaction should be considered proof of a cure.

If a patient obtains a cure so that he does not react to tuberculin, he should, by observing care for one or two years, be able to live an active life, with little if any more danger of a return of the disease than though he had never had it. I think, however, that such a patient would be wise if he were to always spare himself and not subject himself to any unnecessary strain. One or two years of care should be observed in order to allow the scars which form at the site of healing to become firm.

Rales and Permanency of Results.

The difference in the permanency of results when rales still remain in the chest at the time when treatment is discontinued, and when they have entirely disappeared, is shown by Rumpf in Table IX ("Prognose der Phthise," Schröder u. Blumenfeld, Handbuch der Therapie der Chronischen, Lungenschwindsucht, 1904):

TABLE IX.

THE EFFECT OF RALES REMAINING AT TIME OF DISCHARGE ON PERMANENCY OF RESULT.

(Noted Three Years After the End of Treatment.)

At End of Treatment. Rales.	Full working capacity.	Working capacity diminished.	Dead.	Treatment repeated.	Unknown.
Entirely disappeared . .	79.3%	5.1%	1.5%	11.1%	3. %
Still present	31.2%	14.6%	46. %	6.7%	1.5%
Non-consonating	74.3%	6.2%	4. %	13.3%	2.2%
Consonating	21.7%	16.4%	57. %	3. %	1.9%

This also shows that the difference in the permanency of results when rales are present seems to depend somewhat on the character of the rales. If they are consonating the prognosis is not so good as if they are non-consonating.

In the light of such statistics of results we can face the future with courage. We can see that it is possible not only to prevent tuberculosis, but, with an early diagnosis and prompt treatment, to cure it. The enormous waste of human life caused by it is unnecessary. With a better appreciation of its hopefulness impressed upon the minds of both physician and layman, and with a keener appreciation of the part which each is to play in its prevention and cure, the future holds out to us the possibility of its eradication. Shall we wait to take advantage of this hope or shall we "do it now?"

APPENDIX.

CHAPTER I.

THE DUTY OF THE STATE IN THE PREVENTION OF THE SPREAD OF TUBERCULOSIS AND ITS SPECIAL DUTY IN ESTABLISHING STATE SANATORIA.

Tuberculosis is a disease which is fostered by our present day social system. It is caused and perpetuated by poverty and its necessary concomitants, ignorance and filth. While it affects people in all classes, yet it is most commonly found among the poor; and its victims increase with the density of population and the evils accompanying it. The death rate from tuberculosis in cities of over twenty-five thousand inhabitants is almost twice that of the rural population and, in the cities, the death rate in the tenement districts far surpasses that of the well-to-do districts. In Paris, three times as many people die of tuberculosis in the poorest districts as among the well-to-do, while in New York City, in the First Ward near the Battery, fourteen times as many people die of tuberculosis, in proportion to the population, as in a certain ward adjoining Central Park. (Knopf, "Municipal Care of the Consumptive Poor," Boston.)

In a paper before the Tuberculosis Congress in Berlin in 1899, Gebhard (Ausbreitung der Tuberkulose unter der versicherungspflichtigen Befolkerung;" Bericht ueber den Kongress zur Bekämfung der Tuberkulose als Volkskrankheit, S. 80) showed that the death rate among the people is dependent upon their economic condition and varies with their income: "The higher the income the less tuberculosis, and the lower the income the more tuberculosis." He quotes the health report of Hamburg for the years 1896–7 which shows the following facts:

Of one thousand taxpayers with income of	There died of pulmonary tuberculosis.
over 3500 marks ($875)	1.07
from 2000 marks ($500)—3500 marks ($875)	2.01
from 1200 marks ($300)—2000 marks ($500)	2.64
from 900 marks ($225)—1200 marks ($300)	3.93

Thus, among the people with annual incomes of from $225 to $300, three and two-thirds times as many die of tuberculosis as among those who have annual incomes above $875.

The same author cites that more than one-half of the men under thirty years of age and of the women under twenty-five years of age, who were recipients of invalid insurance, were rendered so because of tuberculosis.

Many similar statistics could be produced, but these are sufficient to show that tuberculosis is dependent upon the evils which accompany our social fabric; and, as such, should be dealt with by society as a whole. So deeply rooted is it, that it can never be eradicated without municipal, state and national aid.

Every large city has its hot-beds of tuberculosis. The unsanitary tenements, poorly lighted, with little or no sunshine, where the poorest of the poor huddle together, are constantly transmitting the disease. One of these tenements in New York City is called the "Lung Block." From it, there was reported to the Health Board, in nine years, 265 cases of tuberculosis, and this was perhaps not half of the cases that actually occurred in it. There are 360,000 windowless rooms in New York City, fit only for dens to scatter infection. This same condition exists elsewhere, but we are glad to say that in most cities it has not reached so high a degree. How can this condition be remedied, except by municipal and state aid? These tenements must be replaced by sanitary dwellings, and their occupants must be led to a higher plane of living. These foci for the spread of tuberculosis must be eradicated, and the municipal and state governments must do it.

It is not a matter of indifference to those in better circumstances, whether or not the poor in the tenements are infected and die of tuberculosis, for as long as the disease exists here, it will infect those in other stations of life. Tuberculosis is a mildly infectious, or what I prefer to call a communicable disease, to distinguish it from such virulently infectious diseases as measles, smallpox, diphtheria and scarlet fever. While tuberculosis is communicated from one individual to another, yet a casual association in no wise endangers one; and, an infection is only likely to be transmitted by a prolonged exposure in unsanitary quarters. Measles, smallpox, diphtheria and scarlet fever, on the contrary, are apt to be transmitted by a very brief association, even under hygienic conditions. I further believe that it can be said, without fear of contradiction, that an association with a tuberculous individual in the open air for an indefinite period is free from danger of infection. Fresh air, light and sunshine are nature's enemies of the bacillus and our best protectors, but in many homes, especially those of the poor, none of these enter. Here individuals suffering from tuberculosis infect their rooms and transmit the "plague" to others of their associates.

To meet this condition, not only must the people be aroused and educated, but the poor must be helped. Laws looking toward the protection of the workers must be passed; child-labor must be abolished; shorter working hours, especially for those in unsanitary occupations, must be established; a standard for lighting and ventilation and the proper cubic air space per worker for workshops and homes must be established, and a living wage must be guaranteed to wage earners. These acts contribute very materially, though indirectly, to the prevention of tuberculosis. England, by her workingmen's acts, giving better, more sanitary homes and work-shops to her workers, reduced the mortality from tuberculosis nearly one-half in the half century preceding the discovery of the cause of the disease. Other nations would do well to follow England's lead. If ever tuberculosis is going to be stamped out, and we believe that it is, it will be necessary to improve the hygiene and sanitation of the homes and work-shops occupied by the poor.

It will doubtless be very difficult to interest those, who build tenements simply for profit, in the preservation of the health and life of those to whom they rent their apartments; and until the altruistic spirit becomes universal, it should be the province of governments to define a certain standard of hygiene and sanitation which must be attained.

While society is endeavoring to rid itself of the "great white plague" by raising the standard of living, it must also be mindful of the debt it owes to those who are already so unfortunate as to be afflicted. Fortunately, here, selfishness and altruism meet. The motive which prompts us to help those in trouble, urges us to care for those of our poor who are afflicted with this disease; and, at the same time, self-preservation forces us to the same end. Society, which is responsible for tuberculosis, must take upon itself the burden of its prevention and the care of those afflicted who are unable to provide for themselves.

One of the greatest factors in the warfare against tuberculosis is the State Sanatorium. It attacks the problem from humanitarian, economic, and educational standpoints.

Humanity demands that the state take care of its poor who are mentally and morally defective, and also those who are deprived of certain senses as sight, hearing and speech; and, this obligation is almost universally assumed without question as to its propriety. The same demand is made for those who are so unfortunate as to be afflicted with tuberculosis, and with added reason, because those who are afflicted with this disease are for the most part stricken during the productive part of their lives, when they are of greatest assistance to their families. This is a disease that is curable and its victims, if treated at the right time and in the right manner can be restored to health and earning power.

Think of 150,000 people dying annually in the United States of a preventable and curable disease! Humanity's cry ascends to heaven unheard; the widows and orphans sink into poverty, disgrace and crime. It is estimated that one-fourth of the orphans supported by certain states are rendered so by tuberculosis. It is a potent factor in the production of pauperism. Hillier ("The Prevention of Consumption," page 101) states: "For as the statistics of any poor law work-house or infirmary will show, there is no more fruitful cause of pauperism and invalidity than phthisis."

Without aid, the poor suffering from tuberculosis will almost surely perish, for they cannot cease work as long as they are able to earn wages; for they know the time will soon come when their families will not only be forced to care for them, but will be forever deprived of their support.

The State Sanatorium will offer these people the chance of cure. They can place themselves in these institutions with a hope and expectation that they will be restored to health, and again be able to support their families. Every individual cured in such an institution, as well as many who are only improved, will cease to be a danger to his friends. In the homes of the poor, there is much danger of scattering infection, because of the lack of observance of the rules of hygiene and sanitation and because of the lowered resistance of the poor. Humanity, therefore, demands that State Sanatoria be established, that the afflicted may be cured and that the "great white plague" may not be transmitted to others.

While the unnecessary suffering of the afflicted, the waste of human life, the transmission of the disease to other members of the family who spend their anxious hours administering to the needs of the sufferer appeal to us, yet the demand for a State Sanatorium does not emanate from mere sentiment alone. There is an economic side to these institutions. Every State Sanatorium is a monetary investment, which will return to the state many times the cost of its maintenance. Tuberculosis is a disease which afflicts men and women when they are in the flower of manhood and womanhood, the time when they are of greatest value o the family and the state, and the saving of these valuable lives would be a great economic saving.

The death rate from tuberculosis in California, for example, as reported, is about 3500 annually. For various reasons, a certain proportion who die of tuberculosis are reported as dying from other causes, so the number appears somewhat smaller than it should be. Allowing liberally for the imported cases, our state is perhaps losing 2500 of its citizens every year from this preventable and curable disease.

It is very difficult to place a value on a human life, but taking Bigg's estimate that a human life at the average age at which death from tuberculosis occurs is worth $1500 to the state (and I am sure this is very low), then California loses annually from this cause alone, $3,750,000. These patients are disabled and unable to work for a certain period before death; it would be fair to assume nine months as an average time. During a portion of this time, too, they are helpless and must have some one to nurse them. Medicines and physicians' services are also required. If we take as wages the low rate of $1.50 a day and count for care, medicines and professional service $1.50 more for but half the time, we have an additional loss for each person of $605.50, or an annual loss of $1,518,750 or a total annual loss based on these low estimates of $5,268,750. This enormous waste of money and sacrifice of human life is totally unnecessary. The attendant sufferings and heartaches are permitted to wear away the body and harass the mind without just cause, for tuberculosis is a preventable and curable disease. The state must awaken and do its duty in preventing and curing this disease. If the value of State Sanatoria were to stop at the curing of those who are treated therein, they would be demanded by every sense of justice that exists in the human mind. But it does not stop here; it extends to the countless numbers who will be infected by those who are now afflicted, unless properly cared for and educated. It extends to those of our citizens who by taxes or private charity help to support institutions, such as orphan asylums, poor houses and penitentiaries, wherein many inmates are found because of the physical, mental and moral decay caused by tuberculosis. Its value extends to the entire race of mankind. If we can rid the human race of tuberculosis, we shall take away one of the greatest factors making for deterioration and decay.

We can not estimate the good done by the State Sanatorium; we can only make a rough calculation as to its economic worth.

A State Sanatorium capable of accommodating two hundred patients would be able to care for four hundred patients a year, since the average stay at such an institution is about six months. Taking the results obtained at Rutland, Massachusetts, the first State Sanatorium established in the United States, as an example of what can be done, such an institution would have an excellent record. At Rutland, about fifty per cent of those who enter are cured, while another forty per cent are improved. Applying this to our institution of two hundred capacity, at the end of a year it would have the following to its credit:

200 human lives saved, valued at $1500	$300,000.00
Wages which would have been lost, food, medicines and care which would have been necessary for 200 patients, had the disease continued to a fatal issue, estimated as above at $605.50 each	121,100.00
160 lives prolonged and restored to an earning capacity for an average period of two years at $1.50 a day, counting 300 days to the year	144,000.00
	$565,100.00

But this is not all. Every patient infects, on an average, about one other. It is safe to assume that those who are treated in sanatoria are so instructed as to the method of scattering infection that they cease to be dangerous to their companions; hence, the infecting of four hundred new individuals is prevented, with a like saving of $2,106.50 each, or $842,200.00. Such an institution, then would annually save, simply by curing and restoring of patients to their earning power and by preventing further infection, the enormous sum of $1,407,300.00; not to mention the saving in moneys which would be necessary for the care of those who would have been rendered dependent, had the disease taken its natural course.

Such estimates but poorly represent the value of State Sanatoria. Great as this economic saving appears, it is the least important of the functions of these institutions. Their principal mission is far greater and nobler than the mere saving of money. It is that of preventing the spread of tuberculosis, the greatest scourge known to the human race, a scourge which has caused more suffering, more heartaches, more poverty, more deaths than all the wars of the centuries.

State Sanatoria are important educational centers, where object lessons in the prevention of tuberculosis are given. The patients treated in these institutions come from the homes of the poor. They are taken from their squalid surroundings, where in their ignorance they could scarcely help infecting their friends, and are placed under hygienic conditions to be cured, if possible; if this is not possible, they are at least taught that the chief source of danger lies in the sputum and with careful instruction how to care for this, they cease being a danger to their fellows. They are also taught that fresh air, regular habits and careful living have much to do, not only with curing the disease or prolonging life, but also with preventing the spread of the disease to others.

The individuals treated in these institutions return home as missionaries. In many instances they carry the first rays of hope into the crowded tenements. They teach that air and better living are necessary to life. One such returned missionary can do more by a practical illustration than a score of charity workers. As, in foreign mission fields, it is shown that the native converts are the most influential in spreading the new thought, so it is here. Every one returned from a State Sanatorium is a power for not only the prevention of tuberculosis, but for the betterment and elevation of the class from which he comes; and, when the eradication of the "great white plague" has finally been accomplished, it will not have been done except indirectly by philanthropists, charity workers and health boards, the actual work will have been done by those who have been taken from the homes where tuberculosis develops, and lead to an appreciation of the necessity of better, more hygienic living, and to this end no institution will contribute more than the State Sanatorium.

CHAPTER II.

A STUDY OF TUBERCULOUS INFECTION.

The material for this chapter was originally published in the New York Medical Journal, March 21, 1903. Owing to the fact that the question of infection as discussed here has only been discussed incidentally in the body of the book, and owing to the fact that there have been frequent calls for reprints of this paper, I thought it best to republish it as a chapter in the appendix.

TUBERCULOSIS OF CHILDHOOD. WHY SO PREVALENT?

In our endeavor to find methods to prevent tuberculosis, we must give the period of childhood much more attention than it has been wont to receive; for it is not only possible, but probable, that the seeds which ripen into full fledged cases of tuberculosis in later life were in very many cases implanted in the tissues during the period of childhood, remaining there until a favorable time appeared for their activity. Bollinger[1] states that he has shown tubercle bacilli to be still virulent although encased in glands for twenty years.

That form of the disease which is most common in childhood, is tuberculosis of the lymph glands, although it is not uncommon to find the lungs and meninges affected. Why the lymph glands are so prone to infection and why the disease does not make advancement at this time into the lungs or other parts of the body more often than it does, are questions that have never been answered entirely satisfactorily. Since the answers to these questions will throw much light upon the subject before us, we will now inquire into them at some length.

Cornet[2] says that by several hundred animal experiments he has been able to arrive at the conclusion that the mucous membrane can be penetrated by bacilli, though intact, and that, in young animals, owing to the membranes being more easily penetrated and the lymph spaces being larger than in adults, the bacilli are more easily taken up; hence the lymph glands are more easily affected. In adults, on the other hand, bacilli penetrate less easily and are more likely to cause a local process at the point of entrance. Orth,[3] Klebs,[4] Baumgarten[5] and others have carried out similar experiments, arriving at the same conclusions.

[1] Bollinger. *British Medical Journal*, Oct. 17, 1896, p. 64.

[2] Cornet. *Die Tuberculose*, p. 288.

[3] Orth. Experimentelle Untersuchungen über Fütterungstuberculose, Virchow's *Archiv*, Bd. lxxvi, p. 217.

[4] Klebs. *Allgemeine Pathologie*, p. 236.

[5] Baumgarten. Ueber die Uebertragbarkeit der Tuberculose durch die Nahrung, *Centralblatt für klinische Medicin*, 1884, p. 225.

Jacob and Pannwitz[1] say: "That glandular tuberculosis is more common than that of the lungs (in childhood) is due to the anatomical and physiological arrangements of the parts."

Ponfick[2] says that the lymphatic vessels are disproportionately small compared with the amount of lymph to be carried off; so the least irritation causing an increase of lymph is accompanied by stasis, and a tendency to suppuration if continued long. All such irritations predispose to infection. He also, says: "The existence of this universal susceptibility (to scrofula) rests in certain peculiarities of the structure and mutual relation between the organs, which, it is generally admitted, the childish organism possesses; and which normally presupposes a high morbidity. This peculiarity is founded, on the one hand, on the greater power of absorption of the tissues as well for bacteriological intruders as for certain excretive products, and, on the other hand, on the local development of a pathological condition favorable to their spread and growth."

Virchow speaks of a weakness or imperfect arrangement of the lymphatics in certain individuals as a cause of scrofula.

Whatever the cause of this manifestation in early childhood may be, we know that there is a tendency in a certain not inconsiderable proportion of children to inflammation and enlargement of the lymphatic glands. And we further know that many of these pathological processes are, sooner or later, found to be tuberculous in their nature.

The cause of this frequent lymphatic involvement, I believe, must be sought, not only in the anatomical and physiological arrangement of the lymphatic system, but also in the reduced vitality from which these little ones often suffer. To the natural weakened condition incident to infancy and childhood, which makes them an easy prey to infection, we must add the peculiar weaknesses that come through heredity and the lowered resistance that comes through living in insanitary and unhygienic surroundings as well as from errors in feeding and the various diseases from which they suffer; then, we can better understand why they are prone to infection by the tubercle bacillus. We can not change the normal anatomical and physiological processes, nor can we blot out the inherited tendencies, but we can change the environment in which these little ones live, so as to make these inborn weaknesses less noticeable and these downward tendencies less operable.

If the accepted belief, that a lowered resistance is necessary to infection, is true, then we can hope for much by bettering the sanitary and hygienic conditions and improving the nutrition of individuals. From what precedes, we can see that this prophylaxis should begin as soon as the child is born; for the evil influences which lower vitality are thrown around children from the very beginning of life.

[1] Jacob und Pannwitz. *Entstehung und Bekämpfung der Lungentuberculose*, p. 221.
[2] Ponfick. *Allgemeine medizinische Central-Zeitung*, December 29, 1900.

Children are, with few exceptions, born free from tuberculosis; and statistics show that the danger of infection increases toward the end of the first year, is maintained during the second year, and then gradually declines as childhood advances.

In this connection the following statistics are of interest:

The total number of deaths in the city of New York during the years 1890–92 inclusive, was 128,136. Of these, 32,916, or 26 per cent, died during the first year; 43,463, or 34 per cent, before the end of the second; and 46 per cent before the fifteenth.[1]

When we consider the appalling morbidity which must accompany such a high mortality, we see that the conditions which lower vitality and predispose to tuberculosis are active from birth. The great majority of children are ill and suffer from lowered vitality during the first years of their lives, thus rendering infection easy.

There is a marked coincidence between this great general morbidity and the infection and mortality from tuberculosis, as the following statistics will show:

Heubner[2] observed 844 children under three months of age without discovering a single case of tuberculosis; 218 between three months and six months, with 8 cases, or 3.6 per cent; 93 between six and nine months, with 11 cases, or 11.8 per cent; 75 from nine to twelve months, with 20 cases, or 26.6 per cent; 45 from one to two years, with 14.2 per cent; and 367 from two to three years, with 13.4 per cent.

In 36 sections made by Neuman[3] in children from birth to five months of age, tuberculosis was not found; in 33 cases from six to twelve months it was present 7 times, or in 21 per cent; in 28 cases from one to two years it was present 10 times, or in 35.7 per cent of the cases.

Cornet[4] analyzed the post-mortem records of the Berlin Pathological Institute from 1876–1891, as to the relative number of deaths from tuberculosis, with the following results:

In 486 cases from birth to the end of the first month, tuberculosis was not present; in 33 cases from two to three months, it was present twice, or in 6 per cent of the cases; in 76 cases from three to six months, 8 times, or 10.5 per cent; in 88 cases from six to nine months, 14 times, or 17 per cent; in 65 cases from nine to twelve months, 18 times, or 27.7 per cent; in 311 cases from one to two years, 83 times, or 26.7 per cent; in 189 cases from two to three years, 56 times, or 29.6 per cent; in 160 cases from three to four years, 15 times, or 31.8 per cent, and in 134 cases from four to five years, 30 times, or in 22.4 per cent.

Still[5] reports 769 post-mortems upon children under twelve years of age with tuberculosis present 269 times, or in 35 per cent of the cases.

[1] Holt. *Infancy and Childhood*, p. 40.
[2] Heubner. Zur Verhütung der Tuberculose in Kindesalter, Berlin Congress, 1899.
[3] Jacob und Pannwitz. *Entstehung und Bekämpfung der Lungentuberculose*, p. 198.
[4] *Ibid.*
[5] Still. *British Medical Journal*, August 19, 1899.

Hand[1] reported to the Philadelphia Pathological Society statistics of post-mortems at the Children's Hospital, for the past ten years. Of 332 autopsies made, 115, or 34.3 per cent, showed tuberculosis. The location of the oldest lesion was: bronchial glands, 65 per cent; mesenteric, 8.7 per cent; undetermined (lesion general), 23 per cent; undetermined (lesion distinct), 1.7 per cent; tonsils, 0.8 per cent. Tubercles were present in the heart muscle in 8 per cent of the cases showing tuberculosis.

Too little attention has been paid to the mode of infection and the time that it takes place. When the theory of heredity, as a general cause of tuberculosis, was disproved, it seems strange that science did not bend her energies to discover when infection does take place; but, owing to the interest that centred in other phases of the subject, this has not received the attention that it deserves.

These statistics show us that tuberculosis begins to assume prominence in the last quarter of the first year and that it causes quite a proportion of deaths during the early years of life. While they show the frequency with which tuberculosis either causes death or is present at the time of death, they do not tell us how frequently tuberculous processes are present in those who are living. Such information can not be attained so easily. Attempts have been made, however, to gain this important information; and, while the results are not absolutely reliable, they are sufficiently so to give us an important link in the chain of evidence which favors the lymphatic route of infection.

Krueckman[2] has shown, and in this he is corroborated by others, that the lymphatic glands in children are usually infected before the lungs.

We have now seen how frequently tuberculosis occurs in infancy and early childhood. The next point that we wish to call attention to, is that the glands, especially the bronchial and tracheal, and in a less measure, the mesenteric and retroperitoneal, are nearly always infected when tuberculosis is present; and, since the foci which are farthest advanced are usually situated in some of them, it would suggest them as the original points of infection.

Henoch[3] says: "When tubercles or cheesy processes are found anywhere in the body, one can count it for almost certain that the bronchial and tracheal glands are likewise affected. In the many sections that I have made I have noted very few exceptions to this rule."

Steffen[4] shows the tracheal and bronchial glands to be affected in 54 of 62 cases of tuberculosis; and the mesenteric and retroperitoneal 35 times.

