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A

PRACTICAL TREATISE

ON

PHTHISIS PULMONALIS;

EMBRACING ITS

PATHOLOGY, CAUSES, SYMPTOMS, AND TREATMENT.

BY

L. M. LAWSON, M.D.,

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TO

WARREN STONE, M. D.,

AND

JAMES JONES, M. D.,

PROFESSORS IN THE UNIVERSITY OF LOUISIANA,

THIS VOLUME

IS RESPECTFULLY INSCRIBED,

BY THEIR

FRIEND AND COLLEAGUE,

THE AUTHOR.

TO

WALTER HAYLE WALSHE, M. D.,

Professor of the Principles and Practice of Medicine, and of Clinical Medicine,
in University College, London,

PRE-EMINENTLY DISTINGUISHED AMONG THOSE WHO HAVE BESTOWED
ATTENTION ON THE DISEASES OF THE LUNGS,

THIS TREATISE IS INSCRIBED,

AS A TESTIMONIAL OF PERSONAL RESPECT
AND PROFESSIONAL ADMIRATION,

BY HIS OBLIGED FRIEND,

THE AUTHOR.

PREFACE.

In offering to the profession of the United States this Treatise on *Phthisis Pulmonalis*, I desire to state briefly that I was impelled to the task from a belief that a work on the subject was needed. There has been no American work on phthisis since the publication of Dr. Morton's *Illustrations*, in 1838, which is now out of print; and although many excellent foreign monographs on this subject have been republished in the United States, they can not supply the want of an indigenous treatise. It is not presumed that consumption is different in this country from the same disease elsewhere; but at the same time it is evident that the influences of climate, domestic habits, races, and other modifying conditions, render a systematic account of the disease as met with here highly important. Hitherto, the facts in relation to the prevalence of phthisis in the United States have not been collected in a systematic form, and hence the most opposite opinions prevail on the subject. Some believe phthisis to be most prevalent in the Northern states, while the highest authorities (Forry, Drake) teach that the disease is more common in the South. I have endeavored by the collection of the most accurate statistics to settle this important question, and thus to enable the practitioner to direct his patient to those localities which offer the greatest chances of relief.

But while particular attention has been given to the prevalence

of phthisis in the United States, an account of the *Geography* of the disease, in a general sense, has been introduced; and the subject of a *change of climate* has been carefully considered in its relations to the different stages of the constitutional and local morbid conditions.

It has been attempted, also, to furnish an outline of the whole subject of Tuberculosis, embracing the principal facts which have been clearly established by the concurrent observations of the profession. The most prominent theories of the pathology of phthisis have been noticed, with remarks on their intrinsic merits, to which is added my own opinions.

I have made an attempt to systematize the therapeutics of phthisis, according to the different stages of the disease, thus placing the whole treatment, as far as practicable, on a scientific basis. Particular reference has been made to the forming or *precursory* stage, which, it appears to me, has been too much neglected by systematic writers.

Having for a number of years past been thrown somewhat largely into the treatment of phthisis, in all its aspects, in public institutions and private practice, I have been enabled to form opinions for myself in reference to the treatment of the disease, and these opinions have been candidly stated in the succeeding pages. And while due respect has been paid to the views of others, I have not hesitated to indicate my own preference for particular modes of treatment, based on personal observation and experience.

Finally, whatever defects may be observed in the literary execution of this work, I must plead in extenuation, at least in part, constant and extensive professional engagements, which have prevented that careful revision of manuscript which might otherwise have been made.

L. M. LAWSON.

CINCINNATI, *November*, 1860.

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ERRATA.

Page 229, line 22, for *increases* read *decreases.*

Page 545, insert a dash (—) between *Prognosis* and *Conclusion.*

PART FIRST.

PATHOLOGY OF PHTHISIS.

PATHOLOGY OF PHTHISIS.