Bulius[5] reports post-mortems on 27 nurslings with tuberculosis in whom he

[1] Hand. *Medical News*, November 22, 1902, p. 904.
[2] Krueckman. Virchow's *Archiv.*, No. 138, Heft 3, s. 534.
[3] Henoch *Kinderkrankheiten*, 1893, p. 413.
[4] Steffen. *Zur pathologischen Anatomie des kindlichen Alters*, p. 143.
[5] Bulius. *Jahrbuch für Kinderheilkunde*. Bd. 40, 1890, p. 304.

found the bronchial glands affected every time and showing the furthest advanced lesions.

Cornet[1] cites the following:

Steiner and Neureuter found the lymph glands affected 299 times in 302 post-mortems—the bronchial glands being involved 286 times.

Rilliet and Barthez found lymphatic glands involved 248 times in 312 cases.

Northrup reports glandular involvement every time in 125 cases.

Thus, pathological evidence shows that the glandular system is involved in practically all cases of tuberculosis in children; and not only involved, but the first to show the disease in a large majority of the cases, if this can be inferred from the fact that the glands show the most advanced processes.

While nearly all cases of tuberculosis in childhood show tuberculosis of the glands, this does not say that all cases of tuberculosis of the glands show tuberculosis elsewhere; nor does it allow the inference that all cases of enlarged lymph glands are tuberculous.

The work of Volland[2] is most important in its bearing upon this point. He examined 2,506 school children with reference to the frequency of enlargement of the cervical lymphatic glands, obtaining the following results:

Of 628 from seven to nine years of age, there were 607, or 96.6 per cent, positive.

Of 724 from ten to twelve years, 664, or 91.6 per cent, positive.

Of 722 from thirteen to fifteen years, 607, or 84 per cent, positive.

Of 334 from sixteen to eighteen years, 233, or 69.7 per cent, positive.

Of 98 from nineteen to twenty-four years, 68.3 per cent, positive.

By clinical examination Berutti[3] found the glands of the neck involved in 88.2 per cent of cases.

Balman in 81 per cent.

Wohlgemuth in 430 cases, 93 per cent.

These statistics show us that the lymph glands are almost universally enlarged in childhood, and, while we do not suppose that they are always tuberculous, nevertheless, we know that they frequently are; and, if not already so, the inflammatory condition present is the surest preparation for infection by the bacillus tuberculosis. In this connection I quote Steffen:[4] "Healthy lymph glands are not attacked by tuberculosis. They are predisposed thereto when they are swollen, succulent and infiltrated, and in a condition of hyperplasia."

Osler[5] says: "A special predisposing factor in lymphatic tuberculosis is a catarrhal inflammation of the mucous membranes, which in itself excites a slight adenitis."

[1] Cornet. *Die Tuberculose*, p. 178–9.
[2] Volland. *Zeitschrift für klinische Medicin*, No. 23, 1893.
[3] Cornet. *Ibid.*
[4] Steffen. *Zur pathologischen Anatomie des kindlichen Alters*, p. 159.
[5] Osler. *Practice of Medicine*, 1892, p. 205.

That a very large per cent of these enlarged glands are tuberculous is shown by the experiments of Otis[1] and Heubner.[2] The former tested 29 children with tuberculin, being all who presented themselves at the clinic during the investigation. Of these, 18 reacted positively, and 2 doubtfully, making from 62 to 69 per cent of the number. Of the 11 who did not react, in 6, the enlargement had existed only from one to two weeks. The majority of the reactions occurred where the enlargements had existed for six months or more. I quote his conclusions: "If then the tuberculin test is to be relied upon, our experience would indicate that at least 62 per cent and probably a larger proportion of enlarged glands of the neck are tubercular." In another series, he tested 56 cases and found 33 that reacted well, 6 slightly and 2 doubtfully, making 58.8 per cent without doubtful ones, and 73.2 per cent with them.

Heubner tested 17 scrofulous children and found positive reactions in all but one.

Moore[3] reports 28 cases of enlarged glands, mostly of the neck, which had to be operated on for various reasons. Of these 73 per cent were tuberculous.

Osler[4] quotes the experiments of Eve as showing that scrofulous material invariably produces tuberculosis in guinea pigs, and often in rabbits.

The contribution of Blos[5] to this subject is most important. He reports 328 cases of tuberculous lymphoma occurring in Czerny's clinic, in Heidelberg, during the years 1886 to 1895. Of this number he followed the subsequent histories for a period varying from three to twelve years and found that 40 per cent of them developed tuberculosis in that time. He has likewise collected the records of 2,300 cases studied in the same manner, and arrives at the conclusion that the enlarged glands in childhood are the primary foci from which the disease develops in later life in a very large proportion of cases. While Osler[6] does not go so far as Blos, yet he says: "It is safe to say that in three-fourths of the instances of acute tuberculosis the infection is derived from this source," meaning an unhealed focus of tuberculous adenitis. On this point I also quote Steffen:[7] "The lymph glands offer in a great number, perhaps in the majority, of cases of tuberculosis of individual organs, the primary seat of tubercle formation."

While these statistics do not admit of any conclusion in the nature of a mathematical certainty, nevertheless, when we consider them as a whole, we have some very important data from which we can draw inferences, if not positive conclusions. We are at least justified in saying that:

[1] Otis. *Transactions of the American Climatological Association*, 1899, and *Medical News*, July 1, 1898.
[2] Heubner. Quoted in Jacob und Pannwitz, p. 223.
[3] Moore. *Lancet*, September 17, 1898, p. 734.
[4] Osler. *Practice of Medicine*, 1895, p. 225.
[5] Blos. *Mittheil. aus d. Grenzgebieten der Medizin und Chirurgie*, 1890, No. iv.
[6] Osler. *Practice of Medicine*, 1892, p. 206.
[7] Steffen. *Zur pathologischen Anatomie des Kindesalters*, p. 159.

1. Tuberculosis is common in childhood, causing about 25 per cent of the deaths occurring during the last quarter of the first year, and quite a large proportion of those during the second and third years.

2. Nearly all cases of tuberculosis show involvement of the lymph glands; and if the fact that the process is furthest advanced is an indication, they are in a large percentage of cases to be considered the primary foci.

3. Nearly all children show enlarged glands during the period of infancy and early childhood, of which investigation seems to show from 60 to 70 per cent to be tuberculous; and, of those chronically enlarged, even a larger per cent are so affected.

4. A large per cent of those who have enlarged glands during childhood develop tuberculosis in later life; and it is probable that the gland was frequently the primary focus whence came the spread of infection.

It now remains to show what becomes of the bacilli and tubercles which are found in these lymph glands in childhood.

Why the bacilli, in these children with lowered vitality, do not produce a general tuberculosis at once has not been satisfactorily explained. We must remember that the lymphatic elements have a defensive function; and, may it not be probable that the bacilli meet such opposition in these structures that they are unable to make further headway at the time; but, after a time, the bacilli become accustomed to and adapt themselves to their new environment. Experiments show that the bacilli that come from these glands are less virulent than those that come from other foci, as the lungs. Whether this is due to the absorption of germs of less virulence, and the absence of a general infection is due to this; or whether the lessened virulence is due to the action of the various lymphatic elements upon them; or, whether it is to be accounted for by saying that the rapidity of the process depends upon the number of the bacilli which cause the infection, we are not able to say. Perhaps all of these are to be considered. It must be remembered, as shown above, that the bacilli, when thrown out of the system, are almost always cast into an environment unfavorable to them. The temperature is either too low or too high; or the atmosphere is too dry; or they are exposed to the light or the direct rays of the sun. Consequently, the only bacilli that are taken into the system in a highly virulent state are those that are taken directly from the infected person or from bacillus-bearing material which has been freshly cast off, or from a case in which the bacilli are specially virulent. Such an infection can come through kisses, by the use of the same table ware, or by any very intimate association.

If this theory of infection by germs of lowered resistance together with the defensive action of the lymph elements, is to account, either in part or wholly, for the localization of the tuberculous process that is noted so often in childhood, then we should expect to find that those children who live in intimate association with tuberculous patients, if they develop the disease, are most apt to take on extension to other parts of the organism at once. On this point it would be well to gather statistics, to see if they do undergo a more virulent course than those who receive their infection from a less intimate connection. The statistics which I have at hand indicate this; but they do not cover enough cases to warrant a positive conclusion.

When the bacilli find their way into a lymph gland, if they are not destroyed three courses are open to them. They may cause a local degenerative process in the lymph gland, or they may be carried on into the distant parts of the organism, as the lungs, through the lymph or blood channels; or, they may become encased in the glands to remain quiescent forever unless they are carried out into the lymph or blood stream at some future time, when the gland involved is irritated and swollen from some cause, as is the case in the acute infectious diseases.

That this extension from the lymph glands into the blood vessels, and thence into the lungs or other parts of the body, can take place, has been demonstrated by Aufrecht[1] who has removed the lungs and heart *in toto* from cadavers; then, laying open the arteries and veins, he cut out the portions containing lymph nodes which were firmly adherent to the blood vessels. After hardening and making sections, he arrived at the following result: "Each section passed through both lymph node and vascular wall. Proceeding thus he (the assistant) was able to supply clear proof that the bacilli from the lymph node had passed into the substance of the vascular wall without injury to the latter. Both arterial and venous twigs were thus studded with bacilli as far as the inner surface. One preparation showed a bacillus in an endothelial cell."

From our study thus far, we are compelled to assign an important place to childhood as the time in life when the tubercle bacillus gains entrance to the tissues. The tissues at this time are succulent, easily penetrated, and possessed of feeble resistance. The bacilli are taken in, either with currents of air, with food, or along with other things that the child puts into his mouth; or, it may be, through wounds of the surface. No matter in what way they gain entrance, they pass readily into the lymph spaces and on into the lymph glands.

A discussion of this subject would not be complete without mentioning the part played by tonsillar tissue in infection. That this is a port of entry for the bacillus, can not be denied. Numerous experiments have been made showing tubercle bacilli present in tonsils and adenoids when the disease was not to be detected elsewhere in the body. Lermoyez,[2] by inoculating guinea pigs, secured positive results in 13 per cent of the trials with tonsils and 20 per cent where adenoids were used. Positive results have also been obtained by Dieulafoy, Brindle, Gottstein and others.

[1] Aufrecht. *Berliner klinische Wochenschrift*, October 21 and 28, 1901. Translated in *Journal of Tuberculosis*, Vol. iv, p. 167.

[2] Lermoyez. Quoted by Wright, in *New York Medical Journal*, September 21, 1895.

The writer,[1] in discussing this subject in a former paper, said: "Whether or not tubercle bacilli are found in tonsillar and adenoid tissue at all times in sufficient numbers to infect guinea pigs is not the question. Experiments do show that they are found in individuals who are apparently free from tuberculosis; which fact leads at least to the inference that tonsils and adenoids may be ports of entry whence the germs pass on into the lymph stream."

We will now pass on to the second part of our subject and inquire why infection is so prevalent in childhood? This has already been answered in part, but we will now inquire more particularly into the predisposing causes which are incident to childhood.

The first thing that strikes us is the widespread morbidity present at this time. The statement of Holt, quoted above, that 26 per cent of all children born in New York in the years 1890–92 inclusive, died before the end of the first year, and 34 per cent before the end of the second year is startling. Such a mortality must of necessity represent a much greater morbidity. The great majority of children are ill, more or less, during the first and second years of their lives. At this period, when they are least able to resist bacterial invaders, owing to the natural immaturity of their tissues, they have superimposed upon this natural weakness a vitality much reduced by disease. It would seem that it were more than coincidence that at the very time when these little ones are most prone to other disorders, the greatest number of them should succumb to tuberculosis. The most prevalent trouble at this time is connected with the digestive tract, which results in an inflammatory condition with abrasions of the surface. Owing to poor ventilation and bad hygiene and general mismanagement of the child at this time, it is apt to suffer, more or less, from catarrhal conditions of the upper air passages with abrasions of these surfaces as well. So we find those conditions present in both the respiratory and digestive tracts which make infection easy and certain.

The nature and habits of the child also make it prone to infection by bringing it in frequent contact with the bacillus. Being helpless it is carried about and fondled by its nurse and attendants without regard to whether they are tuberculous or not. Everything that comes within reach of the child is put into the mouth. The hands are constantly going from floor and furniture to the mouth, carrying with them dirt and dust ladened with bacilli.

In this connection the experiments of Preisich and Schuetz[2] are very important in showing how great this danger is. These experimenters examined the dirt under the finger-nails of sixty-six children whose ages ranged from six months to two years. These children were taken at random from the ambulatory clinic of the Stefanie Children's Hospital. The examinations were

[1] Pottenger. The Rhinologist an Important Factor in the Prevention of Tuberculosis, *The Laryngoscope*, June, 1902.

[2] Preisich und Schuetz. Infectiosität des Nagelschmutzes bei Kindern in Bezug auf Tuberculosis. *Berliner klinische Wochenschrift*, May 19, 1902.

positive in fourteen instances, 21.2 per cent. Considering all these things is it any wonder that living tubercle bacilli are found in the lymph glands of so large a proportion of children?

TUBERCULOSIS IN ADOLESCENCE AND ADULT LIFE.

I do not wish to be understood as denying the occurrence of infection in adult life, for we see many cases in which it is unquestionable; but, I do believe that we have been too prone to accept the time when the disease became manifest to the patient or attending physician as the time when infection occurred. On the contrary, in many of these cases, infection must have occurred a long time before. For example, many of the cases of tuberculosis which so commonly follow the acute infectious diseases, such as influenza, measles, and whooping cough, we know must have been due to the lighting up of some previously quiet focus; for, there could not have been time for the invasion to have taken place with the formation of tubercles and the production of such advanced lesions in so short a time; and, too, in many of these cases, there has been no intimate association with tuberculous patients nor has there been any discoverable exposure to infection while suffering from the acute illness; so we should find it much more difficult to account for the infection as taking place at the time of the acute illness than to suppose the disease to be due to a previously quiet focus.

Until we have further proof, we shall be compelled to recognize the possibility of infection taking place through direct inhalation of bacilli into the lungs; but we must also recognize that, in order for this to take place, there are difficulties to be overcome which are almost insurmountable.

It is very important, in the study of the prevention of tuberculosis, to know when infection takes place; for then we can know where to direct our preventive measures. Of course, the primary place to direct such measures is towards the destruction of sputa and the bacillus-bearing discharges of whatever nature. Aside from this, however, we must look carefully after the individual, and this care must be bestowed at that time when infection is most likely to take place. If, as is shown above, the great majority of children have enlarged glands, and these are tuberculous in a very large per cent of those that are chronically enlarged, then the period of childhood must receive our most scrupulous attention. While these bacilli may remain inactive in the glands throughout life, yet they are a constant menace to the individual. They are found in the glands of persons dying of violence and acute diseases in a surprisingly large number of cases, their presence never having been suspected during life. Pizzinni[1] states that he has found virulent tubercle bacilli in 42 per cent of such cases; while Spengler and Kossel also report positive findings in a large per cent of their cases.

[1] Pizzinni. Quoted in Jacob und Pannwitz, p. 226.

Briault and Frenkel[1] examined carefully 83 bodies in the hospital at Lyons, dead of diseases other than tuberculosis, and found 67 or 80 per cent to have concealed tuberculous foci.

Bollinger[2] found one-third of the bodies, dead of other diseases, to contain healed tuberculous foci.

Birch-Hirschfeld[3] made autopsies on 196 cases of accidental death during the years 1896–98, in the Pathological Institute at Leipsic. In none of these was tuberculosis suspected during life, yet lung lesions were found in 42 instances, 21.4 per cent of the cases. Of these, 29 cases were healed and 13 latent.

It will be interesting and profitable to study the manner in which the bacilli find their way into the lung from one of these lymph glands. This has been admirably summed up by Jacob and Pannwitz[4] in a manner which secures every step as taken. Given affected lymph glands they proceed to account for the infection of the lungs upon the authority of the great teachers.

Cornet says: "Through whatever influence the resisting power of an individual is lowered, conditions can come about under which the bacilli slumbering in the glands become mobilized, break through their capsule, and by way of the lymph stream reach the blood to be carried to the lungs."

The accepted theory of Virchow makes this the more plausible, for he says: "An irritation of the lymph glands comes with every inflammatory disease, which (irritation) is caused by the gland being called upon for an increased cell production. Its follicles are enlarged. They contain more cells than previously, which are washed out into the blood. So a condition of leucocytosis accompanies every disease which brings with it an irritation of the glands."

Metchnikoff has proved, and this has been accepted, that in all infectious disease the white corpuscles are to be looked upon as bearers of the infecting germs.

Goldscheider and Jacob have shown that when an increase of wandering leucocytes occurs in the body, no matter what the cause may be, they are heaped up in the capillaries of the lung in such a manner as to cause a thrombus.

Weigert, in discussing the cases of tuberculosis which are so prone to follow measles, says that when a portion of the lung is in a condition of inflammation in an individual whose glands contain virulent tubercle bacilli and who is suffering at the time with such a disease as measles, numerous bacilli are carried from the glands by the white corpuscles and deposited in the inflamed lung. Whether or not a tuberculosis develops at once at the point of deposit depends

[1] Quoted by Heubner. "Die Verhütung der Tuberkulose im Kindeersalter." *Report of Berlin Tuberculosis Congress*, p. 287.
[2] Quoted by Curschmann. *Report of Berlin Tuberculosis Congress*, p. 359.
[3] Birch-Hirschfeld. *Report of Berlin Tuberculosis Congress*, p. 213.
[4] Jacob und Pannwitz. *Entstehung und Bekämpfung der Lungentuberculose*, p. 227.

upon the virulence of the germs, the grade of injury to the lung, and the general resistance of the patient.

Thus, we have a rational basis upon which we may account for many otherwise inexplicable cases of tuberculosis, such as follow immediately upon acute infectious diseases and injuries. In these cases, if the disease manifests itself at once while the acute illness is still on, the probabilities are that it is the awakening of some previous infection; if it manifests itself later, it may be the result of either a new invasion from the lymph gland into the lung or the lighting up of a slumbering focus, or a new infection from without.

The glands once affected or the lungs once the seat of tubercle, though quiescent, there are abundant opportunities during the struggle which is incident to human life for the starting up of an acute process. Adolescence is the period when tuberculosis is most prone to become active. At this time there is a special strain upon people. They are oftentimes depressed. The sexual changes are taking place and many are addicted to indiscretions. Social functions are taxing both physical and mental powers. Studies at this time are hard for them, or, if they are not in school, they are most likely doing work too difficult for their strength. So we find this to be a second period in life when vitality is low; and, like the one in early childhood, it is a period marked by the great number of cases of tuberculosis present. In later life, the earning of a livelihood, business worries, family troubles, various diseases and vicious habits depress the individual, lower his resisting power, and make the soil ready for either new infection or activity in old regions.

From this investigation, I would draw the following conclusions:

1. Tuberculous infection is very common in early childhood.

2. A large proportion of those patients who, although infected, do not show acute symptoms during childhood, develop active tuberculosis in later life.

3. In seeking the cause of this frequent infection, aside from the habits of the child and the carelessness of the parent bringing it in frequent contact with the bacillus, all those things which lower vitality at this time must be considered and, I would call special attention to the fact that there is a connection which seems more than coincidence in the time that tuberculous infection takes place and the time that the child is most apt to suffer from catarrhal conditions of the stomach and bowels.

4. More attention should be given to the care and feeding of children, so that their systems may be resistant to infection.

5. All tuberculous children, whether they have lesions in the glands, bones, lungs, or any other part of the body, should be treated for their disease.

CHAPTER III.

CULTURE PRODUCTS IN THE TREATMENT OF TUBERCULOSIS.

The material in this and the succeeding chapter was published originally in the Therapeutic Gazette of January, 1902, and March, 1903. Chapter III was one of the first papers to appear in America telling why tuberculin failed, and Chapter IV was the first collective investigation which endeavored to gather together the opinions of men who were especially interested in the treatment of tuberculosis, and present their opinions of tuberculin and its therapeutic use. The demand for these two papers, like the preceding one, has been so great that I believe my readers will appreciate their appearance in this form.

In presenting a paper before this society upon the subject which I have chosen, I recognize full well that there is no specific remedy for tuberculosis, which is recognized by the medical profession generally; none which corresponds to antitoxin in diphtheria, the iodides and mercury in syphilis, or quinine in malaria; yet there are certain remedies which, while they have enjoyed only a limited trial by the profession, are found to have a specific action upon tuberculous tissues wherever found.

That the value of these products has not been recognized is due to a misconception of what should be expected of such remedies. Antitoxin is recognized as the anchor of hope in diphtheria; yet the profession well knows that to be efficacious, it must be used early; and all things being equal, the prognosis varies with the early or late administration. So it is with other diseases. The earlier the case falls into the physician's hands, the better. In surgery, we know the knife is a specific for many troubles; yet its field of usefulness is limited, and after a certain point in the disease has been reached this specific fails. While the field of these specifics is limited, yet their value is recognized, and in no way impaired by the fact of this limitation. On the other hand, the profession bends every energy to bring the cases under treatment during the period when the remedies are valuable. In the case of tuberculosis, however, the profession has not been satisfied with a remedy of limited value. It has been unreasonable, and demanded that a remedy to be useful and to be recognized must not only cure tuberculosis, but remove dead and decaying tissue; not only cure the disease, but remove all results caused by the disease. Such demands are unfair and preposterous. If the same test were applied to other remedies, how many would stand? In tuberculosis we must demand no more of a remedy, and no less, than in other diseases. As the followers of the healing art, we should seize upon everything that will help, and apply it to the advantage of the patient, not discard even the smallest thing that will aid us to combat disease. To correctly estimate the value of a specific remedy in tuberculosis, we must properly define our disease. We must distinguish between tuberculosis and consumption. Tuberculosis in its early stages—that is, while it is pure tuberculosis—is a very curable disease, yielding as readily to treatment as typhoid fever or pneumonia. But when this pure tuberculous process has changed, and its place has been taken by ulcerations, cavities, cheesy nodules, and these often surrounded and embedded in fibrous tissue—in other words, when consumption has supervened—then the picture is different. We have not pure tuberculosis to deal with, but the results of tuberculosis. Tuberculosis itself will yield readily to treatment, but these results are very difficult to combat, and a remedy for the former should not be expected or required to remove the latter. It would be as reasonable to ask of a remedy for a surface ulcer to remove the resulting scar. So, if we have a remedy at our command which can be shown to have a specific action upon tuberculous processes, we should hail it with delight, not demand of it that it remove cavities and cheesy nodules; but we should improve our method of diagnosis so that we might recognize the disease while it is in the purely tubercular stage, and while the remedy is applicable.

Advances in the field of medicine, as elsewhere, are slow to be recognized. Every new theory must force its way against the prejudices of preconceived ideas; and, if at all revolutionary, meets most bitter opposition. Harvey, when he had called his *confrères* together and made a thorough demonstration of the circulation of the blood, is reported to have said: "Alas, I cannot make a single man over forty-five years of age believe it!" Although vaccination has almost driven smallpox from civilized lands, yet we now and then meet so-called physicians who are opposed to vaccination. The germ theory of disease is doubted by some, and the efficacy of antitoxin is not unquestioned. Is it any wonder then that the value of culture products in tuberculosis is not recognized?

It is unfortunate that the field of medicine is so large that we cannot prove the value of new theories for ourselves. Such independent work and thought would be wholesome, but with the cares and responsibilities which are forced upon us, we can only investigate some small field wherein our greatest interest lies, and this in a very unsatisfactory way. The greatest portion of our knowledge we are obliged to take second-hand from men whom we recognize as authorities; and, when we know how often they are mistaken, it behooves us to do as much original investigation as possible. Conservatism is a safeguard, and it is praiseworthy, but it should not lead to blindness. New methods of combating disease should be weighed carefully and tested thoroughly before acceptance or rejection; but it is hardly fair or just for the great majority of the profession to reject a remedy, although they have never tried it, simply because certain noted men say it is useless, when at the same time other equally noted men are obtaining good results by its use. In the examination of sputum, one positive evidence of bacilli will outweigh a dozen negative results; so in the employment of new remedies one unquestioned result should outweigh a dozen failures. By the use of the culture products in the treatment of tuberculosis many cures have been made; but these have been lost from sight because in certain other cases cures were not effected.

In 1890 the medical world was startled by the announcement that Professor Koch had discovered a lymph which would cure tuberculosis. The news was received with delight. Unfortunate victims from all parts of the world looked to Berlin for life. Physicians left their busy practices, and went to see the great master administer his reputed cure. Perhaps there never was a discovery made in medicine from which such great results were expected. But, alas, how quickly these hopes were blasted! Those who saw the administration of the remedy at this time of unfortunate trial were so disappointed in not seeing patients in the last stages of consumption restored to health that they overlooked all good results that were obtained, and returned to their respective homes with nothing but hostility in their hearts toward the new lymph. They did not take into consideration that tuberculin was a new remedy on trial for the first time, and that its limitations and the proper mode of its administration were to be determined by clinical experience.

It must be remembered that Professor Koch was forced to disclose his remedy before he was ready, and before he had determined the mode of its action, or had learned the proper method of administration. He was in a new field, and should have had the assistance of the medical profession in determining the use of his remedy. But with that respect for authority which is characteristic of the German race, those who believed the remedy to be used in a faulty manner were afraid to say so, lest they should offend the master; so the improper administration continued, with its disastrous results to tuberculin.

A careful study of the literature of the time should convince any fair-minded man that, whether or not the remedy possessed any virtues, it was not used in a proper way. And when we consider it in the light of our present knowledge of the culture products, we are able to point out the mistakes which were then made, and judge it according to its actual worth.

In the first place, Professor Koch recommended its use only in the early stages. In this he was right, for its curative value lies in its action upon the newly formed or recent tubercles. While there are areas of greater or less extent even in advanced cases where recent tubercles are found corresponding to the more recent advances of the disease, yet when a remedy of such great importance is on trial it is wrong to cripple its usefulness by the choice of improper cases. If used properly we can expect and often see the recent tubercles disappear from a patient's lungs, in whom the disease is far advanced, and whose vitality has been much reduced; but when the eyes of critics are sharpened, it is better to confine the remedy to those cases wherein it is known to

21

be of value. In spite of Professor Koch's recommendations, patients whose lungs were riddled with cavities, and whose constitutions were worn by the long-continued drain of suppuration, and whose vitality was destroyed by continued high fever, were subjected to treatment, with only the result that should have been foreseen—disappointment. In order to have satisfied those who were posing as critics of tuberculin, it would have been necessary for the remedy to have removed dead and dying tissue, to have cured suppurating foci, to have removed all symptoms resulting from a heart long overburdened, and to have restored to normal a system whose organs were all more or less diseased. When such a remedy has been found, it will be a specific, not only for tuberculosis, but for all diseases to which mankind is heir. But even in these cases, unsuitable as they were, had the remedy been administered in the proper doses good results might have been obtained, and at least no harm could have been done.

The second mistake which was made was the administration of too large doses. This dosage depended upon the erroneous view which Professor Koch held as to the manner in which tuberculin acted. He believed that the end desired was the destruction of the granulation tissue surrounding the tubercles, thus allowing the defensive forces of the body to attack the germs *in situ;* or by liquefaction to secure the expulsion of the tuberculous tissue. In order to produce this result doses were given which caused severe reactions, both local and general. The temperature was often elevated to 104° and 105° F., and the remedy administered at such intervals that the patient was kept in a constant feverish condition. As a consequence the patients lost appetite, became emaciated, and soon succumbed; and all such results were recorded as scores against tuberculin. Instead, they should have been considered as due to the *improper use* of tuberculin. Strychnine is a valuable remedy and capable of producing brilliant results when administered in doses of $\frac{1}{60}$ to $\frac{1}{20}$ of a grain, but when given in 1-grain or 2-grain doses it destroys the patient. This poisonous effect is one of the characteristics of the drug, and is taught to the profession; but in no way handicaps the remedy, for the result desired is obtained without the poisonous effects. So it is with tuberculin. In small doses it is capable of producing beneficial results; in large doses it produces poisonous results. But the fact that it was administered in poisonous doses almost exclusively in the early period of trial in 1890 and 1891 caused the poisonous symptoms to be considered as the only ones which the remedy was capable of producing. Instead of recognizing the brilliant results in lupus, and early stage cases of pulmonary tuberculosis, even when the remedy was used in what would be considered to-day a faulty manner, and thus making the physician's armamentarium richer by one valuable remedy, hostile critics could see nothing but harm; so they gave out the erroneous idea, from which the medical world has not yet freed itself, that tuberculin can produce no good results, but on the contrary is liable to do much harm. To show the method of administration, I will cite some examples from the literature of that time.

January 17, 1891, a patient in von Leyden's[1] clinic had a paracentesis made, removing a clear, serous exudate. Examination showed rales in the right apex, relatively dull percussion note, slightly tympanitic, and diminished respiration. The spleen was somewhat enlarged. Temperature 100.4° F.; next day after the operation, 102.5° F. On the 19th an injection of two milligrammes of tuberculin was given. By February 12 the patient had received ten injections, the last being 50 milligrammes. During the period the patient became rapidly worse. On February 10 the temperature reached 104° F., where it remained continuously until the patient's death on the 19th of February. Reutimeyer[2] reports a case in which he gave eleven injections in eleven days, in spite of reactions of 104° F.

These two cases are not exceptions, but such was the method employed generally when tuberculin was first put upon trial. Had these patients received as an initial dose one-tenth milligramme, and then a gradually increasing dosage, so as to avoid fever reactions, they would have had the benefit of the specific action which the remedy possesses over tuberculous foci; many of them would have been benefited, some would have been cured, and culture products to-day would be warmly praised by the medical profession in the treatment of tuberculosis.

Besides being held accountable for the effect produced when used in unsuitable cases, and when administered in poisonous doses, tuberculin was also held responsible for all post-mortem findings. Pathologists who before had found so little interest in tubercular lungs that they had only given them a casual glance, now began to make the most minute examinations. Every finding was carefully recorded and ascribed to the advent of tuberculin.

Perhaps the work of Virchow had more to do with the discrediting of tuberculin than that of all other critics combined; and, strange to say, those who have quoted him have made his utterances much more hostile than they really were. Virchow made the post-mortems and recorded his findings; but much of the interpretation that has been put upon them is not his, but that of others.

One of the commonest objections that has been urged against tuberculin is that it is prone to produce acute miliary tuberculosis; and critics assign the authority for this statement to Virchow. This he did not say. The error comes from a juggling of words. He said that in the various organs of the body "miliary or submiliary nodules were observed," but did not ascribe them to the remedy, except in a suggestive way, saying:[3] "I have only shown

[1] *Berliner klin. Wochenschrift*, 1891, p. 237.
[2] *Berliner klin. Wochenschrift*, 1898, p. 124.
[3] *Berliner klin. Wochenschrift*, 1891, p. 191.

what we have found; I believed—and I think there is here sufficient evidence—that this exhibition would show the magnitude of the danger which might arise. How frequently this danger arises, in what cases it arises, by what it is especially caused, are questions that can be definitely decided only after long research." Krause,[1] in a review of Virchow's criticisms, says: "In order that they might account for these miliary tubercles, so frequently observed, Virchow and his pupils, especially Hansemann, assumed that the eruption of tubercles occurred regularly during the injections. For this assumption both master and pupil are without a proof, because pathological anatomy has not yet found a criterion by which one can determine the age of a tubercle." To make tuberculin responsible for these "miliary and submiliary nodules," it would be necessary at least to show that they occurred only during its administration; but these same miliary nodules are found when tuberculin has not been administered. Petruschky[2] reports that he has observed constantly fresh miliary crops around old tuberculous foci in consumptives who have died with evidences of secondary infection, but who had never received tuberculin.

That acute miliary tuberculosis could be so frequently produced by the injection of tuberculin as to make it one of the chief dangers of its administration is almost too absurd to receive notice; but since it has been so generally believed, we will examine into the supposed danger. Acute miliary tuberculosis can only be produced in one way, and that is by tubercle bacilli finding their way into the general blood stream, either "by the rupturing of a tuberculous focus directly into a pulmonary vessel, or into the thoracic duct." How often this happens we may judge from the investigations of Kossel,[3] who together with a number of other investigators examined the blood in 800 cases that were treated with tuberculin, with only three positive results, and one of these doubtful. He expressed his opinion as follows: "I am convinced after a great number of negative results that a dissemination of tubercle bacilli into the general blood stream of patients treated with tuberculin does not take place." That such an accident might occasionally happen when the remedy was administered in doses sufficient to cause high local as well as general reactions can be believed; that it would happen during the proper administration of tuberculin can scarcely be conceived. However, granting that such an accident should occur during either the faulty or proper administration, it would carry little evidence against the remedy, for a focus which would break down so easily under the use of the remedy would have likely broken down without it, and, scattering the bacilli in the blood stream, caused the same acute miliary tuberculosis.

Another supposed danger attending the use of tuberculin was that it might

[1] *Journal of Tuberculosis*, vol. ii, p. 246; translated from *Zeitschrift fuer Hygiene und Infectionskrankheiten*, vol. xxxiii, 1900.

[2] Paper before Berlin Congress; quoted in *Journal of Tuberculosis*, vol. ii, p. 63.

[3] *Berliner klin. Wochenschrift*, 1891, p. 471.

"mobilize latent foci" which were "apparently innocent." Such a result has never been shown; so the burden of proof still rests upon the critics. And, granting that the dangerous results which were pointed out did actually obtain under the gross misuse to which tuberculin was subjected, it would have absolutely no weight in the consideration of the remedy when administered properly.

Virchow said:[1] "I think that we may now with certainty say that any process that can be brought about by tuberculin can also come about without that remedy, but the course certainly often seems to be extraordinarily hastened."

Even in spite of the disastrous results caused by bad selection of cases, and improper dosage, there were a few men who could not help seeing the true value of the remedy. These began to use it cautiously, and with one accord determined that its proper administration consisted in beginning with small doses and gradually increasing as toleration was established, but always avoiding marked local reactions and general reactions entirely. Under this mode of administration, von Bardeleben, Guttmann, Renvers, Ehrlich, Petruschky, Cornet, Goetsch, Turban, Krause, and many other noted men abroad, as well as von Ruck, Whittaker, Denison, and others in America, report excellent results. It is the general experience of all those men, who have carefully and painstakingly sought to do the remedy justice, that tuberculin is a very useful remedy, and that it has a specific action in tubercular cases. Professor Petruschky[2] says: "If in its (tuberculosis) treatment we desire to attain success, we must bring to our resources all means which are available to medical science, and a prominent one of these is undoubtedly tuberculin. After nine years of trial of the remedy it is possible to arrive at a conclusion of its value. Only a comparatively small number of physicians have used and studied this remedy continually during this time, but it is significant that these have arrived at a favorable judgment of its value."

Dr. Goetsch[3] reported his experience in one hundred and seventy-five cases of pulmonary tuberculosis treated with tuberculin during the past ten years. Of the cases treated, one hundred and twenty-five, or seventy-one per cent, were cured. This report was made at the suggestion of Professor Koch, and to it he appended a note, in which he said: "All physicians who have had considerable experience with tuberculin treatment, and have published the same (Spengler, Turban, Petruschky, Krause, Thorner, Heron, Rembold, Baudelier), assert that if the treatment is restricted to purely tuberculous and not too far advanced cases—that is to say, non-febrile cases of pulmonary tuberculosis—the influence of the remedy is favorable without exception." Should not the testimony of these clinicians, whose experience has extended

1 *Berliner klin. Wochenschrift*, 1891, p. 191.
2 Paper before Berlin Congress; reported in *Journal of Tuberculosis*, vol. ii, p. 62.
3 *Deutsche medicinische Wochenschrift*, 1901; quoted in *Journal of Tuberculosis* vol. iii, p. 277.

over the entire period from Koch's announcement in 1890 to the present time, outweigh the doubt expressed by the hosts of physicians who have never given the remedy a trial? Again, I repeat, *one positive result should outweigh a dozen failures.*

I have endeavored to present in a clear light the circumstances under which tuberculin, the first culture product used in the treatment of tuberculosis, was given its trial by the medical world, and I have endeavored to show why it has been held in such disrepute. Now let us make a more careful study of tuberculin itself, and those other culture products which have grown out of it.

Soon after the germ theory of disease was propounded, bacteriology became the most active branch of medicine. In the laboratories the action of germs was carefully studied. In 1883 Charrin[1] discovered that the blue color sometimes seen on wounds and dressings was due to an organism, which, when inoculated into animals, caused death by septicemia. He found also that by inoculating the animals with sterilized cultures of the same bacillus they were rendered immune to the inoculations by virulent cultures. Brieger and Frankel[2] found that the filtered culture fluid of the diphtheria bacillus, when heated to 60° or 70°, had protective properties, rendering guinea pigs insusceptible to inoculations with diphtheria virus.

Such observations as these, many of which were made at that time, led to the conclusion that pathogenic organisms produce a certain substance during their growth which is inimical to the organisms themselves.

The observation which led to the discovery of tuberculin was as follows: Professor Koch found that when healthy guinea pigs were injected with virulent cultures of tubercle bacilli, during the first few days the wound healed; but after two weeks nodules formed, which broke down and continued ulcerating until death. But guinea pigs already tubercular, when inoculated, at first showed the same small wound; however, nodules did not form, only a general induration appeared about the point of inoculation, which later became necrotic, sloughed off, and quickly healed, without the lymph glands even becoming infected. When, instead of virulent cultures, dead cultures were used in healthy guinea pigs, a local suppuration occurred; while in tubercular guinea pigs, even small doses caused death; but if the cultures were much attenuated and administered very gradually, the disease, unless too far advanced, came to a standstill. From these observations, Koch concluded that tubercle bacilli, during their growth, produce a substance which has curative properties in tuberculosis. After a series of experiments he produced tuberculin, which is the culture fluid upon which bacilli have been grown, concentrated to one-tenth its original volume, and filtered.

Klebs found that tuberculin contained substances both beneficial and toxic,

1 *Arch. Gén. de Méd.*, Paris, 1882, vol. ii.
2 Untersuchungen über Ptomains, dritte Theil., s. 85, 1886.

and by certain methods of treatment produced tuberculocidin and antiphthisin, for which he claimed the advantage of tuberculin, without its toxic working substance.

One of the most enthusiastic workers in the field of culture products is our own fellow countryman, Dr. Karl von Ruck, of Asheville, N. C. When Koch made his announcement, von Ruck hurried to Berlin, and through his friendship with Dr. Paul Guttmann had special opportunities offered him to study the new remedy. While he saw the mistakes that were being made in the administration of tuberculin, he also noted the good results that it was capable of producing.

Coming home, Dr. von Ruck began experimenting in his own laboratory, and as a result in a few years produced tuberculinum purificatum, which was made by boiling the culture fluid containing the bacilli, *in vacuo*, at a temperature of 130° F. for two or three months. By this prolonged boiling and maceration a considerable portion of the proteids from the body of the bacillus were brought into solution.

If the culture fluid contained the substance which was beneficial, it must come from the bacillus; hence the bacillus must contain it, either as secretion or excretion. Now, instead of using the culture fluid alone or in part, Koch produced a new remedy by the pulverizing of dried cultures in a mortar and mixing them in distilled water. The mixture was then thoroughly centrifuged. This was given forth in 1897 as tuberculin R. In this preparation Koch believed that he had obtained a true solution of the bacillus, hence obtained the most complete remedy that could come from cultures. It was shown that this preparation was an emulsion containing not only fragments of bacilli, but entire bacilli, which were still virulent; hence the preparation was soon withdrawn from the market. However, it has since been freed from this disadvantage, and used with marked success.

In 1896 Dr. von Ruck succeeded in producing a true solution of the tubercle bacillus, which he calls the watery extract of tubercle bacilli. The method of producing it is as follows: [1]

"The tubercle bacilli are filtered out of the rapidly growing and highly virulent culture. After washing with distilled water for the removal of the remains of the culture fluid, they are dried in a vacuum desiccator. Next they are powdered in an agate mortar, and then extracted with sulphuric ether This extraction removes the fats. They are again dried and powdered as before, and their further extraction takes place in sterilized distilled water over a vacuum bath, with a temperature of 120° F. The proteids becoming dissolved in the distilled water, the fluid is then decanted and filtered through porcelain, when finally the amount of proteids is determined and the preparation standardized to a certain per cent."

[1] *Therapeutic Gazette*, June, 1897.

This is entirely free from culture fluid, and is the most refined of all the culture products, and its efficiency has proven to be superior in the hands of all who have used it.

Thus we can see a gradual evolution in the production of these culture products. First, the pure culture fluid was used—tuberculin; then a purified culture fluid—tuberculocidin and antiphthisin; then a mixture of culture fluid and proteids from the bodies of the bacilli—tuberculinum purificatum; then an emulsion of bacilli and fragments of same—tuberculin R.; and finally a pure solution of the bacilli—watery extract. That this is the end we do not know. We hope not. Yet we have in this last a product whose value cannot be questioned by any one who will give it a reasonable trial. All of these products are of value, and deserve a place in the history of the combat with tuberculosis. I have had personal experience with all of these products in treatment, except tuberculin (my experience with it being confined to making the tuberculin test), and I have been surprised that their worth has not been more generally recognized.

In what manner these culture products act is still debatable. Various theories have been offered. The original explanation of Koch that tuberculin broke down the granulation tissue surrounding the tubercles and allowed the defensive forces of the body to attack the bacilli, or by this breaking-down caused the tuberculous masses to be thrown off, was never accepted by those who placed any value upon the remedy, because they considered it absolutely essential to avoid the reactions which would cause such a result.

Landgraf,[1] who observed the disappearance of tubercles in the choroid and also on the epiglottis under the use of tuberculin, gave it as his opinion that the action of tuberculin "is not, as was maintained, an acute necrosis and throwing off, nor a suppurating process, but an acute cheesy degeneration of the tuberculous granulation masses followed by their absorption."

Krause[2] says: "It is well known that tuberculin has no effect upon the actually tuberculous tissue (the tubercle with its necrotic center), but only upon the newly formed tissue, which is richly supplied with blood-vessels and surrounds the tubercle."

Biedert[3] says: "When the irritation (caused by the local reaction) is moderate, an increased cell growth takes place in the encapsulating wall of the tuberculous process. If the inflammation is more intense, marked exudation occurs, while in the stage of extreme inflammatory irritation, cell death, necrosis, results." Trudeau[4] says it acts "probably by inciting the formation of fibrous tissue."

[1] *Berliner klinische Wochenschrift*, 1891, p. 286.

[2] *Zeitschrift für Hygiene und Infectionskrankheiten*, vol. xxxiii, 1900; translated in *Journal of Tuberculosis*, vol. ii. p. 242.

[3] *Berliner klin. Wochenschrift*, 1891, p. 107.

[4] *Transactions of the Association of American Physicians*, 1900.

These quotations refer to tuberculin, but since all these culture products contain perhaps the same active principle, they will apply to the others likewise. My experience with the culture products would lead me to believe that they have an action which causes absorption and removal of recent tubercles; otherwise the roughened and enfeebled respiratory notes would not become normal when healing has taken place.

The many opportunities offered for studying these remedies, where the action can be watched by the naked eye, should furnish sufficient evidence to convince the most skeptical that in culture products we have remedies which are a specific in their action upon tuberculous lesions. Even the earliest reports made, those during the fated years of 1890 and 1891, are replete with such evidence. Albrant saw the complete disappearance of a conjunctival tuberculosis; Landgraf[1] that of tuberculous processes of the choroid and epiglottis; Renvers[2] cured a patient whose pharynx, epiglottis, and mucous membrane over the arytenoids were covered with ulcers; Koenigshofer and Maschke[3] obtained cures in tuberculous corneal ulcerations; while it was not at all uncommon to see cases of lupus yield to its administration. The literature of recent years also bears much valuable testimony in such cases. Dr. von Ruck[4] reports many cases of laryngeal tuberculosis in which the lesions have disappeared.

Schmidt[5] insists upon the unmistakable benefit derived from tuberculin in the treatment of mild cases of laryngeal tuberculosis where surgical interference is uncalled for, and cites many cases cured by such means. Dr. Hale[6] reports a very interesting case of tuberculosis of the nose, in which the triangular cartilage was entirely gone. There was a large ulcerating surface discharging pus along the inner surface of the left ala of the nose, also ulcerations upon the uvula. The discharge showed tubercle bacilli. A complete cure was effected by the use of tuberculinum purificatum (von Ruck). During the past winter it was the writer's pleasure to see an ulceration of the left vocal cord in a patient who had lesions in both lungs heal under the use of the watery extract. While in many cases such as these healing has been observed, the great field for the culture products is in the treatment of pulmonary tuberculosis. It would be enough to make the names of the discoverers of these products immortal if their field of usefulness were limited to the cure of visible tuberculous infiltration and ulcers only, particularly those affecting the larynx, which complicate nearly one-fifth of all pulmonary cases, and which heretofore have

[1] *Berliner klin. Wochenschrift*, 1891, p. 285.
[2] *Deutsche med. Wochenschrift*, 1891, p. 512.
[3] *Deutsche med. Wochenschrift*, 1891, p. 76.
[4] *Journal of Tuberculosis*, vol. i, p. 22, and Clinical Report from Winyah Sanitarium for the years 1899 and 1900.
[5] *Krankheiten der Oberen Luftwege*, 1898.
[6] *Journal of Tuberculosis*, vol. iii, p. 239.

almost baffled treatment. But the results obtained in the lung are no less brilliant, as they are observed by the ear of the trained diagnostician.

To make a fair test of culture products in pulmonary tuberculosis, one must, in the first place, be able to interpret the pathological condition by the physical signs, so as to know what is removable and what is not. Secondly, he must have some means of comparison. It is impossible to carry in one's mind the percussion and auscultatory signs of one case, let alone a dozen; so, if one wishes to know whether or not his cases are improving, he should make systematic examinations, say at least once a month, and record his findings upon a chart for comparison at the next examination. Thirdly, he must remember that the remedy must be used for a length of time. Slight results are often seen during the first month of treatment, and during the second the change becomes more evident. But, finally, when the recent tubercles have all disappeared, and one has to deal with dead and decaying tissue, he must not become impatient because of the time that it takes to heal such lesions.

Let us next consider whether there is any ground for claiming an advantage for culture products over the hygienic, climatic, and ordinary medical treatment of tuberculosis. To this end we will bring forth the statistics of various men who have had considerable experience in tubercular work.

In 1891 Langenbuch and Wolff[1] reported 99 cases treated with tuberculin, and 99 without. Of the former, 33 were cured and 40 improved; of the latter, 9 were cured and 45 improved. Of tuberculin cases, 73 per cent were improved and cured; of those treated without it, 54 per cent were improved and cured.

Goetsch in a recent report, referred to above, sums up his experience since 1891, as having treated 175 patients, and cured 125, or 71 per cent. The remaining 50 patients interrupted the cure from time to time, so the results were less favorable.

Heron[2] since 1890 has treated 51 cases of pulmonary tuberculosis with tuberculin. At the end of 1900, 17, or $33\frac{1}{3}$ per cent, had been lost sight of. Of the remaining 34, 16, or 47 per cent, were well and earning their own living. Ten of these had been discharged seven years.

Krause[3] in six years has treated 27 patients, of whom 12, or 44.4 per cent, are well, and 13, or 48 per cent, are improved.