THE pathology of *Phthisis Pulmonalis* embraces every element of disease, connate and acquired, from the mere *diathesis*, or hereditary tendency, to the lesions resulting from the local deposits. It includes, therefore, that well-known, but ill-defined condition, denominated the tuberculous constitution, or diathesis, no less than the fully developed stage of tubercular deposits, together with all the ulterior changes which take place in the various organs and tissues of the body. These different stages of disease will be examined under the following heads:

I. THE DIATHETIC ORGANISM.
II. THE PRIMARY MORBID CHANGES.
III. THE SECONDARY PATHOLOGICAL ANATOMY.
IV. THE TERTIARY LESIONS.

I.

THE DIATHETIC ORGANISM.

CHAPTER I.

THE TUBERCULOUS CONSTITUTION.

THE most extended and accurate observations conclusively establish the fact, that certain organizations are naturally predisposed to the ultimate development of tubercular disease. In what this constitutional predisposition essentially consists must, of necessity, like all ultimate facts, remain largely conjectural; but that it is of a character capable of transmission from one generation to another, and of ultimately merging into active disease, numerous facts abundantly attest. The term *diathesis*, applied to this particular organization, is employed to designate a mere *tendency* to disease, but not itself a morbid condition.

It appears to me, however, that this application of the term diathesis is palpably unphilosophical, and contrary to the well-known laws of the human organism. If the term does not indicate disease, it must, of necessity, represent a state of health; and if a normal state of structure and function exist, there can not be at the same time a predisposition which leads *spontaneously* to a particular form of disease. On the contrary, when the organization and vital actions are perfectly normal, the *tendency* is to the maintenance of that condition, and the development of disease requires the intervention of an exciting cause. A state of the organism, therefore, which *spontaneously*

leads to a particular disease is of itself an abnormal condition, and consequently is something more than a mere *predisposition* to morbid action. Hence, instead of employing the term diathesis in its conventional sense, I shall substitute the phrase *tuberculous constitution* to designate a state of the organism which is a departure from the true physiological type, and which, under varied influences, may remain stationary, recede, or spontaneously advance to the completion of the tubercular process. The tangible changes which constitute this tuberculous constitution, are observed in the modifications of certain structures and functions, which indicate a departure from the physiological type, instead of a simple *predisposition* to disease.

SECTION I.

THE PHYSICAL CONFORMATION.

The physical conformation indicative of the constitutional predisposition to phthisis, is believed by many to be sufficiently marked to admit of ready recognition. But it must be observed that most writers include under this head those external signs connected with the scrofulous diathesis, which impairs the accuracy of their general statement; for whatever may be the relationship of scrofula and tuberculosis, I have no doubt that, in general, the same external manifestations do not exist.

Sir James Clark, speaking of the tubercular cachexia, makes the following statement: "When of hereditary origin, it is manifested by a peculiar modification of the whole organization,—in structure and form, in action and in function."* And he proceeds to state that the countenance, in early childhood, has a pale, pasty appearance, the cheeks full, and the upper lip and nose tumid. If the complexion is dark, the skin is sallow; if fair, it is white or blanched, with prominent veins. The external signs become more marked with advance of age.

* Treatise on Pulmonary Consumption.

The eyes and pupils are large, with long eye-lashes. When the complexion is fair, there is great beauty, with a placid expression of countenance; while in the dark complexion, the skin is coarse and sallow, and the features less regular. The body, in early infancy, is large, but is not firm, and there is a want of proportional development as age advances. The head is large, trunk small, abdomen tumid, large, and clumsy, or slender, with large joints, The development of the body is irregular, being slow and imperfect, or preternaturally rapid.

Such is the description given, by one of the most distinguished writers on the subject, of the physical evidences of the tubercular cachexia, and it will be readily recognized as that which is usually applied to scrofula. Dr. Glover* has condensed the statements of Le Pelletier and Deygallières, Fisher, Disse, and Bredow, (who, in turn, copied their descriptions from Hufeland,) in relation to scrofula, and it will be observed, from the following abstract, that they agree sufficiently with that of Sir James Clark, as applied to the tubercular conformation. 1. A want of bodily symmetry, by a tendency to disunion at the mesial line; a gibbous chest; weak and often crooked limbs; broad jaws, low, angular forehead, and short neck. 2. A peculiar expression of countenance, due to the form of the jaw and forehead, and a large head, puffed visage; eyes and pupil large, and eyelids œdematous; meibomian secretion in excess; eyelashes long, etc.