Denison[4] reports 196 cases treated by culture products, including all the various products from tuberculin to watery extract. His results show an apparent recovery of 34 per cent, and a marked improvement in 42 per cent. He remarks that this was not a list of easy cases, the following complications being present: "Lupus three cases, meningitis two, Bright's disease one, pyone-

[1] *Deutsche med. Wochenschrift*, 1891, p. 935.
[2] Paper before London Tuberculosis Congress, 1901.
[3] Cited in Heron's paper before London Tuberculosis Congress, 1901.
[4] *Journal of Tuberculosis*, vol. iii, p. 111.

phritis one, tubercular kidney two, glandular cases six, joint tuberculosis four, tubercular testicle two, bladder tuberculosis three, and intestinal tuberculosis two." Of these, 49 were in the first stage; 38, second; and 109, third.

Trudeau[1] makes a comparison of the incipient cases treated at the Adirondack Sanitarium with and without tuberculin. Twenty-four cases were treated with the remedy, of which 20, or 83 per cent, were apparently cured; and 113 without, of which 82, or 72 per cent, were apparently cured—a slight percentage (11 per cent) in favor of tuberculin. He then chooses 50 patients discharged as apparently cured with tuberculin since 1894, and 50 patients corresponding in lesions and time of treatment who were cured without tuberculin, to see the relative permanency of the cures. Three of those treated with tuberculin could not be traced; so three were dropped from the list treated without tuberculin. Of the remaining 47, 41 of the tuberculin-treated patients remained well, 1 had relapsed and was living, 4 had relapsed and were dead, and 1 had died of insanity. Of the 47 treated without tuberculin, 36 remained well, 6 had relapsed and were living, and 5 had relapsed and died. So we see 82 per cent of those treated with tuberculin remained well as against 72 per cent of those treated without it, a balance of 10 per cent in tuberculin's favor; or, putting it in another way, at the end of the time considered, 68 per cent of those treated with tuberculin remained well, and 52 per cent of those treated without tuberculin remained well, a balance of 16 per cent in favor of tuberculin. While the author says the cases treated with tuberculin were very carefully chosen, yet he adds in another place that "the results in the cases classed as advanced (treated with tuberculin) were proportionally somewhat more favorable." So, from this report, we may say that tuberculin does undoubtedly possess some advantages in the treatment of pulmonary tuberculosis; and since it is the permanency of the cures that is desirable, we must find in it a valuable aid in combating this great scourge.

Perhaps few men have had as much experience with culture products as Dr. von Ruck,[2] who has reported 1030 cases treated with them, with the following results: (I will insert 816 cases treated without culture products for comparison; as these were all treated in the same institution, the comparison is all the more valuable.)

	No. of cases.	Recovered.	Improved.
Without specific treatment	816	12.1%	31.0%
Treated with Koch's tuberculin	379	35.5	37.5
Treated with antiphthisin and tuberculocidin	182	32.5	46.8
Treated with tuberculinum purificatum (von Ruck)	166	43.4	39.2
Treated with watery extract of tubercle bacilli (von Ruck)	303	56.1	33.7

[1] *Transactions of the Association of American Physicians*, 1900.

[2] *Journal of Tuberculosis*, vol. i, p. 23; Clinical Report from Winyah Sanitarium for years 1899 and 1900; and *Therapeutic Gazette*, May, 1896.

Now, let us take statistics of cases treated without the use of culture products.

Curschman,[1] of Leipzig, says: "Lung sanatoria give a percentage of permanent improvement which amounts to about one-fifth of all cases treated." This is by the ordinary sanatorium method.

Stubbert's[2] report of the Loomis Sanitarium for the year ending November 1, 1899, shows 85 patients treated by ordinary sanatorium methods, of whom 14 per cent were apparently cured, and 62 per cent improved. Since the opening of the institution 456 patients have been treated, with the result that 22.6 per cent have been cured and 40 per cent improved.

Flick[3] reports 18 per cent as cured, 10 per cent disease arrested, and 26 per cent very much improved.

Trudeau and Baldwin[4] report that 67 per cent of truly incipient cases were cured, and 11 per cent of advanced, in a material of 300 incipient and 900 advanced cases; 73.5 per cent of incipient cases were cured in 1897 and 1898.

A report of German sanatoria[5] recently published shows, of 5986 patients treated, an apparent cure in 7.4 per cent. Then to show the permanency of results, statistics of 1878 patients are given, who have been dismissed for four years. The percentage of those able to work at the end of each year is noted. Of this number 424 patients were in the first stage of the disease, 863 in the second, and 373 in the third. The results are as follows:

Patients able to work at end of—	First stage. Per cent.	Second stage. Per cent.	Third stage. Per cent.
First year	89.1	80.3	56.5
Second year	89.1	60.7	24.1
Third year	63.7	49.2	14.3
Fourth year	44.4	16.7	0.

Among these patients the number of cures is not given; hence, since they are to be compared with results produced with culture products we will grant that all who were able to work at the end of four years were cured, which, of course, we know is too large a number. Then we have 21 per cent cured. Counting all of the remainder, who were able to work upon dismissal as improved, we have 67 per cent.

The report of the surgeon in charge of the Army Hospital for Consumptives at Fort Bayard, N. M.,[6] shows 49 patients dismissed prior to August 6, 1900. Of these 4, or 8 per cent, are designated as cured; 11, or 22.4 per cent, as convalescent; 20, or 40 per cent, as improved.

[1] Address before Berlin Congress, 1899; reported in *Journal of Tuberculosis*, vol. i, p. 90.
[2] *Philadelphia Medical Journal*, Dec. 30, 1899.
[3] *Journal of Tuberculosis*, vol. iii, p. 116.
[4] *Transactions of the Association of American Physicians*, 1900; *Albany Medical Annual*, April, 1900; *The Practitioner*, February, 1899.
[5] Results of the Open Air Treatment of Consumption, Berlin, 1901.
[6] *Journal of the American Medical Association*, Oct. 20, 1900, p. 1003.

Bowditch and Clapp,[1] of the Massachusetts State Sanitarium for Consumptives, have treated 273 cases, curing 115, or 42 per cent. In selecting these cases great care was used, 60 per cent of applicants being rejected.

The report for the Sailors' Consumptive Hospital at Fort Stanton, N. M.,[2] to June, 1900, shows 17 discharged, of whom 4, or 23.5 per cent, were apparently cured, and 13, or 76.5 per cent, improved.

A careful comparison of these results cannot help but give one a favorable impression of the culture products, particularly of the more refined culture products, in the treatment of tuberculosis. Especially is this true of the permanency of results.

While it is difficult to draw exact conclusions from a mass of statistics as given above because of the difference in classification of what is cured and improved, and because some authors have chosen only incipient cases and others have included all stages in their report, nevertheless, I will arrange them in a table so that it can be seen at a glance what is being done for the tubercular patient both with and without the use of culture products. Those who are interested can look up the references and draw their own conclusions. The table comprises 12,569 cases in all; 1795 treated by culture products and 10,744 treated without.

CASES TREATED WITH CULTURE PRODUCTS.

	No. cases treated.	Apparently cured. Per cent.	Improved. Per cent.
Langenbuch and Wolff (old tuberculin)	99	33.3	40.0
Goetsch (incipient only, Koch's tuberculin)....	175	71.0	29.0
Krause (Koch's tuberculin)	27	44.4	48.0
Heron (Koch's tuberculins)	34	47.0	....
Denison (Koch's tuberculin)	57	32.0	40.0
Tuberculocidin and antiphthisin (Klebs)........ Tuberculinum Purificatum (von Ruck)..........	94	33.0	40.0
Watery extract of tubercle bacilli (von Ruck) ..	45	40.0	49.0
Trudeau (incipient only, Koch's tuberculin)	24	83.0	....
Von Ruck (Koch's tuberculin)................	379	35.5	37.5
(Antiphthisin and tuberculocidin—Klebs):			
First stage	32	81.0	19.0
Second stage	74	35.1	56.7
Third stage........	76	9.0	47.3

[1] *New England Magazine.*
[2] *Journal of the American Medical Association,* Oct. 20, 1900, p. 1010.

CASES TREATED WITH CULTURE PRODUCTS.—*Continued.*

	No. cases treated.	Apparently cured. Per cent.	Improved. Per cent.
(Purified tuberculin—von Ruck)	166	43.4	39.2
(Watery extract of tubercle bacilli—von Ruck):			
First stage	73	94.5	5.5
Second stage	117	66.6	33.3
Third stage	113	20.3	52.2
Various reports (watery extract of tubercle bacilli—Von Ruck)	210	44.0	42.0

CASES TREATED WITHOUT CULTURE PRODUCTS.

	No. cases treated.	Apparently cured. Per cent.	Improved. Per cent.
Langenbuch and Wolff	99	10.0	45.0
Trudeau, first stage	300	68.0	....
Advanced stage	900	11.0	....
Bowditch (Mass. State Sanitarium):			
First stage	66	59.0	40.0
Second stage	45	22.0	64.0
Third stage	30	23.0	63.0
Clapp (Mass. State Sanitarium):			
First stage	82	64.6	34.0
Second stage	40	15.0	45.0
Third stage	10	....	30.0
Flick	...	18.0	36.0
Ft. Bayard Sanitarium	49	8.0	62.4
Ft. Stanton Sanitarium	17	23.5	76.5
von Ruck	816	12.1	31.0
Stubbert (Liberty Sanitarium):			
First stage	163	58.0	36.8
Second stage	216	9.0	56.0
Third stage	77	....	4.0
German Sanatoria	5986	7.4	80.3
German Sanatoria [1]	1878	21.0	68.0

The total number of cases treated and number of apparent cures, both with and without the use of culture products, are set forth in the following table for comparison:

	No. cases treated.	No. cases apparently cured.	Per cent apparently cured.
With culture products	1795	806	44.9
Without culture products	10774	1486	13.8

[1] In making up these percentages I counted all who were living and able to earn a livelihood four years after dismissal from the Sanatoria as cured, as mentioned above.

So much that is adverse has been written on this subject that I will add the opinions of some of the men who have tried culture products, and know their value.

Trudeau[1] says: "My experience with tuberculin treatment at the Sanitarium thus far has led me to believe that, when carefully applied, in suitable cases, it has proved apparently free from danger, and that it has seemed to have some favorable influence in bringing about healing of the lesions, probably by inciting the formation of fibrous tissue." Again:[2] "The injections, nevertheless, seem to have had a favorable influence in preventing the natural tendency of the disease toward relapses, which occur in many who recover under climatic and hygienic methods alone."

Krause[3] says: "The failures of the first tuberculin epoch are, without exception, the result of the improper methods at that time employed in the administration of the remedy. For that reason no one is justified, on the grounds of the experience of 1891, in passing adverse judgment upon the remedy. On the contrary, it is important that the remedy be extensively tried anew in accordance with the now accepted indications. For thereby entirely different results than those of 1891 will be obtained and the medical profession will be richer by one valuable remedy."

Denison[4] says: "Despite the charges of failure of this specific method of treatment, made by hasty and indiscriminating critics, it is coming more and more to be acknowledged by those physicians who are willing to test the matter, that there *is* a special and specific stimulation of tubercular living tissue, which is characteristic of a healing process."

Von Ruck[5] says: "The favorable and specific action of the remedy becomes manifest not only in the general improvement with subsidence of subjective symptoms, but in a more direct manner. . . . It consists in the disappearance of tubercular lesions accessible to sight and touch, as well as of those which we recognize through percussion and auscultation. Tubercular cervical, axillary, and other accessible glands that are not caseous or fibroid, disappear under its use; infiltrations in the larynx grow less and finally disappear; and infiltrations in the lungs revealed by slight percussion dulness, and by rough, harsh, or bronchovesicular respiration with or without circumscribed catarrh, grow perceptibly less and disappear under the treatment, without other medication. These are changes which we do not note from the application of other methods. The latter, so far as I know them, fail in directly influencing the pathological lesions, and while they are indirectly

[1] *Transactions of the Association of American Physicians*, 1900.
[2] *The Practitioner*, February, 1899.
[3] *Zeitschrift für Hygiene und Infectionskrankheiten*, vol. xxxiii, 1900; translated in *Journal of Tuberculosis*, vol. ii, p. 255.
[4] *Journal of Tuberculosis*, vol. iii, p. 112.
[5] Clinical Report of the Winyah Sanitarium, Asheville, N. C., for years 1899 and 1900.

beneficial and aid in bringing about the previous condition of latency, they do not actually cure. In this view I am confirmed by the fact that while without specific medication subjective symptoms may disappear, the objective evidence continues; percussion dulness over the tubercular areas does not clear up; rales may disappear, but the abnormal respiratory sounds persist in the parts which were and still are the seat of tubercles, and the patient still reacts to the tuberculin test; whereas in patients that have been successfully treated with the remedy under consideration (watery extract of tubercle bacilli) the physical signs of recent tubercular processes disappeared entirely, and no reaction occurs to the tuberculin test up to the present time, even in the earliest cases treated. . . . In the cases that came under treatment in the early stage I have seen or heard of no relapses yet. . . . That it produces a relative degree of immunity has been shown by the animal experiment, and clinically by the marked freedom from extension of tubercular processes, and from relapses of patients who are under treatment, or have been discharged."

The question is often asked, "Can these products do harm?" Of course they can, the same as morphine, strychnine, or any other remedy. The results of 1890 and 1891 show that they can do harm; but it is the experience of all those who have made a careful study of the products, and given them a fair trial in practice, that they cannot do harm when administered carefully. My own experience has been very encouraging. I have made a careful study of my cases, and I have never seen the least harm done. On the contrary, my results have been most happy, and I do not believe that they could be duplicated by any other treatment.

The time has certainly arrived when the medical profession should give the culture products a fair trial. The opinions of men who have not tried these remedies, but who have drawn their conclusions entirely from the wrong use of tuberculin when it was first introduced, are to be compared with the opinions of those who know from experience, and who report the cases that have been treated, and show the results obtained. Culture products have the right to demand a trial by an unbiased court wherein spurious evidence will be discarded, and only positive evidence taken. All friends of these remedies will stand by the decision.

It must be remembered, however, that the friends of culture products should not relax their efforts in other lines. It has been said by the critics of men employing these remedies that they use hygienic, dietetic, and climatic treatment as well. So they do; they would be foolish if they did not. The surgeon combines all of these with his use of the knife, and it is considered praiseworthy in him. So those who recognize the value of culture products find their results are much better when their cases are properly handled, and they always endeavor to guide the entire life of their patients. It should be considered as malpractice to simply inject culture products, and leave the patient to guide his own life. With reference to this point Professor Koch is reported to have said at the Tuberculosis Congress held in London in 1901[1] that he did not wish anybody to get the idea that he himself thought there could be any antagonism between treatment by tuberculin and the outdoor treatment in or out of sanatoria. He has always insisted that the two should go on together.

A careful review of this subject, together with practical experience in the use of culture products, leads me to the following conclusions:

1. Culture products *do* have a specific action upon tuberculous foci.

2. That this has not been recognized is due to the early unfortunate experience with tuberculin: (*a*) When it was used in too large and too frequent doses; (*b*) when it was employed in unsuitable cases; (*c*) when it was held responsible for all post-mortem findings.

3. The field of usefulness for culture products is where recent tubercles are found, and this especially in incipient cases.

4. If used in advanced cases, culture products will help remove areas of recent extensions, but must not be expected to remove dead, decaying, or newly formed tissue.

5. Where culture products are used, they should be re-enforced by every means at command. Every phase of the patient's health should be cared for, and the proper hygienic and dietetic measures prescribed.

6. Where the case is managed properly and culture products are used, the proportion of cures is greater than when culture products are not used.

7. Culture products produce an immunity, which protects the patient from relapses; hence, make a permanent cure more often than hygienic and climatic treatment alone, which fact of itself should be enough to warrant their use in all suitable cases.

[1] Reported in *British Medical Journal*, July 27, 1901, p. 214.

CHAPTER IV.

A CRITICAL STUDY OF TUBERCULIN AND ALLIED PRODUCTS BASED UPON A COLLECTIVE INVESTIGATION.

When our worthy president requested me to prepare a paper to be read before this section treating upon the subject of tuberculin and allied products, I thought best to make the basis of the paper a collective investigation. Accordingly I sent out three hundred and twenty-five letters to some of the leading clinicians of this country and Europe, taking pains to include the names of those whom I knew to be especially interested in the subject of tuberculosis, requesting answers to the following:

1. Have you had personal experience in the use of tuberculin or other culture products in the treatment of tuberculosis?

2. How many cases have you treated? What was the average period of treatment? What was the result of treatment?

3. What is your opinion of their value, and do you favor their use in the treatment of tuberculosis?

I have received one hundred and forty-three replies answering my questions either wholly or in part. That you may know the value of this investigation I will mention that replies have been received from such leaders in the crusade against tuberculosis as Schroetter and Weismayer, of Austria; Gehrhardt, Dettweiler, Weicker, Krause, Goetsch, Bandelier, Gebhardt, Johne, Koehler, Rietschel, and Moeller, of Germany; Turban and Spengler, of Switzerland; Brouardel, of France; Giovanni, of Italy; Ransome, Heron, Latham, Mackenzie, Semon, Yeo, and Saundby, of England; and Trudeau, Bowditch, von Ruck, Loomis, Stubbert, Solly, and Denison, of the United States; and from many more besides who occupy eminent positions as clinicians.

For the kind and painstaking replies of those who assisted me in this investigation I wish here to openly express my appreciation. The cordial letters which I have received show an interest which is highly gratifying, and indicate that the profession does not bear that hostile attitude toward these remedies that it formerly did. While the medical profession is naturally conservative, yet it is progressive, and is constantly taking advantage of new methods of curing disease, and today it stands ready to sanction at least, if not adopt generally, any remedy or any method that will aid in the cure of tuberculosis, that disease which has so long baffled its skill.

An analysis of the replies to my inquiry shows the probable reason why certain members of the profession have failed to secure satisfactory results from the use of these culture products, while others have obtained such gratifying results.

Of the one hundred and forty-three who replied, thirty-two, or 22.4 per cent, recommended their use; fifty-two, or 36.3 per cent, did not recommend them; while fifty-nine, or 41.3 per cent, expressed no opinion at all. Of the fifty-two who did not recommend them, thirty-four expressed themselves as not being opposed to them, but simply not being convinced of their value; although twelve of these acknowledged that the remedies had contributed to cures in their hands. Eighteen were absolutely hostile.

Of those replying, the answers were based on personal experience in fifty-four instances. Of these, thirty-two, or 60 per cent, believed these remedies to be of value in treatment, while twenty-two, or 40 per cent, did not recommend them.

This is a much better showing than I thought possible. These remedies have certainly gained friends during recent times. It was a great surprise to find that 38 per cent of those expressing an opinion were favorable, and only 21 per cent absolutely hostile. No less a surprise was it to find that 60 per cent of those who had had experience with the remedies recommended them.

Thirty-four gave me an opinion as to the diagnostic value of tuberculin also. Of these only one was opposed; but he was so terribly afraid of the remedy that he was not sure that it should even be used upon cattle. He certainly has not read the statistics of veterinarians upon this point. Bang has collected reports from numerous tests made upon cattle without ill results following in a single case. McEachran[1] reports 22,023 cattle tested in which harm was not recorded in a single instance. Jones, of Rochester, in a letter to the writer, relates his experience upon cattle during the past four years. He has tested 12,000 animals without observing ill effects, and says that examination of the carcass after slaughter always verified the diagnosis. From his experience he is enthusiastic over the test both for cattle and man. Dr. J. M. Anders[2] collected statistics of 3638 tests given upon the human subject, and reports that ill effects were not recorded in a single instance. Koch[3] also has observed over 3000 tests upon the human subject without harm. Certainly these experiences should be sufficient to place the tuberculin test upon a safe basis.

Judging from the replies received, much of the disappointment and failure to observe improvement upon the part of those who have tried tuberculin and other culture products, as well as of the harm done, has been due not only to an insufficient understanding and faulty application of the remedies, but also to an inadequate knowledge of the disease which they were attempting to treat. General practitioners and surgeons began the employment of tuber-

[1] McEachran. *Transactions of the British Congress on Tuberculosis*, vol. iv, p. 114.
[2] Anders. *Trans. Am. Clim. Ass.*, 1900.
[3] Koch. *Trans. Brit. Cong. on Tuberculosis.*

culin without any special preparation or fitness for the work, and the result is about what should have been expected, about the same as would be produced if the same men without any previous preparation should begin to examine eyes and fit glasses. With such a trial, condemnation would be a foregone conclusion.

When Koch gave tuberculin to the world, medical men knew little of tuberculosis. Even the pathologists knew little of the minute pathology of the disease. Few men had ever paid close attention to its clinical course. Tubercular patients had never been watched day by day from the time the disease made its first invasion of the tissue. When men began observing, as was necessary in the administration of tuberculin, they were surprised to find that the disease runs an uneven course, and not knowing what else to ascribe the unfavorable periods to, blamed many of them upon the remedy. Patients may get worse, as many of them do, under hygienic and dietetic treatment—periods of absorption, fever due to mixed infection and cavity formation, are apt to come in all cases at all far advanced—but this is not ascribed to the treatment. Let this same thing happen if culture products have been used, and it is ascribed to the remedies. When post-mortems were made on tuberculin-treated patients during the early period of its use, everything found was attributed to the remedy; when exactly the same thing could have been found in cases treated without it, or in those without treatment. I want to emphasize this one point: The effects of culture products upon the course of tuberculosis cannot be judged without an understanding of the natural clinical course of the disease; neither can the post-mortem effects be judged without a knowledge of the post-mortem findings where culture products are not used. So, as essentials to successful tuberculin treatment, I would place a knowledge of the natural course of the disease, a thorough training in pathology, and the ability to interpret the pathology ante mortem by the clinical course and physical signs.

No less essential is it to understand the remedy to be applied. It is not only necessary to know what it will do, but equally necessary to know what it can not do. The application of remedies to disease is a responsible study. This responsibility increases with the gravity of the disease to be treated and the activity of the remedy to be employed. Therapeutic exactness, although always to be desired, is absolutely necessary at certain times. Suppose that a physician hears that strychnine is a good remedy for giving tone to the nervous system, and that, in order to obtain best results, it must be given in ascending doses. Without studying the remedy, he begins. Soon the patient has a convulsion. He gives him another dose, larger, because in order to obtain results "it must be given in ascending doses." Another convulsion occurs. Soon the patient dies. It is very likely that this physician would ascribe the death of this patient to the remedy instead of to the improper use of it;

and, of course, would fear to use it ever after. Such an order of therapy gave tuberculin a stunning blow when it was first introduced. No one knew much about it, and, furthermore, no experience had been recorded from which to gain knowledge. If there ever was a remedy that demanded therapeutic exactness, it is tuberculin. Here we have a disease which is grave and a remedy most powerful—powerful for good, if administered rightly; powerful for evil, if administered wrongly.

That the hostility to culture products is due to therapeutic inexactness is shown by my replies. Of the eighteen hostile critics, nearly all based their opinion upon trials of tuberculin when first introduced. Few of them have tried the newer preparations, which are more perfect, nor have they learned the careful manner of employing them now in use.

Those who recommend them base their opinions upon a total experience of 5742 cases treated. Those who do not recommend them have had experience in 813 cases.

Of those who did not recommend them, only four had had an extensive experience. One treated 150 cases from four weeks to twelve and fifteen months. He says: "Curative value, especially in the hands of the general practitioner, is doubtful. Further experience in sanatoria and under close inspection for long periods seems advisable."

Another, who had experience in about 100 cases, does not give the average time of treatment, but says that he saw no advantage over ordinary treatment except in five or six cases.

Another used old tuberculin and tuberculocidin for three years after their introduction, treating 230 cases from five to ten weeks, with negative results. He does not "at present favor their use but favors keeping an eye on this line of treatment."

A fourth treated 141 cases from three and a half to four and a half months, but abandoned it in the year 1891. He does not consider the newer preparations as dangerous, but does not believe that they would be active in the small doses recommended.

It is noteworthy that none of these men are hostile in their attitude. Two of them have had no experience in recent years.

Aside from these four, only one man tried the remedies on a case for as long a period as six months, and only two others had tried them as long as three months. The rest mention from two weeks to two months. So, of the fifty-two men who did not recommend them, only six (granting that the one who treated 100 cases used the remedies more than three months) had tried the remedies on a case for three consecutive months. It takes three months to cure a very early stage case; and the danger of relapse is lessened if the time is extended longer. So we can say that, in the light of recent developments in the use of culture products, the failure to recommend them on the part of those who answered my inquiries (and I believe the same will hold good throughout, for my answers are from representative men) was based, with few exceptions, upon faulty and insufficient trial.

Contrast the short period of treatment employed by those who do not favor their use with that of those who favor it. Of the latter, one man was convinced of their value by trying them for two months. Three gave three months; and the remaining twenty-eight gave from three months to more than one year as the time necessary in order to bring about a cure. Petruschky[1] believes the best results are obtained by extending the treatment over several years, giving a course of a few months each year.

I did not undertake to gather statistics as to the stage of the disease in which the trial was made, but many made mention of it in their replies—enough to show that it was not made in suitable cases. When a new remedy is on trial, it should be used in cases over which it is known to have an influence, and then, after succeeding in these, it is time to experiment in new fields.

The test of a remedy is that it should do what it is recommended to do. Than this no more can be asked. Will antitoxin cure diphtheria? Yes, if administered early. Will it cure when the patient is moribund? It is not likely to do so. This is not held against antitoxin, however earnestly we wish that it might control these advanced cases. The success of antitoxin treatment depends upon the earliness of its administration, and in spite of the fact that men have failed to secure results in severe, advanced cases, the remedy stands approved, for antitoxin will do that for which it is recommended.

Culture products are remedies to be used in *tuberculosis*. That is what they are recommended for. *They are not represented as having any influence over dead tissue, or as being able to regenerate cells that have been destroyed.* If they will contribute to the cure in pure tuberculosis—that is, in incipient cases before mixed infection, or breaking down with absorption, occurs—they will do all that should be asked of them. They will then stand as remedies of value in treatment. Unfortunately, tuberculosis is a chronic disease, and results are obtained slowly. If culture products could produce their results as quickly as antitoxin, their adoption would be quick and certain. Few men have the patience to work and wait months for the result; but unless they do, they must not hope to become successful phthisiotherapists.

That these remedies will do what is claimed for them is proven by the results obtained by those who have had experience with them, as shown in the following:

Jessen[2] treated 14 first-stage cases, curing 14, or 100 per cent.

Goetsch[3] treated 356 first-stage cases, curing 278, or 78 per cent.

[1] Petruschky. "Zur Koch'schen Tuberculin Behandlung." Bericht über den Kongress zur Bekämpfung der Tuberkulose als Volkskrankheit, Berlin, 1899.

[2] Jessen. *Centralbl. f. inn. Med.*, 1902, No. 23.

[3] Goetsch. Personal letter to the writer.

Trudeau[1] treated 24 first-stage cases, curing 20, or 83 per cent.

Von Ruck[2] treated 105 first-stage cases, curing 98, or 93 per cent.

Rembold[3] treated 16 first-stage cases, curing 12, or 75 per cent (six years after).

Turban[4] treated 20 first-stage cases, curing 20, or 100 per cent.

Wilkinson[5] treated 12 first-stage cases, curing 12, or 100 per cent.

Petruschky[6] treated 18 first-stage cases, curing 18, or 100 per cent.

Klebs[7] treated 14 first-stage cases, curing 14, or 100 per cent.

Pottenger[8] treated 10 first-stage cases, curing 10, or 100 per cent.

Here we have for consideration 589 cases in the first stage of the disease, treated with tuberculin and allied products. Of this number 496, or 84.2 per cent, were apparently cured. This is certainly enough cases upon which to base an opinion, and our verdict must be that culture products stand the test and accomplish that for which they are recommended, namely, the cure of pure tuberculosis. This is all the more emphasized when we compare these results with those obtained without culture products in the same purely tubercular cases:

Bowditch[9] treated 66 first-stage cases, curing 39, or 59 per cent.

Clapp[10] treated 82 first-stage cases, curing 53, or 64.6 per cent.

Trudeau[11] treated 300 first-stage cases, curing 204, or 68 per cent.

Stubbert[12] treated 163 first-stage cases, curing 95, or 58 per cent.

This table furnishes us with 611 cases, all of which were not only in the first stage of the disease, but all of which had the advantage of sanatorium treatment. Of this number 391, or 64 per cent, were apparently cured. Now we must admit one of three things: either the difference is accidental, or those who use culture products are the abler men and more successful in their treatment, or that culture products do contribute materially to the cure. The first we cannot believe, and if either of the latter alternatives be true, they speak well for the remedies, for if the ablest men in the field of phthisiotherapy are convinced of the value of these remedies, we should certainly give their opinions weight; and, on the other hand, if they are no more skilled but are

[1] Trudeau. *Trans. of the Ass. of Amer. Physicians*, 1900.

[2] von Ruck. *Journal of Tuberculosis*, vol. i, p. 23; Clin. Rep. of Winyah Sanitarium, 1899 and 1900; *Therapeutic Gazette*, May, 1896.

[3] Rembold. Quoted by Wilkinson. *British Medical Journal*, June 7, 1902.

[4] Turban. Beiträge zur Kenntniss der Lungentuberkulose.

[5] Wilkinson. Observations on Tuberculin as a Remedy in Treatment of Tuberculosis of the Lungs. *British Medical Journal*, June 7, 1902.

[6] Petruschky. Specifische Behandlung der Tuberculose. Paper before the 71st assemblage of the German Naturalists and Physicians, Munich, 1899.

[7] Klebs. *Berlin klin. Wochenschrift*, 1902, No. 23.

[8] Pottenger. Unreported.

[9] Bowditch. Report of Mass. State Sanatorium at Rutland.

[10] Clapp. *Ibid.*

[11] Trudeau. Reports of Adirondack Cottage Sanitarium

[12] Stubbert. Reports of Loomis Sanitarium.

able to produce better results, curing 20.2 per cent more patients by the use of them than can be cured without them, we should certainly be convinced of their value.

It is a notable fact, and one which my replies bear out, that nearly all men who have determined to give culture products a thorough test have become convinced of their value. As stated above, only five men who had given them a trial of six months failed to recommend them. On the other hand, those who had given them a trial of several months in suitable cases, and whose experience had extended over several years, with the exceptions mentioned, recommended their use.

As further proof of their worth, I will cite the comparative results obtained with and without the remedies by two of the world's leading lung specialists—Trudeau of Saranac Lake, and Turban of Davos-Platz. Trudeau's experience I will quote from my former paper on "Culture Products in the Treatment of Tuberculosis."[1]

"Twenty-four cases were treated with the remedy, of which 20, or 83 per cent, were apparently cured; and 113 without, of which 82, or 72 per cent, were apparently cured—a slight percentage (11 per cent) in favor of tuberculin. He then chooses 50 patients discharged as apparently cured with tuberculin since 1894, and 50 patients corresponding in lesions and time of treatment who were cured without tuberculin, to see the relative permanency of cures. Three of those treated with tuberculin could not be traced, so three were dropped from the list of those treated without tuberculin. Of the remaining 47, 41 remained well, 1 had relapsed and was living, 4 had relapsed and were dead, and 1 had died of insanity. Of the 47 treated without tuberculin, 36 remained well, 6 had relapsed and were living, and 5 had relapsed and were dead. So we see 82 per cent of those treated with tuberculin remained well, not counting the one dying of insanity, as against 72 per cent of those treated without it, a balance of 10 per cent in tuberculin's favor; or, putting it in another way, at the end of the time considered, 68 per cent of those treated with tuberculin remained well, and 52 per cent of those treated without tuberculin remained well, a balance of 16 per cent in favor of tuberculin."

The experience of Turban is so interesting and so to the point that you will pardon me if I quote it as described by Weicker[2] at length:

"(*a*) Turban treated 21 cases in stage III with tuberculin: in 8 there was tuberculous laryngitis; 9 cases survived five years, three more remained alive four years, only 5 out of 21 died within two years—25 per cent. Only one died of miliary tuberculosis, and that six and one-half years after treatment; none died of hemorrhage. Hence tuberculin does not increase risk of

[1] Pottenger. *Therapeutic Gazette*, January, 1903.
[2] Weicker. Beitraege zur Frage der Volksheilstaetten, p. 22.

hemorrhage or generalized tuberculosis. Three were quite well six years after—in all, 5 were well. Tubercle bacilli disappeared from the sputum in 4 cases. Of cases treated in other ways—that is, without tuberculin—61 out of 84 died—5 from hemoptysis, 3 from tuberculous meningitis; 41 out of 84 died in less than two years—nearly 50 per cent. Compare this with 25 per cent under tuberculin treatment.

"(*b*) Forty-eight cases in stage II were treated with tuberculin: 9 died within two years of treatment, 3 in three years and more, 16 were alive six years after treatment, 5 more five years after treatment, 3 more four years after treatment—in all, 36 were alive. Thus of 48 cases, 36 were alive and 12 dead. Of 152 cases treated in the ordinary way, 45 were dead and 107 alive, but the figures show greatly in the favor of tuberculin treatment, because of the 107 a great number (49) had been under treatment more than one or two years.

"(*c*) Twenty cases in stage I were treated with tuberculin. Tubercle bacilli were in sputum in 17. All were well: 10 of them six years after treatment, 2 more five years after, 1 more four years after, 3 three years after, 2 two years after, and 1 one year after treatment. In all the tubercle bacilli disappeared from the sputum. The three cases giving no tubercle bacilli in sputum had to pass through the ordeal of the tuberculin test. On the other hand, 57 cases, in which tubercle bacilli were not found in sputum, were treated in ordinary ways. They were not subjected to tuberculin test. Of the remaining 22 cases, there was one death, and in 2 cases there was still tubercle bacilli in the sputum. Turban himself says: 'Now, if we compare the results in early cases in which tubercle bacilli were found in the sputum, the result is substantially in favor of tuberculin treatment.' Of the 86 cases with tubercle bacilli in the sputum treated with tuberculin, 45, that is 52 per cent, yielded a permanent result; of the 241 cases with tubercle bacilli in sputum that received no tuberculin, 95, that is 39.4 per cent, gave a permanent result. Still more distinctly does the effect of tuberculin show itself, if we ask how many of these cases are now free from tubercle bacilli in their sputum. Of the 86 tuberculin patients 41 are now free from bacilli—47 per cent. Of the 241 not treated with tuberculin, only 66—27.4 per cent."

For further statistics on the comparative success of treatment with and without culture products, see my former paper.[1]

If the fact that all those men who are devoting their energies to the treatment of tuberculosis, and who have given tuberculin and allied products a fair and extended trial, have found them to contribute immeasurably to the cure; if the fact that those who use them cure a larger proportion of their cases than those who do not; if the fact that, in the hands of the same men, a much greater percentage of cures can be made with them than without them is to be given consideration, then we must give these remedies a very important

[1] Pottenger. *Ibid.*

place in the treatment of tuberculosis. It has often been said that the same results could have been produced without their use as has been with them. The mere saying of this is not argument; but I wish to mention a few experiences which refute it. Unless he be very much prejudiced, the man who treats the cases should be best able to judge whether or not the remedies contributed to the result.

Lucius Spengler[1] says: "In the discussion which my former success provoked, they say that here at Davos they obtain equal success without tuberculin, and that it is difficult to distinguish the part that has been contributed to the cure by climate and the part by tuberculin. I simply wish to say that of the 39 patients whom I have treated and whom I am still treating with T. R., 30 had been with me six months or more, some even several years, before T. R., was made known."

Thorner[2] says: "I have cured poor patients with tuberculin who could not go to a sanatorium, and some others who were very poor and who had failed to be cured by several courses of treatment at different sanatoria."

Denys[3] certainly has put the remedies to a test, so that his results leave no doubt as to the part that was contributed to the cure by them. He treated 174 cases, curing 51, or 29 per cent, nearly curing 12, or 6 per cent, and improving 64, or 36 per cent. He designates those as cured who have no more bacilli in the sputum, whose general condition is satisfactory, and who no longer react to tuberculin. He says of these: "The tuberculin treatment covered an average period of seven months. No other method was used, neither rest, air, nor medicine."

This is a creditable showing and compares favorably with the best results obtained in sanatoria, where rest, fresh air, and the best of food are provided; nevertheless, the friends of these products do not believe this to be the right way to use them. Oliver[4] says: "Of patients who remain nine months under treatment in the Adirondack Cottage Sanatorium, 34.5 per cent go away apparently cured." Gabrilowitch[5] says that as a result of ten years of treatment at Halilia, Russia, 1000 cases have been treated and 253, or 25.3 per cent, apparently cured, and 472, or 47.2 per cent, improved.

The idea seems to have gained ground in the minds of some men that tuberculin treatment and general hygienic and dietetic treatment are to be contrasted. Such an idea is absurd. The only contrast is between those cases treated with it and those treated without it; for rest, exercise, fresh air, diet, hydrotherapeutic measures, and measures for the building up and strengthening of the pa-

[1] Spengler, Lucius. "Contribution a l'etude du traitment de la tuberculose par T. R." Translated from *Deutsche med. Wochenschrift*, 1807, No. 36.

[2] Thorner. Tuberkulin und Tuberkulose, Leipzig, 1901.

[3] Denys. "Action curative de la tuberculin. Denys, contra la tuberculose." *Ann. med. clin. du Hainaut*, March, 1902.

[4] Oliver. *Jour. Amer. Med. Assn.*, October, 1900, p. 1006.

[5] Gabrilowitch. *Zeitschrift f. Tuberkulose u Heilstaettenwesen*, Bd. iii, p. 207.

tients are used by every one who pretends to cure tuberculosis, no matter what remedy or remedies he employs. Artificial digestants will sometimes help stomach troubles, but their effect is heightened by the use of a properly regulated diet. The surgeon's knife removes the tumor, but the regulation of the patient's life promotes recovery. So it is with culture products. Whatever preparation is used is only one of several aids in the production of the cure; and he who does not use all is to that extent negligent of his patient.

The cure of an infectious disease consists in establishing immunity. In acute infectious diseases this is established soon or the patient succumbs; in chronic diseases, however, immunity is established slowly and often not at all.

Hansemann [1] says that when a tuberculous process extends beyond a single lobe, the chances are that it will not heal of its own accord. In these cases help from the physician is required, and if it were obtained earlier there would be little need of such extensive processes as we so often see occurring. The physician's part in treating tuberculosis, either when it is pure tuberculosis or when it has reached the consumptive stage, consists in fortifying the patient against the disease. He orders hydrotherapeutic measures, rest and exercise, fresh air, and a nutritious diet, that a state of perfect nutrition may be attained, and that the body cells may become resistant to the disease. In the loose way in which we use the term, he is trying to make the tissues immune or increase the natural immunity of the patient. He can do more than this. He can induce an artificial immunity. Kitasato, Spengler, Koch, von Ruck, and others have by the use of culture products rendered animals immune, so that when doses of virulent bacilli were injected into them the disease did not spread beyond the local ulcer which formed at the site of injection. Another proof of this immunity, aside from that shown upon experiment animals, is the phenomenon of agglutination. Vaughan and Novy [2] say: "It should be understood that agglutination is only one of various indications that the body juices of immunized animals rob their homologous bacteria in part of their virulence. Why agglutination does not take place in all instances we are not as yet able to determine; but when it does occur, it is an indication that the blood of the immunized animal has some detrimental effect upon the growth and virility of the micro-organism." Koch,[3] Moeller,[4] as well as several other experimenters, have shown that by the use of tuberculin the agglutinative power of the blood can be raised from 1 in 10 to 1 in 300; and furthermore, that an improvement in the general health accompanies the rise. This should be sufficient proof to establish the immunizing power of these remedies Happily, clinical evidence corroborates these facts, for when treatment is begun in an

[1] Hansemann. "Ueber Heilung und Heilbarkeit der Lungenphthise." *Berlin. klin. Wochenschrift*, Aug. 11, 1902, p. 747.

[2] Vaughan and Novy. Cellular Toxins, 1902, p. 180.

[3] Koch. *Deutsche med. Wochenschrift*, 1901, No. 48.

[4] Moeller. *Zeitschrift für Tuberkulose und Heilstaettenwesen*, 1902, p. 302.

early case of tuberculosis the patient seems to become immunized; so that the disease shows less tendency to extend to healthy tissue than is usually the case, and also, when an apparent cure has been attained, there is less tendency to relapse.

With this positive, scientific proof of the immunizing power of culture products, and the corroboration which it has secured at the hands of those who have had large experience in their use, we conclude that where culture products are not used in those cases which are suitable, the patients are deprived of one of the agencies which would contribute materially to their cure.

With such proof as to their value, should these remedies be employed generally, or should their use be confined to specialists? Upon this point many of my answers were emphatic, the writers taking the ground that where there was so much hope for those afflicted with tuberculosis bound up in given remedies, it were better that their use be confined to those who understand them until such time as their exact mode of administration and the exact part contributed by them to the cure might be fully determined. This opinion has been well expressed by editorials in the *Journal of the American Medical Association* and the *British Medical Journal* during the past year, which I will quote: "In the hands of those who have used this preparation (tuberculin) most faithfully and continuously, and, therefore, it is to be assumed, most intelligently, the results have been most gratifying; but tuberculin is a powerful agent, and it has shown its ability for evil as well as good. In the absence, therefore, of a remedy possessing specific curative properties and susceptible of safe *general* employment, the clinician is forced to depend upon those natural resources by which the resistance of the organism to the activities of the tubercle bacilli are increased.[1] And later:[2] "With a better understanding of the way in which it is to be used, and of the cases which are suitable for its employment, tuberculin now seems about to enter on a period of usefulness as a curative agent."

"This T. R. was proved to possess distinct immunizing properties, and its curative effects were demonstrated upon tuberculous animals. It has now been before the profession for some years, but does not seem to have been much employed, although there is good evidence that it possesses the properties claimed for it by its discoverer. . . . It is perhaps as well that there should be no *general* desire to resume trial of this and similar remedies, for there can be little doubt that until their mode of production has got far beyond its present imperfect stage, the use of these preparations ought to be restricted to those who clearly understand the nature of the materials with which they are working."[3]

The tone of these editorials leaves no doubt as to the value of tuberculin. It

[1] Editorial: *Journal of the American Medical Association*, March 29, 1902.
[2] Editorial: *Journal of the American Medical Association*, Aug. 16, 1902.
[3] Editorial: *British Medical Journal*, Jan. 11, 1902.

is to be hoped that it will become more generally used, but it is further to be hoped that no one will attempt its employment who will not first thoroughly study the remedy and thoroughly acquaint himself with the disease, as to its physical signs, clinical course, and pathology. Then, with patience and perseverance and a thorough control of the patient to be treated, he should proceed cautiously, ever recognizing the importance of his work and the end to be attained.

I now wish to quote some of the opinions as expressed in the letters and monographs received during this investigation, in order to show the attitude of the profession toward these remedies. For obvious reasons I will not mention the names of the writers in connection with the letters, but where I quote from a published article I will cite the reference.

Here is a characteristic letter from one who does not recommend the remedies: "Experience with old tuberculin in eleven cases—eight for several weeks and three for three or four months. One seemed practically cured. Heard from her at the end of one and two years. Treated two with watery extract of tubercle bacilli. Under all these serums and some other kinds of so-called specific treatment many patients improve for a time, gaining in weight, coughing less, and even showing a lessened proportion of bacilli in the sputum. I know of no cures from any of them alone. Of course, my little experience is not enough to base an opinion on, but I am quite sure from it, added to that of others, that we have not yet struck the right thing."

Another writes: "I have treated twenty cases from three weeks to two months. Treatment resulted in no improvement, but fortunately no accidents. My opinion is unfavorable."

Another says: "Have used Koch's tuberculin, 1891, T. R., and oxytuberculin. Treated eight cases from two to six months. Result: in some cases negative; in others, especially the early cases, the patients seemed to break down more rapidly than usual. My reading and experience alike make me doubtful of their value."

Another: "Treated a few cases. Results were unsatisfactory and bad. I believe it of very little if any value, and I do not favor its use. I discarded it myself because I believed it harmful."

Still another says: "Have not used it myself, but observed ten cases under others. Do not recall period of treatment. In one case there was recovery. I have not seen or heard of a recovery or improvement that could not have been brought about under equally good environment by other treatment. I believe the method to be dangerous in unskilled hands, and unnecessary in skilled ones."

Now I wish to give some of the opinions on the other side. One man says: "Have used it constantly since its discovery by Koch, restricting its use to patients at the sanitarium who are under close observation and who are treated free. Have treated perhaps 100 to 125 cases, averaging about five months, with generally encouraging results. I favor their use in hospitals and sanatoria, and by men thoroughly familiar with this form of treatment, in suitable cases only. Their indiscriminate use in acute and febrile cases is not admissible."

Another: "While I recognize that tuberculin is not a cure for all cases of tuberculosis, yet I have noted that it has contributed immeasurably to the cure in cases which, under dietetic, hygienic treatment at the sanatorium showed no signs of healing. I hold the combination of hygienic, dietetic, sanatorium treatment with tuberculin treatment as the most useful in all those cases which present a doubtful prognosis, with a possibility of cure. I have treated about 100 with the new tuberculin; cannot say how many with the old. Treatment lasted over a period of several months, and was given with intervals of rest between."

Another writes: "Have used old tuberculin, T. R., and bacillus emulsion in 446 cases, treating on the average 130 days. Seventy-eight per cent have been discharged as cured, and all of those have been under my observation more or less ever since, some since 1891. I hold that Koch's tuberculin as applied in purely tuberculous cases, and by the method described by me, is a specific remedy against tuberculosis, and at present the best treatment."

Another says: "Have used them for ten years in about 300 cases with good results. The use depends largely upon the proper selection of cases and the exclusion of those already overtaxed by the care of toxins appreciated by their non-resistant systems. Diagnostic skill and knowledge of technique become then most important essentials to the successful use of this immunizing method."

Spengler[1] says: "Thus with the careful choice of cases, the judicious application of T. R. has given me only good results, and I consider it at the present time as a very valuable remedy in phthisiotherapy."

Heron[2] says: "In properly selected cases, with proper surroundings, and proper care, tuberculin can be used, not only with safety but with distinct benefit in the treatment of tuberculosis."

Moeller[3] says: "According to our experience (in the sanatorium at Belzig) we consider tuberculin as an extraordinarily valuable remedy in connection with sanatoria. More observations are needed to determine which cases are most suitable to the old preparation, and which are suited to T. R.; but as to the curative value there is no doubt."

Petruschky[4] expresses the hope that the personal fight which was shown in

[1] Spengler. "Contribution a l'etude du traitment de la tuberculose par T. R." Published in pamphlet form from *Deutsche med. Wochenschrift*, 1897, No. 36.

[2] Heron. Report to the Committee of Management of the City of London Hospital for Diseases of the Chest, March 21, 1901.

[3] Moeller. "Ueber die diagnostische und therapeutische Verwendung des Tuberkulins." *Zeitschrift für Tuberkulose und Heilstaettenwesen*, 1902, p. 302.

[4] Petruschky. "Der gegenwaertige Stand der Tuberkulin-behandlung," 1901.

the bitter opposition to tuberculin is now to be laid aside, and that the next decade will see the sanatorium and tuberculin treatment everywhere used in combination. He says: "The combination of the physical-dietetic treatment, alternating with the tuberculin treatment, is at the present time the most satisfactory treatment for those cases of pulmonary tuberculosis which are not too far advanced. The proper use of tuberculin for diagnostic and therapeutic purposes has been so well worked out by years of experience of a few painstaking men that it is now possible for the well informed physician to avoid all mishaps in its use."