In these statements we perceive precisely what has been remarked by almost every writer, from Hufeland to the present day, as indicative of the scrofulous constitution; and, as suggested by Dr. Glover, the descriptions are evidently copied, one from another, and each one with but little inquiry as to the truth or fallacy of the general statements.

Much has been said, too, of the particular conformation of the chest in those predisposed to tubercular consumption. The gibbous, conical, narrow chest, are the terms applied to indicate a malformation, or a deficient development of the pulmonary structures. Fournet, Woillez, and Hertz have attempted to

* Pathology and Treatment of Scrofula.

establish some general laws on this subject, especially that, in the tuberculous constitution, the transverse diameter at the superior part of the chest is diminished, which gives the thorax a cylindrical form, and diminishes its general capacity.

In opposition to these views, however, we may quote the opinions of Hasse and Rokitansky. The former declares that "a frame of body certainly indicative of future phthisis does not exist;" while the latter states that "the well-known and so-called phthisical conformation of the chest is not always present; and what peculiar relation it bears to tubercular disease is still unknown. The assumption that it depends on smallness of the lungs is unwarranted and hypothetical."

In the midst of these contradictory statements, each observer must be left to decide in accordance with what passes under his own immediate observation; and guided by this rule, I have long since reached the conclusion, that there are no certain and infallible external indications of the tuberculous constitution. It is true, certain inferences may be drawn from incomplete, irregular, or preternatural development of the organization; it may become a fair conclusion that in such systems, premature decay, or the development of disease, acute or chronic, will more often supervene than in well-developed bodies; but, at the same time, it is impossible to know that such persons will become scrofulous or tubercular, or whether they may not fall victims to other forms of chronic disease. If we meet with a person exhibiting the conformations of the chest described by Fournet, *and we know that he comes of a tuberculous family*, we might safely predict the occurrence of the same form of disease; but if we observe a similar condition of the thorax independent of a known hereditary taint, we would not be authorized, in the present state of knowledge, to declare such a person to possess a tuberculous constitution.

There can be no doubt, however, that when the tuberculous taint is very strong, (for example, when both parents have been affected,) the development of the body is more or less incomplete, and often presents some of the peculiarities named; but these signs are not always present, even in extreme cases, and are more frequently manifested in the functions than in the

external structures. Governed, therefore, by my own observations, I have no hesitation in reaching the conclusion, that the external marks of a phthisical tendency are too inconstant and variable to admit of ready recognition, or to be relied on in diagnosis. Being daily in the habit of examining the chest, I have failed to recognize in its contour any constant or even frequent deviation, until after the deposition of tubercles takes place. And I can not avoid suspecting that many of the descriptions of prominent shoulders, contracted chests, and projecting clavicles, have been taken from the actual disease, instead of the mere predisposition. It is probably true that tall persons are more prone to phthisis than short ones; but certainly we could predicate but little on such a fact, for we would scarcely be safe in affirming that every tall person was predisposed to consumption. Nor do I doubt that *scrofula* has more evident external signs than phthisis; indeed, this form of disease is more prone to affect the exterior, and hence is more distinctly impressed on the external structures.

But there is sufficient reason to believe that the phthisical constitution is more distinctly foreshadowed in the functions than in the structures of the body; and these deviations will be briefly enumerated.

SECTION II.

CHANGES IN PRIMARY DIGESTION.

The condition of the digestive function, as presented in the well-marked tuberculous constitution, has been carefully studied by many competent observers; but the conclusions do not exhibit that degree of uniformity, and that definiteness of result, so desirable in scientific investigations. The facts, however, which have been disclosed, are sufficient to arrest attention, and are capable of becoming the basis of a safe generalization.