From the answers received during this investigation I would draw the following conclusions:

1. The interest of the medical profession in tuberculin and allied products is increasing, and its attitude is gradually becoming less hostile.

2. The attitude of the profession in Europe is more favorable than in this country.

3. The greatest opposition comes from those who were unfortunate in their experience when tuberculin was first introduced, and those who, although they have had no experience, base their opinions upon this early trial, discrediting the work of recent writers upon the subject.

4. Not one man who had given the later remedies an extensive trial, in suitable cases, failed to observe benefit from their use.

5. The disapproval and rejection of the remedies in most instances was based on faulty application and upon trials in unsuitable and far advanced cases.

6. Those who have studied these remedies most carefully, and who have exercised greatest care and judgment in the selection of their cases, have, almost without exception, been convinced of their value; and they have been able to report enough cases to prove that these remedies will do that for which they are recommended.

7. Basing an opinion on the results in 1200 first-stage cases, 611 of which were treated in sanatoria by the usual dietetic and hygienic methods, and 589 by the same careful management plus tuberculin and allied products, we find that, of those treated in the latter manner, 20.2 per cent more were cured than where the tuberculin preparations were omitted from treatment.

8. In patients treated with tuberculin and allied products there is less tendency for the disease to spread to new tissue, and when an apparent cure is attained there is less danger of relapse.

9. Tuberculin and allied products are fast becoming established as therapeutic measures in the treatment of tuberculosis, and are worthy of the earnest attention of the medical profession.

INDEX

Abdominal compress in insomnia, 277
Abortion induced in tuberculous women, 270
Abscesses, sterile, following slow absorption of bacillary emulsions, 176
Acid, picric, counterstain for bacilli, 37
Adhesions, apical pleural, cause of hoarseness, 9
  effect of, causing displacement of thoracic viscera, 84
  pleural, cause of drawing in of intercostal spaces, 63
  pleural, show signs on auscultation resembling rales, 253
  pleural, sometimes obliterate cavity, 250
Advanced cases, plea for treatment of, 223
  specific climate sought by, 229
  suffer from results of tuberculosis, 223
  tuberculin relatively of greater value in, 201
Advanced cases not hopeless, 95
Adventitious sounds heard on auscultation, 76
Agaracin in night sweats, 274
Age, a factor in prognosis, 98
Agglutinating power of blood, increased by injection of bacillary products, 183
Agglutination of bovine and human bacilli differ, 35
Air, bacteria in, killed by sunlight, 234
  comparison of bacterial content of that of rooms, and the open, 124
  effect of impure, upon the individual, 123
  outside and inside compared, 123
  purity depends somewhat on motion, 123
Alps, immunity from tuberculosis noted in, 233
Alkaline hot drinks in treatment of cough, 272
Altitude, causes extra demand upon the system for tissue repair, 238
Altitude, causes greater strain on and development of heart and lungs than low elevations, hence unsuited to treatment of pulmonary tuberculosis, 238
  causes of blood changes at, 236
  disadvantages of, for the tuberculous, 236
  effect of, upon heart at rest and during exercise, 240
  false conclusions drawn from apparent immunity from tuberculosis noted at, 233
  heart affected by, 236
  immunity from tuberculosis thought to be conferred by, 233
  many patients unfit for life at, 234
  merits of low and high, 235
  objections to, in treatment of tuberculosis, 240
  patients suited to treatment in, 235
  patients unsuited to treatment in, 235
  respiration increased in force and frequency by, 236
  table showing effect of, on pulse, respiration and vital capacity, 237
  thought to be an essential to cure, 233
  treatment of tuberculosis contrary to the principle of rest, 236
American Desert, immunity from tuberculosis noted in, 233
Amyl nitrite in treatment of hemoptysis, 264
Anemia in early tuberculosis, 10, 17
Andes, immunity from tuberculosis noted in, 233
Animal experimentation, immunizing power of tuberculin proven by, 182
Antagonism, vaccines from human and bovine type of bacilli show, 179
Antibodies may be produced by dead bacteria or their toxins, 116
  produced in infections, 116
  specific, 116
Antitubercle serum, 207

Appetite, causes of variability of, 138
improves with improvement of patient, 138
in early tuberculosis, 9
not safe guide for eating in tuberculosis, 137
solid food stimulates, more than liquid, 259
variable in tuberculosis, 49
Apex, height of, in health, 70
natural difference in right and left and cause of same, 16
Apex beat, detection of difficult in advanced tuberculosis, 89
drawn away from chest wall in advanced tuberculosis, 64
lowers from birth to old age, 80
position of, evidence of pulmonary condition, 63
Apex of heart, palpation of, facilitated by having patient bend forward, 71
Apical outline, method of determining, 19
shows contraction in early tuberculosis, 19
Arneth, changes in neutrophile leucocytes noted by, 186
Arrestment, possible in many advanced cases, 95
Assimilation, open air improves, 124
Athletes, heart and lungs of, overdeveloped, 238
tuberculosis common in, 238
Atropine in night sweats, 274
Auenbrugger's percussion, 66
Auscultation, changes on, in early tuberculosis, 20
difficulties in, 21
effected by pressure on stethoscope, 15
errors in, 21
furnishes most reliable evidence in early tuberculosis, 20
in advanced pulmonary tuberculosis, 73
Auscultatory percussion, 67
Auscultatory stroking in diagnosing pleural effusion, 251

Bacilli, bovine and human cause tuberculosis in man, 177
bovine and human produce lesions which differ, 178
bovine and human type differ in growth, 177
bovine and human type of, antagonistic, 177
Bacilli, causing infection, come from a previous case of tuberculosis, 103
change from products made from human, to bovine and vice versa valuable in therapy, 195
chief source of, human beings with advanced tuberculosis, 102
climatic conditions favoring destruction of, 234
climatic conditions favoring growth of, 234
climatic conditions inimical to, found at all elevations, 234
constant attempt of, to escape from focus of infection, 92
cultural differences of, of human and bovine types, 34
dead, show more tendency to the production of fibroid tissue than living, 115
disappearance of, from sputum, statistics of, 202
effect of sunlight upon, 104
examination of stools for, 245
form of, and prognosis, 99
found in sputum after hemoptysis, 27
human and bovine, antagonistic in their action, 34
human and bovine type of, differentiated, 33, 34
long beaded, less virulent, 99
mobilization of, a myth, 189
multiplication of, outside of the body, 102
not to be relied upon for early diagnosis, 25
numbers of, in prognosis, 29, 99
presence of, shows destruction of tissue, 29
products of, action of, 181
retain virulence months outside of body, 103
rules governing staining for, 30
short thick, virulent, 99
stain for differentiating bovine and human, 35
type of, made basis of therapy, 177
type of, studied in 112 cases, 34
tubercle, discovery of, 286
watery extract of (von Ruck), 176
where, chief factor, the tendency is toward fibrosis, 115
Bacilli emulsion (T. E., Koch), 175
Bacilli emulsion, absorbs slowly, 176
dosage of, 176
produces greatest immunity, 176

Bacillus, discovery of, revolutionized ideas, 286
Bacillus pulp (Maragliano), 208
Bacillus, vaccines made from, increase specific antibodies, 119
Bacillary products, animals immunized by, 183
Bacteria, killed by diffused light, 234
sunlight kills, 234
Bacterial content, comparison of open air and room air in, 124
Bacteriolysin (Maragliano), 207
Bath, alcohol, 156
cleansing, 163
cold, contraindication for, 156
cold, fear of, 156
cold sponge, description of, method of employing, and end attained by, 157
conditions governing, 155
dripping sheet, value of, and technique, 158
tepid sponge, in reduction of temperature, 157
Baths, time of day for taking, 164
Beard, should not be worn by tuberculous patients, 103
Bed clothing, too much should not be used, 126
Bed, warmed at night, 126
Behring's theory of milk infection, 102
tulase, 181
Bell sound in pneumothorax, 255
Belzig sanatorium, results of cases treated with and without tuberculin in, 201
Beraneck's tuberculin, 174
Biedert, view of, regarding action of tuberculin, 182
Bier's hyperemia, 209
results in joint tuberculosis treated by, 213
rules for employment of, 212
suggestion for, of lungs, 213
Bismuth, use of, in tuberculous diarrhea, 247
Blood, agglutinating power of, increased by injections of bacillary products, 183
cause of changes in, at altitude, 236
changes in, noted in low, warm, dry climates, 236
coagulability of, important in treating hemoptysis, 265
Blood, cure of bacterial diseases comes through, 209
light absorbed by, 234
negative, as a rule in mixed infection, 256
opsonic power of, determination of, establishes value of tuberculin therapy, 184
prevented from entering areas of infection, 210
red corpuscles of, decreased by deprivation of light, 235
role of, in infection and immunity, 210
sunlight enriches, 234
Blood pressure, lowered in early tuberculosis, 9
in epidemic hemoptysis, high, 262
lowered in treatment of hemoptysis, 264
Blood spitting, almost always tuberculous, 12
Blood supply, shut off from tubercle, retards healing, 186
Bodington, first recommends open-air treatment, 122
Bovine bacilli, stain for, 35
Bovine emulsion (P. E., Spengler), 177
Bovine tuberculin (Spengler), 174
Bowels in hemoptysis, 266
Breath not dangerous, 108
Breathing, amphoric, 75
bronchial, description of and cause of, 75
bronchial, found normally in chest, 75
bronchial of pathological origin, 75
cogwheel in early tuberculosis, cause of, 25
cogwheel, location of, 24
exaggerated, cause of, 74
harsh, in early tuberculosis, cause of, 23
involuntary act, 150
mixed, description of and cause of, 75
prolonged expiration in early tuberculosis, causes of, 23
puerile, in early tuberculosis, cause of, 23
rough, in advanced tuberculosis, 75
rough, in early tuberculosis, cause of, 22
sharp vesicular, in early tuberculosis, cause of, 23
vesicular, cause of, 21

Breathing, weakened, cause of, 73
weakened, due to enlarged bronchial glands, 74
weakened, due to thickened pleura, 74
weakened, in early tuberculosis, cause of, 23
weak, in pneumothorax, 255
Brehmer, established first sanatorium, 1859, 286
exercise a feature of his treatment, 142
Bronchitis, relieved by dry air of low bacterial content, 240
Bronchial catarrh, evidence of activity in tuberculous process, 51
symptom of tuberculosis, 9
Brown, permanency of results in cases treated by, where tuberculin was used, 203
statistics of disappearance of bacilli from sputum, 202
Bulloch, table of, showing opsonic power of blood in lupus, 185
Bungalow, Pottenger Sanatorium, 219

Calcium chlorid in treatment of hemoptysis, 265
California, Southern, climate of, 232
Candor, essential in dealing with tuberculous patients, 26, 280
stimulates co-operation, 283
Carbohydrates, form of administration, 137
Cattle, milk from, as cause of tuberculosis, 3
Cavity, metallic resonance over, 73
percussion note over, 72
sputum from, with odor, 48
Cell activity, sunlight increases, 234
Centrifugation, method of examining sputum, 38
Chart of chest, necessary for accuracy, 13
Chest, bulging of, in pneumothorax, 255
chart of, necessary for accurate comparison, 13
index of, 62
movements of, on inspection, 62
phthisical, 61
phthisical, broad or deep?, 61
shape of, conditions affecting, 62
shape of, differs in healthy individuals, 60
shape of, due to pathological changes, 61
Children, born of tuberculous mother may be strong, 269
Children, danger of, being infected by associating with afflicted, 106, 108
danger of, infection to, through crawling on floor, 7
later ones of large family most susceptible to tuberculosis, 8
tuberculosis of glands frequent in, 248
Childhood, Behring's theory of infection through milk, during, 102
prophylactic measures in, 106
time when infection often occurs, 3
tuberculin diagnosis in, 45
Chill, accompanying pleurisy with effusion, 251
in mixed infection, 257
treatment of, in mixed infection, 258
Chloralamid in insomnia, 277
Circulatory system in advanced tuberculosis, 49
Classes in tuberculosis, 110
Clavicle, difference in elevation of acromial ends of, a sign of early tuberculosis, 18
Click, upon inspiration, meaning of, 77
Climate, best, for given individual, 230
best, for individual where tissue change is carried on to best advantage, 231
care in prescribing, necessary, 233
change of, not advisable for all, 230
change of, should not be made by patients without money, 230
choice of, patient's judgment not safe in, 232
coast, of Southern California, 232
cold, and those of high altitudes suited to robust individuals, 231
cold, demands high rate of tissue change, 231
cold, dry, disadvantages of, 240
cold, effect of, 231
cold, humid, disadvantages of, 240
comparison of high altitude, and low dry, 236
complications must be considered in choice of, 231
diet varies according to, 133
diurnal range in, 231
dry, warm, effects of, 231
effect of, depends on heat abstracting power, 231
elements of importance in, 229, 231
elements of, which favor the treatment of tuberculosis, 240

Climate, favorable, facilitates open-air treatment, 241
favorable, not absolutely necessary for cure of tuberculosis, 230
foolishly advised, 229
foot-hill, of Southern California, 232
good use of bad, better than bad use of good, 230
important consideration in choice of, 230
important in health and disease, 229
in the treatment of tuberculosis, 229
inland, of Southern California, dry with cool nights, 232
irritates, 231
majority must be treated without, 230
mixed and secondary infections prevented by sunny, 234
most good from, can come where patient maintains best nutrition, 231
mountain, characteristics of, 235
near-by places differ much in, 232
no specific, for tuberculosis, 229
pecuniary circumstances considered in change of, 230
physical conditions must be considered in change of, 230
primary effect of, 231
reactive power of patient most important factor in choice of, 231
rigorous, for robust individual, 231
rigorous, injures weakened patient, 232
rigorous, makes greater demand on system than warm equable, 229
rigorous, unsuited to weak individuals, 231
soothes, 231
stage of disease must be considered in choice of, 230
strength and reactive powers of patient important in choice of, 231
usual unfair comparison of, at low and high elevation. 235
warm, humid, disadvantages of, 240
warm, humid, effect of, 231
Climatic change desirable, 241
not essential, 241
specific instructions for, necessary, 232
Climatic conditions favorable to destruction of bacilli found at all elevations, 234
Climatic conditions in common between altitude and low, warm, dry countries, 233
treatment, value of, lies in, 240
Clinical distribution of lesions produced by bacilli of the human type, 178
forms of tuberculosis of bovine and human types differ, 177
Closed tuberculosis does not mean a cure, 299
Clot, importance of, in checking hemoptysis, 265
Clothing, importance of proper, 126
too much, lowers tone of skin, 126
Coal tar products, little use for, in fever, 258
Codein, cough of pleurisy relieved by, 254
in treatment of cough, 272
Coincidence, cases illustrating how such occur, 40, 145
Cold compress, treatment of tuberculous laryngitis with, 243
Colds, repeated, symptom of tuberculosis, 9
simulated by activity in tuberculous process, 51
Colon, irrigation of, in tuberculous diarrhea, 247
Communicability, fear of, 107
Comparison of length of life of treated and untreated cases, 292
Complicating processes cut short by rest, 144
Complications, considered in climatic change, 231
influence of, on prognosis, 98
of pulmonary tuberculosis, 242
temperature above normal in morning suggests, 54
treatment of, with tuberculin, 202
tuberculous, prevented by use of tuberculin, 199
tuberculous, will yield to intelligent treatment, 224
what, are a barrier to treatment?, 223
Conception, prevention of, a duty in tuberculosis, 270
Conditions favoring spread of tuberculosis, 234
Confidence between physician and patient necessary, 285
Constipation, cause of and dietary treatment of, 139
treatment of, in intestinal tuberculosis, 246

Consumption, a condition resulting from tuberculosis, 223
Contraction of lung, pain in, 51
Co-operation of physician and patient necessary, 283
Corsets, force diseased parts of lung to do increased work, 151
Cough, caused by disease of oro- and naso-pharynx, 48
caused by wrong method of living, 48
cause of, 271
cause of, key to treatment, 271
codein in, 254
cold compress relieves, 243
danger of, and value of, in hemoptysis, 265
due to conditions in upper air passages, 272
effect of, 271
emesis produced by, 272
harmful effect of, upon lungs, 144
injures tender fibrils of new tissue, 271
interferes with healing, 151
interferes with nutrition, 271
may or may not be present in early tuberculosis, 9
much of the usual, unnecessary, 271
nothing characteristic in, 48
of tuberculous laryngitis, relieved by orthoform and heroin locally, 243
patient should be instructed to resist, 271
rest relieves, 144
treatment of, 271
unnecessary, much of the usual, 48
wearies and exhausts the patient, 271
wet jacket in, 272
will power most potent remedy for, 271
Cracked pot sound, 73
Creaking, heard in vicinity of cavity, which resembles rales, 76
Creosote, method of administering, 272
Croquet, a permissible sport, 149
Cultural differences in bovine and human bacilli, 177
Curability, evidences of, at hand, 221
ideas of, gained credence during past fifteen years, 287
of tuberculosis, 94, 114
of tuberculosis depends upon, 281
Cure, can be obtained in nearly all early cases, 288
chances of, best in good climate with intelligent treatment, 230
Cure, closed condition does not mean, 299
delay takes away chances of, 221, 288
early, best prophylactic measure, 101
early diagnosis first importance in, 288
factors upon which, depends, 288
frequent visits of physician in sanatorium aids in, 226
how obtained quickest and surest?, 221
investment feature of, 290
nature of, 115
nature of, in tuberculosis, 165
regaining of weight not test of, 298
responsibility of physician in, 94
responsibility of, upon family physician, 94
time important factor in computing cost of, 221
tuberculin as a test for, 45, 299
tuberculin produces, more surely and more quickly, 199
what is a?, 298
Cuspidors, patients should use, 103
Cyanosis, diseases of heart causing, incompatible with tuberculosis, 211
Cystitis, tuberculous, treated by tuberculin and dead culture from associated infection, 266

DaCosta's sign, 24
Davos, a lesson from, 112
native death rate from tuberculosis not increased in, by visiting consumptives, 112
Death rate from tuberculosis, decrease of, in Prussia, 112
responsibility for, must lie largely with physicians, 281
Deceptive terms not permissible, 281
Deep breathing, blood and lymph flow in lung hastened by, 152
destroys tender fibrils of new tissue and interferes with healing, 151
favors aspiration of mucus into new parts, 151
harmful, 150
unnatural and unnecessary, 150
Depressions, explanation of, in early tuberculosis, 18
Desert, American, immunity from tuberculosis in, 233
Dettweiler inaugurated rest cure, 142
Diabetes, sputum in, may be scant, 48

Diagnosis, demanded by best interests of patient, 282
- early, auscultation in, 20, 29
- early, before bacilli in sputum, 6
- early, burden of, upon family physician, 93
- early, importance of physical examination in, 28
- early, inspection in, 16
- early, meaning of, 6
- early, necessary for prophylaxis, 6
- early, necessary for cure, 6
- early, palpation in, 18
- early, percussion in, 19
- importance of early, 26
- negative, should not be made because of failure to find bacilli, 9, 25
- of intestinal tuberculosis, 245
- of pleural effusion, 251
- of variety of bacillus causing infection, may be made, 178
- prognostic importance of, 47
- therapy depends upon accurate, 47
- tuberculous laryngitis, 242

Diaphragm phenomenon, 64

Diarrhea, diet in non-tuberculous, 140
- diet in tuberculous, 141
- irrigation of colon in tuberculous, 247
- non-tuberculous, treatment of, 140
- treatment of, in tuberculous involvement of intestines, 140, 246
- troublesome in tuberculosis of colon and rectum, 245

Diet, experiments of Goodbody, Dr. Bardswell and Mr. Chapman, 131
- in constipation, 139
- in dilatation of stomach, 139
- in hyperchlorhydria, 139
- in mixed infection, 258
- in non-tuberculous diarrhea, 140
- in tuberculous diarrhea, 141, 246
- influence of climate upon, 133
- liberal, in fever necessary, 138
- minute details necessary, 137
- present system unsatisfactory, 129
- proteids suitable for, 136
- rational, 131
- should be adapted to the patient, the disease, and the climate in which he lives, 133
- should be prescribed by physician, 137

Dietary, carbohydrates in, 137
- fats in, 136
- proteids in, 136

Dietary, scientific, for tuberculous not widely different from that of health, 129
- standard (Mundesley Sanatorium), 132
- standard (Voit), 131
- standard for tuberculosis (Fanning), 131

Differentiation of bacilli of bovine and human type, 33, 34, 35

Digestion method of examining sputum, 38
- open air improves, 124

Digestive disturbances, cause of, in advanced tuberculosis, 49
- forms found in tuberculosis, 49
- heart as cause of, 49
- improve with improvement of patient, 96
- of advanced tuberculosis, 49

Discouragements due to lack of candor, 283

Disease, theories of, 209

Disinfection, method of, 109

Dispensaries, 109

Disposition, often changes in tuberculosis, 8

Droplet theory of infection, 102

Dry air, reduces expectoration, 240

Dust theory of infection, 101

Dusting, approved method of, 105
- danger from ordinary method of, 105

Dyspnea, 277
- caused by pleurisy, 251
- causes of, 277
- exercise improves, 147
- in pneumothorax, 255
- rest indicated in, 147
- treatment of, 277

Ear, advantages and disadvantages of, in auscultation, 14

Early stage, climate, wide range of choice for, 230

Early tuberculosis, general picture of, 27

Earning capacity, large per cent of patients restored to, 292

Eating, regularity of, very important, 137

Ebstein's touch percussion, 67

Effusion, pleural, may be caused by focus at apex, 12

Education, most important prophylactic measure, 107

Eggs, methods of using in tuberculosis, 136

Elastic tube percussion, 68

Emphysema, compensatory, benefits derived from and dangers resulting from, 90
prolonged expiratory note in, 74
Emphysematous lung, difficulties of diagnosing tuberculosis in, 72
Emulsion of tubercle bacilli (T. E., Koch), 175
Emulsion of tubercle bacilli (T. E., Koch) dosage of, 176
Encapsulation, after history of, 2
one method of cure, 2
Envelope, bovine bacillus has thicker, than human, 35
bovine bacillus, injured by heat and acid, 35
injury of, shows resistance on part of organism, 37
Environment, previous, affects prognosis, 97
Ergot, contraindicated in hemoptysis, 265
Etiology, study of 112 cases with reference to type of bacillus found, 34
tuberculosis in man has double, 34
Examination, general rules for, 13
physical, importance of, in early diagnosis, 28
Excesses, cause of tuberculosis, 105
Exercise, contraindications for, upon part of heart, 146
heart injured by injudicious use of, 145
heart strengthened by judicious use of, 146
signs of heart strengthening under, 146
with reference to meal-time, 148
what form most suitable?, 148
when indicated?, 147
valuable in course of treatment at proper time, 146
value of, 142
Expectoration, danger of dissemination of tuberculosis lies in, 103
decrease of, in dry air, why?, 240
destruction of, removes practically all danger, 108
Expiratory murmur, prolongation of, cause, 74
Extension of infection causes morning rise in temperature, 54

Falkenstein, death rate in, not increased by presence of sanatoria, 112
Fats, form of administration, 136
Feces, examination of, after patient has taken care about swallowing sputum, 245
pus in, sure sign of ulceration, 245
Strassburger's method of examining for bacilli, 245
Feet, care of, important, 127
should be warm before retiring, 126
Fever, caused by absorption, 56
caused not alone by tubercle bacillus toxins, 56
cause of, in tuberculosis, 56, 274
cause of, must be treated, 275
degree of, can not be measured by patient's feelings, 57
in tuberculosis, 274
liberal diet necessary in, 138
lowering of, *per se* not curing patient, 258
relieved by injections of tubercle bacillus vaccines, 180
rest indicated in, 143
treated with tuberculin, rationale of its action, 275
treatment of, in mixed infection, 258
tuberculin treatment during, 189
Fever case, charts showing benefit derived from tuberculin treatment in a, 190, 193
Fever cases, action of tuberculin in, based on Wright's opinion, 192
Fibroid tissue, tuberculin increases amount of, 186
Fibrosis, extensive, contraindication for forced feeding, 130
Financial condition, prognostic significance of, 98
Fistula in ano, 247
effects of operation on patient should be carefully considered, 247
heals under tuberculin treatment, 248
not operate, while disease in lungs active, 247
Floor, danger of infection from, greatest, 104
Flügge's droplet theory of infection, 102
Focus, closed, temperature in, 55
Fog, no contraindication for treatment with open air, 127
Food, solid, should be used in fever of mixed infection, 250
time for administration of extra, 137
Foods, what best for the tuberculous?, 135

Forced feeding, common instances of, 129
contraindicated in weak heart, 130
effects of, upon gastro-intestinal tract, 130
evil effects of, 130
fibrosis contraindicates, 130
gastro-intestinal diseases contraindicate, 130
kidneys in, 130
symptoms of, on part of intestinal tract, 130
temporary measure at most, 130
Formaldehyde disinfection, 109
Fresh air, how best obtained, 123
how obtained in homes, 123
Friction fremitus, 65
Fruit, can it be eaten with milk?, 134
Fürsorgestellen, 109

Games, danger of overexertion in, 149
Gastric neuroses of toxic origin, 138
Gastro-intestinal diseases, contraindicate forced feeding, 130
Gastro-intestinal symptoms in early tuberculosis, 9
Gastro-intestinal tract, organic disease of, 138
symptoms on part of, 278
Gelatine in treatment of hemoptysis, 265
Genito-urinary, lesions to be treated medically, not surgically, 266
Genito-urinary tuberculosis, 266
Germicides, used in disinfecting sputum, 103
Glands, cases of enlarged, should be submitted to the tuberculin test, 248
children frequently have tuberculosis of, 248
chronically enlarged, usually react to tuberculin, 248
enlarged bronchial, cause weakened breathing, 74
frequency of tuberculosis of, 248
surgery in tuberculosis of, very unsatisfactory, 249
suppurative tuberculous, best treatment for, 249
tuberculosis of, 248
tuberculosis of, ideal infection to treat, 248
tuberculosis primarily a disease of, 4
tuberculosis of, should be treated by tuberculin without delay, 248
what should be the attitude toward enlargement of, in children?, 248
Goerbersdorf, death rate in, not increased by presence of sanatoria, 112
Grocco's sign, method of determining, 251
Guidance, constant, careful, intelligent, necessary for best results, 284
Gums, red line on, found in early tuberculosis, 17

Handkerchief, patients should not expectorate into, 103
Hands, should be washed frequently, 103
Hardiness, demanded by high altitude and cold climates, 231
Harrington's sign, 17
Healing, with little scar tissue desirable, 151
Health board control essential, 108
Heart, athletes injured by overdevelopment of, 238
burden upon, in advanced tuberculosis with high degree of contraction on the part of one lung, 88
burdens thrown upon, in tuberculosis, 145
case illustrating overstrain upon, 146
chronic disease of, and tuberculosis, 211
diseases of, producing cyanosis incompatible with tuberculosis, 211
displacement, effect of, 90
displacement of, causes of, 88
displacement of, in pleural effusion, 251
displacement of, in pneumothorax, 255
displacement of, where double apical infection is present, 89
displacement, symptoms accompanying, 90
displacement to left, 63
displacement to right, 63
effect of altitude upon, at rest and during exercise, 338, 340
effect of altitude upon, 236
exercise strengthens when advisable, 146
factors burdening, in tuberculosis, 95
factor in prognosis, 95
hypertrophy of, militates against tuberculosis, 211
importance of recognizing pathological changes in outline of, 83
impulse, directly against chest wall, 64

Heart, impulse of, on chest wall due to side of ventricle, 90
injured often by injudicious exercise, 145
lung, portions of, adjacent to, heal slowly, 237
movability of, depends upon condition of aorta, 81
movements depend upon size of pericardium, 81
normal outline of, 83
position of, depends upon pericardium, 80
position of, gives evidence of pulmonary condition, 63, 71
position of, normal changes in, during life, 80
prognostic signification in advanced tuberculosis, 49
rest imperative on account of, 145
statistics of lesions of, and tuberculosis, 212
strain on, in advanced tuberculosis, 50
unstable in early tuberculosis, 9
weakening of, influences prognosis, 96
weakness of, causes digestive disturbances, 49
weakness of, contraindicates forced feeding, 130
metallic character of sounds of, in presence of cavity, 50
Heat center, instability of, in tuberculosis, 52
Heat, gentle, should alone be used in staining for bacilli, 30
Hemoglobin, increased by sunlight, 235
Hemoptysis, 261
amount no significance as to extent of disease, 12
astringents useless in, 266
cause of, 262
congestive origin of, 266
dangers of, 98
danger of new infection following, reduced by rest, 145
diagnostic significance of amount of blood lost during, 263
early, should always give patient advantage of early treatment, 26
epidemic character of, 262
fatal, case illustrating necessity for rest, 145
faulty treatment of, 262
frequency of, 261
Hemoptysis, indications for treatment of, 263
less frequent in institutions than on outside, 263
necrosis of vessel wall an element in, 265
often first sign of tuberculosis, 12
prognostic significance of, 98
relationship of, to early diagnosis, 261
relief following, 99
rest imperative in, 144
rest in treatment of, 263
treatment of, 262
treatment of, likened to the management of a rupture in a system of rubber tubing connected with central pump, 263
vaso-dilators in treatment of, 264
Heredity, part played in tuberculosis by, 7
small part played by direct, 107
resisting power of patient a matter of, 107
Heroin, in treatment of cough, 272
High altitude, demands high rate of tissue change, 231
History, clinical, very important in making a diagnosis, 8
History, family, 7, 47
of family shows index of resistance, 7
Hoarseness, cause of, in early tuberculosis, 9
larynx should be examined when, present, 51
Home, patient required to do unwise things while being treated in, 225
requirements of, for proper prophylaxis, 106
Home treatment, difficulties of, 225
method of supplying, 128
Hope, engendered by association in sanatoria, 227
Hopefulness of tuberculosis, 300
Horseback riding, 140
Hospitals for tuberculosis not dangerous to surroundings, 111
Hospitals, necessary for advanced cases, 110
Hospital, results compared with those of sanatorium, 204
Houses, approved method of sweeping and dusting, 105
clean, danger of infection in, 104
danger in ordinary method of sweeping and dusting, 105

Houses, dirty, danger of infection in, 104
infection of, as determined by inoculation experiments, 104
House, tuberculosis contracted in, 104
Huggard's table showing effect of altitude on heart, respiration and vital capacity, 237
Humoral theory of disease rehabilitated, 209
Hydrotherapy, 153
effect of, upon internal organs, 155
effect of, on night sweats, 273
effect of, upon the skin, 155
reaction in, 153
temperature reduction least important part of, 153
value of, 153
valuable in fever of mixed infection, 258
Hygienic treatment falls short in the production of antibodies (opsonins), 117
Hygienic treatment, what can be accomplished by, 117
Hyperchlorhydria, cause of, and diet for, 138
Hyperemia, 209
active versus passive, 209
aim of, 213
cardinal rules for employment of, 212
due to position aids in cure of lungs, 215
effect of, 210
immunizing measures should be used in conjunction with, 215
method of using, 212
pulmonary, produced by light, 214
pulmonary, produced by pneumatic cabinet, 214
pulmonary, produced by tuberculin, 214
technique all-important, and not simple, 212
treatment of pulmonary tuberculosis by, 213
treatment of tuberculous joints by, 213
tuberculin causes, in tuberculous foci, 186
warning against careless use of, 212
Hyperresonance, causes of, in advanced tuberculosis, 72
Hypersensibility, overcome by using product made from another variety of bacillus, 195
Hypersensibility, patients rarely show, to products made from both human and bovine bacilli, 195
shown to tuberculin during fever, 189
to bacillary products, 194
Hypochlorhydria, treatment for, 139

Immunity, altitude *per se* does not confer, 233
altitude thought to confer, 233
climates apparently conferring, possess certain characteristics, 233
direct, 117
emulsion of bacilli produces greatest, 176
how produced, 115
indirect, 117
method of establishing, in tuberculosis, 165
present when cure results, 115
role of blood in production of, 210
Immunization, active, more valuable in tuberculosis, 207
animal experiment proves tuberculin's power in, 182
tuberculin sets machinery of, in motion, 182
Immunizing bodies applied directly to tuberculous focus by the hyperemia caused by injections of tuberculin, 186
Immunizing response, maximal produced with doses short of constitutional disturbances, 196
Incipient cases, nearly all can be cured, 288
Incipient tuberculosis, why most curable?, 93
Indio, climatic conditions of, 232
Infection, a struggle between bacilli and protective forces, 1
athletes subject to, 238
caused by bacilli of bovine and human type antagonistic, 178
children who have been exposed to, should be watched, 94
climatic conditions favoring spread of, 234
danger of, greatest near end of life, 110
danger of, greatest on floors of rooms, 7
danger of, in clean and dirty houses, 104
danger of, removed in sanatoria, 107

Infection, defensive powers of blood used up during, 93
droplet theory of, 102
dust theory of, 101
extent of, influences prognosis, 92
factors in causation of, 104
ingestion theory, 102
law governing, 92
milk as carrier of, 102
mixed and secondary, prevented by sunlight, 234
nature's method of dealing with, 1
opportunity of, important in taking history, 7
opposed by natural defenses of organism, 92
problem for adherents of inhalation and ingestion theory of, 101
prognosis, depends upon nature of, 92
relation of, to deaths from tuberculosis, 114
role of blood in prevention of, 210
routes of, 92
spread of, inhibited where tuberculin used, 198
symptoms appear long after, 1, 2, 7
tendency of, to spread, affects prognosis, 92
transmitted within doors, 125
Infiltration may exist long time without ulceration, 4
Inhalations in treatment, 272
Injection, antiseptic precautions in, 195
site of, 195
Insomnia, 276
caused by gastric acidity, 276
sleeping powders should be used cautiously in, 277
terminal, 277
Inspection, evidence obtained by, in advanced tuberculosis, 60
Insurance societies of Germany treat insured, 290
Integument, conditions of, over chest, 60
Intelligent patient, best patient, 284
Interest of physician and patient mutual, 284
Intercostal spaces, bulging of, due to pleural effusion, 63
drawing in of, due to the presence of pleural adhesions, 63
Intestinal stenosis, relieved by surgery, 247
Intestinal tuberculosis, 244
Intestinal tuberculosis, bacilli in stools, of, 245
constipation should be combated in, 246
diagnosis of, 245
frequency of, 244
mushy stools of, 245
nocturnal stools of, 245
statistics of frequency of, 244
subnormal temperature in, 56
symptoms of, when cecum seat of infection, 245
symptoms of, when colon and rectum seat of, 245
temperature depressed in, 245
treated with tuberculin, 247
treatment of diarrhea in, 246
ulceration, site of, in, 245
Investment, state sanatoria well run prove to be, 290

Jacket, wet, description of, and therapeutic application, 162

Kumyss, formula for making, 135
Koch, bacilli emulsion of, 175
new tuberculin of, 175
results of, showing agglutinating power of blood increased by bacillary products, 183
view of, regarding action of tuberculin, 182
Koch's discovery of tubercle bacillus, 286
Koch's rules for use of tuberculin, 168
Kitasato's method of examining sputum for mixed infection, 256
Kidney, tuberculous, treated by tubercle vaccines, 266
Kidneys, disease of, contraindication for forced feeding, 130

Lactic acid, unnecessary in treatment of tuberculous laryngitis, 244
Lagging, cause of, 17
detected by inspection, 17
detected by palpation, method of, 18
important early sign in tuberculosis, 17, 18
in bilateral involvement, 19
in tuberculosis, 63, 66
most valuable in unilateral involvements, 19
La grippe, tuberculosis often follows, 106
tuberculosis treated for, 28
Laryngitis, tuberculous, any part of larynx may be involved, 243

Laryngitis, tuberculous advanced, difficult to cure, 242
 begins as infiltration, 242
 diagnosed by tuberculin test, 243
 diagnosis of, 242
 differentiated from non-tuberculous by experience in examining throats, 242
 early appearance of, 243
 lactic acid in treatment of, 244
 protargol as local application in, 243
 prognosis in, depends on whether or not tuberculin is used, 243
 prognosis in, depends on earliness of diagnosis and intelligence of treatment, 243
 perhaps always secondary, 242
 rest in treatment of, 243
 treated by sunlight, 244
 treatment of, 243
 treatment of, with cold compress, 243
 tuberculin most important remedy in, 244
 when diagnosed early offers excellent chances of cure, 242
Larynx, may be seat of infiltration for long time without ulceration, 4
 routine examination of, should be made in cases of pulmonary tuberculosis, 242
 sputum taken from, as aid to early diagnosis, 38
 symptoms on part of, in early tuberculosis, 17
 tickling in, in early tuberculosis, 9
 tuberculosis of, frequency of, 242
 ulcerations of, treated by orthoform, 243
Latency, alternates with activity, 2, 4
 important to recognize, 4
 proofs of, 4
Laxatives, use of, in intestinal tuberculosis, 246
Lead, use of, in tuberculous diarrhea, 247
Legislation, unjust, provoked by fear of disease, 108
Leucocytes, effect of tuberculin upon, 186
Life greatly prolonged by treatment, 292
Light, blood absorbs, 234
 effect of, in preventing infection, 104, 105
 deprivation of, reduces red blood cells, 235
 diffused, kills bacteria, 234
 oxidation increased by, 235
Light, pulmonary hyperemia produced by, 214
 quickens vital forces of man, 234
Limitations of tuberculin, 205
Litten's sign, 64
Localization of, bovine and human bacilli in body differs, 35
Lung, areas near heart heal slowly, 151
Lungs of athletes, injured by overdevelopment, 238
Lung boundaries, cause of displacement of, 83
 effect of displacement of, 87
 normal, 81
 outline of, 70
Lung, capacity of, in man greater than necessary, 150
 compensatory emphysema of, benefits and dangers of, 90
 contraction of, conditions favoring, 84
 importance of recognizing change in position of borders, 83
 mobility of borders, lessened by disease, 71
 mobility of lower borders, 71
 priority of involvement of, indicated by position of heart, 89
 rest and exercise for, 149
Lupus, opsonic index of blood in, 185

Magnesium sulphate, use of, in tuberculous diarrhea, 246
Malaise, 8
Maragliano, antitoxic serum of, 208
 bacteriolysin of, 207
 watery extract of tubercle bacilli of, 207
Marmorek's serum, 208
Measles, tuberculosis often follows, 106
Meat juice, method of preparing, 136
Medical directors of sanatoria, qualifications of, 216
Meningitis, tuberculous, symptoms of, 267
 treatment of, 268
Menses, cessation of, shows tuberculosis already present, 58
 resumed with returning strength of patient, 59
 rise of temperature at time of, 57
Mental activity, effect of, on temperature, 52
Mercury, red iodid, in treatment of cough, 272

Metabolism, climate affects, primarily, 231
Micro-organisms, associated, cause rise in temperature, 56
stimulate cells to production of immune bodies, 116
Miliary tuberculosis, acute, causes morning rise of temperature, 54
percussion note in, 72
Milk, amount of, required for exclusive diet, 135
can it be eaten with fruit?, 134
cause of all tuberculosis, 3
importance of, in dietary, 133
method of prescribing, where patient feels that he can not take it, 133
modification of, 133
not a liquid food, 134
quantity of, to be prescribed, 134
should be chewed, 134
teeth and mouth should be cared for when used, 135
Mitulescu, study of effect of tuberculin upon leucocytes, 185
Mixed infection, a factor in all cases beyond early stage, 257
blood as a rule negative in, 256
cultures from the walls of cavities immediately after death show, 256
danger of, reduced by open-air life, 125
diagnosis of, 256
diet in, 258
dry air with maximum of sunshine prevents, and tends to relieve, 240
micro-organisms found in, 256
opsonic index in diagnosis of, 257
rational treatment of, consists in vaccinating against tubercle bacillus and associated organsims, 257
serum treatment of, 259
sunlight prevents, 234
symptoms of, 257
treatment of convalescence from, 261
Morphia, harm done by, in hemoptysis, 265
Mountain climates, characteristic of, 235
Mouth, should be washed before meals, 103
Mustache, tuberculous patients should not wear a, 103
Myalgia in tuberculosis, 52

Nagel, statistics of disappearance of bacilli from sputum, 202
Nasal stenosis, a cause of weak breathing, 21
Necrosis, caused by toxins, 114
Negative phase, importance of, exaggerated, 197
not as dangerous as Wright suggests, 187
Wright's interpretation of, 197
Neglect not permissible if best results are to be had, 284
Nerve, recurrent laryngeal, bound down by apical adhesions or enlarged tuberculous glands, 9
Nerve reaction, in hydrotherapy, 153
Nervousness in mixed infection, 257
Nervous system in advanced tuberculosis, 50
Nervous system, symptoms on part of, in early tuberculosis, 8
Neuralgia, intercostal, differentiated from pleurisy, 71
Neurasthenia, dripping sheet bath in, 158
often caused by tuberculosis, 8
often evidence of the presence of tuberculous infection, 3, 27
Neutrophiles, show increase in granulation after tuberculin injections, 186
Night sweats, vinegar and water in treatment of, 273
Nitrite of soda in treatment of hemoptysis, 264
Nitroglycerine in treatment of hemoptysis, 264

Oil, castor, use of, in tuberculous diarrhea, 246
Oil enemas, use of, in constipation, 246
Olive oil, method of administering, 140
Open air, action depends upon, 123, 125
cause of more deaths than any other measure, 127
change to, must be made with judgment, 126
danger of infection in, nil, 104
effect of, upon nervous system, 124
effect on night sweats, 273
essential of, is constantly changed air, 123
first recommended by Bodington, 122
hardens patients, 124
how derive most benefit from?, 127
is there danger at beginning of, treatment?, 125
improves digestion and assimilation, 124

Open air, judgment must be exercised in using it, 126
lessens danger of new and secondary infections, 125
minute instructions necessary for, 127
not a question of oxygen, 123
not specific, 122
patients who develop tuberculosis while living in, not favorable for treatment, 97
temperature reduced by, 125
treatment at home, 128
treatment not understood, 122
treatment of fever, 275
treatment of tuberculosis, 122
Opthalmo tuberculin test, 46
Opium, derivatives of, in dyspnea, 278
use of, in intestinal tuberculosis, 247
Opsonic index, diagnostic value in mixed infection, 257
shows defensive antibodies used up in combating infection, 93
status of, in tuberculous infections, 184
Opsonic power of blood, determination has established value of tuberculin in treatment, 184
determination of, 184
increased by injections of bacillary products, 184
increased by injections of tuberculin, 184
reduced in lupus, 185
meaning of, 184
Opsonic power of lymph in areas of infection low, 210
Optimism necessary in treatment of advanced cases, 223
Optimism, of tuberculous patient, 50
Orthoform in treatment of laryngeal ulceration, 243
Overcrowded, tuberculosis most common among, 105
Ovary, apparently cured by tuberculin treatment, 267
Overexertion, cause of cough, 271
danger of all sports is, 149
Oxygen, decrease of, at altitude calls for increased effort upon part of respiratory and circulatory organs, 236
lack of, not cause of tuberculosis, 149
not the main factor in open-air treatment, 123
Ozone may be disregarded in choosing climate, 241
Pain, 276
accompanying pleurisy with effusion, 251
cause of, 276
causes of, in advanced tuberculosis, 51
in advanced tuberculosis, 51
in intestinal tuberculosis, 245
in pneumothorax, 255
location of, in early tuberculosis, 12
lung tissue not sensitive, 276
of acute congestion, 51
of pleural origin, 276
symptoms of early tuberculosis, 11
treatment of, 276
Palpation, 18
detection of pathological breathing by, 65
enlarged glands detected by, 18
fremitus detected by, 18
in advanced tuberculosis, 65
Paracentesis in pneumothorax, 255
Paravertebral triangle of dulness, 251
Patient, judgment of, not to be relied on in choice of climate, 232
killed by friends, 225
must know that he has tuberculosis, 281
not spared by withholding truth, 281
responsibility of, in early diagnosis, 94
should be informed of presence of tuberculosis in a humane manner, 282
Patients, help each other, 227
need mental support of their physician, 285
tuberculous, become selfish and dependent, 50
weak, injured by rigorous climate, 232
Percussion, Auenbrugger's, 66
auscultatory, 67
cavity, 67
Ebstein's touch percussion, 67
elastic tube, 68
evidence derived by, in advanced tuberculosis, 66
heavy, throws great portion of chest wall into vibration, 15
immediate, 15
light, preferable in early tuberculosis, 15
mediate, 15
ordinary method of, 70
palpatory, very useful, 19, 66

Percussion, resistance to finger, in, very important, 15
too many, strokes over same area, confusing, 16
varieties of, 15
what is to be noted on, in early tuberculosis, 19
Percussion hammer, 70
Percussion note, 72
causes of dulness of, in chronic tuberculosis, 72
cause of higher pitch of, at right apex, 16
causes of hyperresonance and tympany of, in chronic tuberculosis, 72
cause of tympanitic character of, in acute miliary tuberculosis, 72
changes of, on deep and shallow breathing, 16
non-tympanitic, 72
of acute miliary tuberculosis, 72
of acute pneumonic phthisis, 72
of chronic tuberculosis, 72
pitch of, in early tuberculosis, 19
pitch of, raised on inspiration, 73
quality of, in early tuberculosis, 19
tympanitic, characteristics of, 72
Pericardium, position of heart depends upon, 80
Permanency of results 203, 294
Personal prophylaxis, 103
Pessimism, influences prognosis unfavorably, 98
Pfeiffer's method of examining for mixed infection, 256
Pharynx, naso-, cough caused by disease of, 48
Phthisiophobia, due to ignorance, 108
Phthisiotherapy, American pioneers in, 287
Physician, great responsibility of, in tuberculosis, 280
traits of, for treatment of tuberculosis, 94
Physician and patient, 280
Physician's frequent visits with patient large element in cure, 226
Pirquet's tuberculin diagnosis in childhood, 45
Pitch, changes of, in early tuberculosis and method of detecting, 19, 29
Pleura, pains caused by inflammation of, 51
rough respiratory note, due to inflammation of, 76
Pleura, thickening of, shows increased or decreased vocal fremitus, 65
Pleural adhesions, obliterate pleural cavity, 250
show auscultatory signs resembling rales of intrapulmonary origin, 253
Pleural effusion, removal of, 254
Pleural inflammations, physical signs remaining after, 253
Pleural rub in effusion, 251
Pleural sounds, 77
sounds, differentiation of, from rales of intrapulmonary origin, 77
affected by pressure on the stethoscope, 78
Pleural thickening, remaining after inflammation, 253
Pleurisy, 250
blister in treatment of, 253
diet in, 253
differentiated from intercostal neuralgia, 71
dry, 250
effusion in, causes immobility of side of thorax, frequency of, 250
iodine, in the treatment of, 253
morning elevation of temperature suggests, 54
physical signs of, in case of effusion, 251
rest in, 253
strapping chest with adhesive straps in, 253
symptom of early tuberculosis, 12
symptoms of, 251
treatment of, 253
treatment of pain in, 253
varieties of, 250
Pleurisy with effusion, 250
paravertebral triangle of dulness in, 251
serous, at the base may be caused by apical involvement, 250
Pleximeter, 70
manner of using, 16
Pneumogastric irritation causes digestive disturbance, 49
Pneumonia, morning rise of temperature suggests, 54
Pneumothorax, 254
cause and seriousness of, 254
symptoms of, 255
treatment of, 255
Pocket, rubber lining in, for carrying cloths for sputum, 103

Pot fêlé over cavity, 73
Poor, patients offer good prognosis when put under good conditions, 97
Pottenger, permanency of results in cases treated by, 203
  results of treatment of, 201
  statistics of disappearance of bacilli from sputum, 202
Pottenger Sanatorium Bungalow, 219
Predisposed, many "so-called," already infected, 106
  prophylactic measures for, 106
Predisposed, should be treated for tuberculosis, 106
Pregnancy, complicating tuberculosis, 269
  danger of quiescent foci lighting up after, 270
  effect of, on prognosis, 99
  interruption of, in tuberculous women, 270
  should not occur for several years after patient is well of tuberculosis, 270
  symptoms may abate during, 270
Pre-tubercular stage, really tubercular, 6
Prevention, measures for, are simple and humane, 107
Prognosis, age a factor in, 98
  affected by extent of lesion, 92
  bacilli, form of, a factor in, 99
  complications influence, 98
  depends upon financial condition, 98
  depends upon intelligence of treatment, 93
  depends upon family physician, 93
  depends upon nature of infection, 92
  digestive system in, 96
  former environment a factor in, 97
  heart an important factor in, 49
  heart in, 95
  hemoptysis a factor in, 98
  in advanced tuberculosis, 95
  individual resistance a factor in, 96
  in tuberculosis, 92
  laryngeal tuberculosis, of, varies according to earliness of diagnosis and intelligence of treatment, 243
  length of illness important in, advanced condition, 97
  length of treatment a factor in, 100
  loss of weight in, 96
  number of bacilli and, 99
  patient's responsibility in, 94, 95
  pregnancy influences, 99
  treatment a factor in, 98

Prognosis, temperament a factor in, 96
  why best in incipient tuberculosis?, 93
Prophylactic measures for sick and well, 107
  measures in building construction, 106
Prophylaxis, 101
  burden not upon afflicted alone, 105
  care of sputum in, 103
  classes, role of, in, 110
  danger of infection removed by, 107
  dispensaries, role of, in, 109
  early cure best, 101
  education, most important in, 107
  education, role of, in, 107
  health board control, role of, in, 108
  hospitals, role of, in, 110
  in childhood, 106
  light and ventilation in, 104, 105
  personal, 103
  personal and general, rules for same, 110
  sanatorium, role of, in, 110
Proteids for the tuberculous, 136
Prussia, death rate from tuberculosis decreasing in, 112
Pulmonary tuberculosis, complications of, 242
  hyperemia in, 213
Pulmonary valve, accentuation of, 50
  stenosis of, usually followed by tuberculosis, 211
Pulse, accompanying pleurisy with effusion, 251
  high, and not responding to rest, unfavorable, 50, 96
Pulse-rate in early tuberculosis, 9
Pupils, inequality of, a sign of early tuberculosis, 17
  inequality of, caused by, 17
  widely dilated in tuberculosis, 17

Quiescent foci, toxins escape from, and injure other tissues, 92
Quarantine not desirable, 109

Rales and permanency of results, 299
Rales, cause and description of, 76
  constancy of, in tuberculosis, 77
  differentiation of, from sounds of pleural origin, 77
  dry, description of and cause, 77
  effect of cough on, 76
  in early tuberculosis, 24, 29

Rales, large bubbling, persisting in one place suggests cavity, 77
metallic, 77
moist, persisting at apex suspicious of tuberculosis, 77
simulated by sounds of pleural origin, 24
Rational, diet, 131
treatment consists of, 120
Reaction, avoided by care in use of tuberculin, 188
caused by bovine tuberculin usually reaches height on second day, 188
in tuberculous focus aids healing, 187
local, at site of injection, index of reaction in tuberculous areas, 174
local (Pirquet), a test for tuberculosis in childhood, 46
nerve, in hydrotherapy, 153
skin, in hydrotherapy, description of, 153
tuberculin, description of, 187
tuberculin, disregarded in early trial of tuberculin, 168
tuberculin, general, 42
tuberculin, local, 41
tuberculin, secondary, 188
tuberculin, secondary, due to auto-inoculation, 188
value of hydrotherapeutic measures depends upon, 153
vascular, in hydrotherapy, 154
Reinfection, danger of, in swallowing sputum, 103
part played by, in tuberculosis, 101
Relapse, more common in cases treated without tuberculin, 203
Remedial measures, classification of, 117
Resistance, individual, a factor in prognosis, 96
normally greatest in health, 116
Respiration, constant change in position of organs of, during life, 79
effect of altitude upon, 236
in early tuberculosis, 9
Respiratory murmur, intensity of, dependent upon, 73
Rest and exercise for lung, 149
Rest, cough relieved by, 144
dyspnea an indication for, 147
fever an indication for, 143
great reduction in weight demands, 147
heart demands, in tuberculosis, 145
Rest, hemoptysis demands, 144
in dyspnea, 277
in hemoptysis, 263
in treatment of fever, 274
non-febrile cases require, 144
reduces danger of new infection in hemoptysis, 145
the treatment of all inflammations, 150
treatment of tuberculous laryngitis with, 243
value of, 142
what degree of temperature requires?, 143
Results, best, prevented by premature interruption of treatment, 298
clinical, very satisfactory where tuberculin used, 198
comparative, where tuberculin used and where not used by Turban, 201
comparative, where tuberculin used and not used by Weicker, 201
comparison of, at Belzig, where tuberculin is used and where not used, 201
permanency of, 203, 294
sanatorium and hospital, compared, 294
Results and permanency of, in tuberculosis, 286
Results, permanency of, last few months of treatment most important in, 298
presence of rales at the time of discharge influences, 299
Results of hygienic-dietetic-open-air treatment more apt to be a quiescence, 203
Results of treatment by author, 200
Results of treatment of tuberculosis compared with those of other diseases, 292
Results of tuberculosis, 223
Retractions, explanation of, in early tuberculosis, 18
Rib, ankylosis of first, with sternum, predisposing cause of or result of tuberculosis?, 61
Rocky Mountains, immunity from tuberculosis noted in, 233
Rokitansky's idea of heart lesions and tuberculosis, 211
Röntgen rays in early diagnosis, 38
Rooms, floors of, offer greatest danger of infection, 7

Room temperature, should be kept low, 125
von Ruck, statistics of disappearance of bacilli from sputum, 202
statistics of permanency of results, 297
watery extract of tubercle bacilli, 176

Sanatoria, advantages of pavilion and cottage system, 217
buildings for, should be adapted to climatic conditions, 217
gloom not present in, 227
hopefulness pervades, 227
not dangerous to surroundings, 111, 112
rooms of, on one side of corridor, 217
state, medical directors for, 216
ventilation of, 217
Sanatorium, advantages of, 216
advantages of treatment in, 226
affords close relationship between physician and patient, 226
agency whereby cure can be best carried out, 216
best chances offered to advanced cases by, 223
cases most suitable for, 222
choice of patients for, 220
medical director, characteristics of, 216
patients in, help each other, 227
private, must admit advanced cases, 222
results of, compared with those obtained in hospitals, 294
role of, in prevention, 110
superior to home or open resort, 225
treatment of tuberculosis, 216
Sanitary vacuum cleaner, 105
Saturation, failure of absorption of bacillary products shows, 176
School rooms, requirements of, for proper prophylaxis, 106
Secondary infection, danger of, reduced by open air, 125
Senile lung, difficulties of diagnosing tuberculosis in, 72
Serum, antitubercle, 207
antitoxic, Maragliano, 207
Marmorek, 208
treatment of mixed infection with, 259
Skin, effect of hydrotherapy upon, 155
Smear, homogeneous, advantage of, 29
Smith, Archibald, teachings of, regarding high altitude, 233
Society, tuberculosis a disease of, 105
Sorgo, plan of treating tuberculous laryngitis with sunlight, 244
Specific climate, none, 229
Spengler, bovine emulsion, 177
bovine and human tubercle bacilli, vaccines of, 177
bovine tuberculin of, 174
results of, showing agglutinating power of blood increased by bacillary products made from bovine bacilli, 183
Spit cups, patients should expectorate into, 103
Splitter (spores), found in sputum, 33, 34
Spore, formation shows a resistant soil, 33
Spores, bovine bacilli show spores within them, 35
develop full sized bacilli when furnished with good culture medium, 33
of bovine bacilli, 30, 33
Sporoids, of human bacilli, 30, 33
Sports, overexertion the danger of, 149
Sputum, amount varies with lung condition, 48
bacilli disappear from, statistics of, 202
blood in, significance of, 48
care of, for ambulatory patients, 103
cavity, 48
centrifugation method of examination, 38
character of, in advanced tuberculosis, 48
danger in swallowing, 103
digestion method of examining, 38
drying of, should be prevented, 103
elastic fibers in, 49
examination for mixed infection, Pfeiffer's and Kitasato's methods of, 256
from larynx as aid in early diagnosis, 38
in acute miliary tuberculosis, 49
in early tuberculosis, 9
micro-organisms found in, does not necessarily indicate mixed infection, 256
micro-organisms other than tubercle bacilli in, 49
nummular, 48
odor of, 48

Sputum, should be repeatedly examined if found negative in early tuberculosis, 9
when present should always be examined, 29
Squeak persistently localized, suggestive of cavity, 77
Stage, pre-tubercular, 6
Stain, differential, for bovine and human bacilli, 35
picric acid, directions for, 37
picric acid, of great value where envelope is injured, 37
Staining, rules for, 30
usual method, 30
Statistics, of heart lesions and tuberculosis, 212
of joints treated by hyperemia, 213
Steppes of Tartary, immunity from tuberculosis noted in, 233
Stethoscope, advantages of, over ear, 14, 15
choice of, 14
variable pressure on, affects sound, 15
Strassburger's method of examining feces for bacilli, 245
Street dust, danger of infection from, 104
Streptolytic serum in mixed infection, 261
Stomach, dilatation of, cause and suggestions for managing, 139
Stools, bacilli in, in intestinal tuberculosis, 245
clay color in intestinal tuberculosis, 245
mushy nocturnal, in intestinal tuberculosis, 245
Störk's experiments in producing fibrosis, 114
Subclavian murmur, in early tuberculosis, causes of, 24
Succussion in pneumothorax, 255
Suggestion valuable in treatment, 285
Sulphonal in insomnia, 277
Sunlight, effect of, upon bacilli, 104
importance of, in treatment of tuberculosis, 234
kills micro-organisms, 234
prevents mixed and secondary infection, 234
treatment of tuberculous laryngitis with, 244
Sunshine, cheering effect of, 235
great amount of, invites to outdoor life, 235
Sunstrokes unknown in hot, dry climates of South West, 232
Suprarenal gland, products from, contraindicated in hemoptysis, 266
Susceptible, later children more, to tuberculosis, 8
Sweating in axilla in early tuberculosis, 9
Sweats, disappear with regulation of lives of patients, 273
in advanced tuberculosis, 52
Sweats, night or sleep, 12, 273
cause of, 273
cause of weakness in, 52
danger from, 52
prostration following, 274
treatment of, 273
Sweeping, approved method of, 105
danger from ordinary method of, 105
Symptoms, cause of, 8
early, should be taught in schools, 95
general, in advanced tuberculosis, 47
onset of, sometimes sudden, 28
Symptoms of advanced tuberculosis, bronchial catarrh, 51
circulatory system, 49
colds, 51
cough, 47
digestive system, 49
hoarseness, 51
menstrual flow, cessation of, 58
nervous system, 50
pain, 51
sweats, night or sleep, 52
sputum, 48
temperature, 52
Symptoms of early tuberculosis, anemia, 10, 17
circulatory system, 9
colds, 9, 28
cough, 9
gastro-intestinal system, 9
hoarseness, 9, 17
malaise, 8
nervous system, 8, 27
pain, 11
pleurisy, 12
respiration, 9
spitting of blood, 12
sputum, 9
sweats, night or sleep, 12
temperature, 10, 28
Symptoms of mixed infection, 257
pneumothorax, 255
treatment of, 271
Syphilis, acquired, complicating tuberculosis, treatment of, 268
Syphilis, complicating tuberculosis, 268

Syphilis inherited, a factor in tuberculosis, case illustrating, 268
characteristic auscultatory sign in, 269
treatment of, 269

Temperament a factor in prognosis, 98
Temperature, accompanying pleurisy with effusion, 251
chart, method of keeping, for early diagnosis in tuberculosis, 10
comparison of, in health and tuberculosis, 52
curve in inactive chronic pulmonary tuberculosis, 53
curve of hectic type, 53
depression of, in intestinal tuberculosis, 245
diurnal range of, in dry climates, 231
in advanced tuberculosis, 52
in early tuberculosis, 10
in mixed infection, 251
indication of virulency of infection, 56
instability of, in advanced tuberculosis, 52
instructions for taking, 11
markedly subnormal, suggestive of intestinal complication, 56
morning rise of, suggests complication, 54
natural, for uncomplicated chronic pulmonary tuberculosis, 189
open air reduces, 125
pneumothorax, 255
prognostic import of, 96
reduction of, by tepid bath, 157
remittent type of, in tuberculosis, 53
rise in, due to disturbances of nervous system, 57
rise of, follows deep breathing, 151
rise of, following exercise due to toxins, 144
subnormal, 54
subnormal in early tuberculosis, 10
systematically taken gives picture of disease, 58
two hourly chart of, necessary, 58
what degree of, requires rest?, 143
Tenements, model, needed in cities, 106
Therapy, based upon double etiology, 177, 181
Thermometer, sole guide to temperature, 58
time of holding, in mouth for testing temperature, 11
Thoracic viscera, cause of displacement of, 83
change in outline important, 83
diagnosis of displacements in, 91
management of cases with displacement of, 91
Thorax, changes in upper aperture of, during life, 79
expiratory type of, 79
inspiratory type of, 79
pathologically inspiratory in emphysema, 79
physiologically expiratory in old age, 79
Thorax paralyticus, description of, 61
pathologically expiratory, 80
Throat compress, description of, and therapeutic application, 163
Tonic, open air as a, 124
Tonsils, as portals of infection, 102
Touch percussion, Ebstein's, 67
Toxins, bovine and human, differ, 195
cause of digestive disturbances, 49
change of, in treatment, 195
circulation of, in blood may fail to stimulate machinery of immunization, but injection of, into tissues may, 194
escape from focus of infection and render susceptible other tissue, 92
necrosis caused by, 114
of, bovine and human bacilli differ, 35
tubercle bacilli, influence nervous system, 50
Toxin test, type of bacilli causing infection may be diagnosed by, 178
Treatment, advanced cases can be saved by the best, 222
advanced cases must not be denied sanatorium, 222
advantages of sanatorium, 226
basis of, the type of bacilli present, 177
beginning of systematic, 286
classification of measures used in, 117
climatic, 229
climatic, value of, lies in, 240
comparative results of, in tuberculin and non-tuberculin treated cases by Turban, 201
comparative results of, where tuberculin used and not used by Weicker, 201

Treatment, difficulties of, must not be minimized, 223
fever relieved by, with few injections of tubercle bacillus vaccines, 180
high altitude, contrary to principle of rest in inflammations, 236
hygienic, not all, 117
hygienic, what can be accomplished by, 117
ideas of, grow slowly, 287
immunity the ultimate aim of, 117
Koch's rules for use of tuberculin in, 168
Koch's rules for use of tuberculin in, disregarded, 168
length of, necessary, 100
length of, necessary for apparent cure, 224
life greatly prolonged by, 292
method of, very important, 120
never a time too early to begin, 290
objections to altitude in, 240
open air, 122
plea for early institution of, 221
premature interruption of, prevents best results, 298
principles underlying, 114
rational, consists of, 120
rest and exercise in, 142
results of, by author, 200
results of, compared with results in other diseases, 292
sunlight in, 234
time of, 298
tuberculosis yields readily to, 287
tuberculous laryngitis, tuberculin most important remedy in, 244
what complications are a barrier to?, 223
Treatment of, advanced cases with tuberculin, 201
hemoptysis, 262
intestinal tuberculosis, 246
mixed infection, 257
night sweats, 273
pain, 276
pleurisy, 253
pneumothorax, 255
tuberculosis of the larynx, 243
Trional in insomnia, 277
Trudeau, comparative results of, in treatment of cases, incipient and advanced, with and without tuberculin, 201
view of, regarding action of tuberculin, 182
Tubercle, blood prevented from entering, 210
blood supply shut off from, retards healing, 186
conservative or not?, 210
protective to bacilli, 210
Tubercles, effect of deposit of, in lung on percussion note, 19
Tuberculosis, bovine and human type of, assume different forms, 177
curability of, 114
climatic conditions favoring spread of, 234
differences between early and late, 205
double etiology of, 177
early stage, very curable, 221
immunity the aim of treatment in, 117
intestinal, 244
most curable of all chronic diseases, 221
neglected, a very fatal disease, 221
sanatorium treatment of, 216
sunlight important factor in the treatment of, 234
treated early, most hopeful, 280
treated late, discouraging, 280
unrecognized, 3
Tuberculous patient, safe companion, if careful, 107
Tuberculin, action of, 181
action of, Biedert's views, 182
action of, Koch's original view, 182
action of, Wright's view, 182
acts by causing more blood to flow to part, 182
acts by increasing immunizing bodies in blood, 181
advantage of subcutaneous injections of, 195
agglutinating power of blood increased by, 183
announced in 1890, 165
Beraneck, dosage of, 174
bovine (P. T. O., Spengler), 174
bovine (P. T. O., Spengler) dosage of, 174
can it cause acute miliary tuberculosis?, 40
can it set up activity in latent foci?, 39
clinical results of, favorable where used, 198
clinical signs safe guide to dosage of, 197

Tuberculin, collective investigation showing attitude of profession toward, 171
comparative report of cases, incipient and advanced, treated with and without, by Trudeau, 201
comparison of cases treated with and without, at Belzig Sanatorium, 201
comparison of results of cases treated with and without, 172
cure produced more quickly and more surely when used, 199
Deny's dosage of, 174
description of, 166
dilutions of, for use, 167
discovery of, observations leading to, 165
doomed by circumstances attending early trial, 169
dosage, according to Wright, 196
dosage governed by local reaction in laryngeal tuberculosis, 244
doses, short of constitutional disturbance produce maximal immunizing response, 196
doses smaller than formerly used produce results, 198
effect of, 39, 41
effect of, upon cells and leucocytes, 186
fever cases treated with, 189
fibroid tissue increased by, 186
good results observed at time of early trial of, 170
hope aroused by discovery of, 167
hyperemia caused by, in tuberculous focus, 186, 214
immunizing power of, proven by animal experimentation, 182
instances illustrating early misuse, 169
intelligence, care, patience and perseverance indispensable to its use, 206
intestinal tuberculosis treated with, 247
Koch's claims for, 168
Koch's rules for treatment with, 168
Koch's rules for use of, disregarded, 168
limitations of, 205
most important remedy in tuberculous laryngitis, 244
new (T. R., Koch), 175
old (Koch), dosage of, 167
Tuberculin, O. or T. O. (Koch), 175
opsonic power of blood increased by, 184
patients treated with, should be under close observation, 206
products allied to, 173
prognosis in tuberculous laryngitis depends on whether or not it is used, 243
proper use of, presupposes ability to use stethoscope carefully, 206
reaction against, caused by early misuse, 170
reaction at injection site, index of reaction in tuberculous focus, 174
relapses less common where used, 203, 205
revival of, 171
should not be used haphazardly, 206
site of injection of, 195
spread of disease to new tissue prevented by, 198
studies in immunity have shown, to be based on scientific fact, 207
therapy, value of, proven by opsonic content of blood, 184
T. R., dilution of, for administration, 184
T. R. (Koch), dosage of, 175
T. R., standardization of, 175
treatment of complications with, 202
treatment of fever with, 275
two very important actions of, 214
use of, steadily increasing, 207
value of, relatively greater in advanced cases, 201
Virchow's opinion of, 39
who shall employ?, 206
why cases treated by, show better results, 186
why not universally used?, 206
Wright's method of employing, 196
Tuberculin reaction, avoided by care, 188
caused by bovine tuberculin reaches height on second day, 188
danger and value of, 187
description of, 42, 167, 187
local, 41
local, seen in larynx, 41
secondary, 188
signs of local, heard by stethoscope, 42
time of, 41
Tuberculin test, 38
advantages of, 40
based upon reaction, 41

Tuberculin test, chart showing, 10
comparison of its safety with exploratory incision, 41
contraindication for, 43
fears of, 39
how given?, 44
in infancy and early childhood, 45
is it reliable?, 43
necessary dosage for, smaller where focus is small, 44
ordinary dosage of human tuberculin may not cause a reaction where infection of bovine type, 44
proof of cure afforded by, 45
should be made where glands chronically enlarged, 248
site of injection in making, 44
syphilis and, 43
tuberculous patients sometimes fail to react to, 43
when should it be given?, 42
who shall administer it?, 45
Turban's, comparative results where tuberculin is used and where not used, 201
statistics of disappearance of bacilli from sputum, 202
Tulase (von Behring), 181
Tympany, causes of, in advanced tuberculosis, 72
in pneumothorax, 255
Typhoid fever, danger of treating tuberculosis for, 57
simulated by tuberculosis, 57
tuberculosis treated for, 28

Ulceration, laryngeal, treated by orthoform, 243
Underclothing, qualities necessary in, 126
woolen and linen, 126

Vaccines, bovine and human, proof of antagonism, 179
homologous, perhaps future treatment of mixed infection, 261
increase specific protective bodies in blood (example), 119
injection of, those derived from the bacillus raises opsonic index even above normal, 184
made from tubercle bacilli, specific, 119
rationale of cure when, used, 199
septicemic conditions treated by, successfully, 192
Spengler's bovine and human, 34
Vaccines, spread of disease to new tissue prevented by, 199
T. B. and P. B. (Spengler), 199
T. B. and P. B. (Spengler), dosage of, 180
Vaccine, T. B. and P. B. (Spengler), method of administering, 178
Vascular reaction, in hydrotherapy, 154
Vaso-motor disturbances in early tuberculosis, 8
Ventilation, effect of, in preventing infection, 104, 105
in sanatoria, 217
Veratrum viride in treatment of hemoptysis, 264
Vinegar and water in treatment of night sweats, 273
Virchow's "mobilization of bacilli" a myth, 189
opinion of tuberculin based upon its use in poisonous doses, 39
Virulence, bacilli retain, for long period outside body, 103
effect of, upon prognosis, 92
infection with bacilli of low, tends to healing, 114
necrosis follows infection with bacilli of great, 114
Vocal fremitus, conditions determining change in, 65
increased or decreased in thickened pleura, 65
Voice transmission, 78
Vomiting caused by cough, 272

Walking, best exercise for tuberculous, 148
best method of, for tuberculous, 148
precautions to be observed in, 148
Watery extract of tubercle bacilli (Maragliano), 207
Watery extract of tubercle bacilli (von Ruck), 176
Watery extract of tubercle bacilli (von Ruck), dosage of, 177
Weather, wet, no contraindication for open-air treatment, 127
Weicker, comparative results of treatment in tuberculin and non-tuberculin treated cases, 201
Weight, gain of, is not most important thing in treatment, 135
gain of, is often taken as a cure, 130
loss of, in early tuberculosis, 10

Weight, loss of, influences prognosis, 96
loss of, influences prognosis according to cause, 96
rest demanded by great reduction in, 147
steady gain of, best, 130
Wet jacket, in cough, 272
Wintrich's sign, 73
Wright's dosage of tuberculin, 196
Wright's experience in tuberculin treatment of localized tuberculous infection, 202
method of employing tuberculin, 196
method of treating tuberculous glands, 249
view regarding action of tuberculin, 182