The state of the digestive function has been carefully investigated by many of the German pathologists, and they indicate acidity as the characteristic condition; and still more recently

Dr. Bennett, of Edinburgh, has drawn attention to some special views on the subject. This author mentions particularly the occurrence of *acidity* in the primæ viæ as a constant accompaniment of the tuberculous constitution; and he expresses the opinion that this acid neutralizes the salivary and pancreatic fluids, in consequence of which carbonaceous and fatty food is not properly transformed; and, furthermore, the same condition renders the albuminous element preternaturally soluble, and hence it is introduced into the system in too large quantities, which leads to local disease. In this state of the digestive function, it is presumed the fatty substances enter the circulation in diminished quantities, and hence the want of properly elaborated chyle.*

The opinions of Dr. Bennett, although plausible and ingenious, appear to be largely hypothetical; the observations, indeed, on which they rest are evidently based on limited views or speculative notions. At the same time, I do not presume to deny the modified condition of primary digestion in this state of the system; but it is rather a *predisposition* to disorder than a well-defined state of indigestion, as the remarks of Dr. Bennett would indicate. The delicate character of the structures appertaining to the true tuberculous constitution imparts to the function of digestion a condition of *irregularity* rather than positive disease; hence, such persons exhibit variable, and, at times, vitiated appetites, frequently consuming large quantities of food, with perfect primary digestion. Indeed, a majority of young persons who inherit this constitution manifest a strong desire for food, which is eaten with avidity, and digested with facility; and the only marked deviation from a state of health is the condition of irregularity, more or less constantly observed in such persons.

It is proper to remark, however, that the large quantities of food which some persons take, exceed the powers of digestion, and, as a necessary consequence, acidity and other disorders of the function arise. But this condition is altogether secondary, and therefore not to be regarded as the type of the tuberculous

* Pathology and Treatment of Pulmonary Tuberculosis.

constitution. It would be erroneous, however, to characterize this condition as dyspepsia, or any form of primary gastric disorder; on the contrary, the acidity, nausea, vomiting, diarrhea, and so on, met with in persons of this class, are but the results of over-eating, to gratify a craving appetite. These paroxysms of gastric disorder at once produce the impression of primary dyspepsia; and the constipated or relaxed bowels, vitiated bile, or light-colored stools, together with occasional pain in the stomach and bowels, confirm the first impression. But a careful analysis of the facts shows that the morbid condition is often secondary, being dependent on improprieties in diet, either in regard to quantity or quality.

The dyspeptic phthisis of Dr. Wilson Philip, and the strumous dyspepsia of Dr. T. J. Todd, are widely different from that legitimate tuberculous indigestion to which I have referred. Dr. Philip's indigestion is a primary disorder of the stomach and liver, acting either as a predisposing or exciting cause of phthisis, and is, therefore, no measure of the intensity, or index to the existence of a tuberculous constitution, acquired or hereditary. On the contrary, it is merely an inveterate dyspepsia, which may ultimately lead to the deposit of tubercles. And the strumous dyspepsia of Dr. Todd is the result of primary disease, and not a necessary element of the tuberculous constitution.

The conclusion, therefore, which appears most in accordance with the facts is this: the derangements of primary digestion incident to the tuberculous constitution can not, as a rule, be regarded as a *cause* of the tuberculous constitution, but that the digestive defect, whatever it may be, is a part of the constitutional infirmity, and therefore is an accompaniment, and not a cause, of whatever derangements ensue.

SECTION III.

CONDITION OF THE RESPIRATORY FUNCTION.

It has been previously stated that, according to some observers, the chest frequently affords evidences of diminished capacity, most marked at its superior part, and affecting chiefly the lateral diameter. There is not sufficient evidence, however, that the contour or dimensions of the chest are so constantly and uniformly affected, as to establish a rule in the tuberculous constitution. On the contrary, it has appeared to me, from my own observations, that even when the hereditary predisposition was distinctly marked, the chest was often well-formed and fully developed. Dr. J. S. Campbell* has attempted to prove, that the capillaries of the lungs are imperfectly developed, which is shown by the incomplete passage of injections through them. That such want of development may exist, it would be unwise to deny; but, at the same time, additional experiments are required to determine the question.

I do not believe, therefore, that any degree of deformity of the chest, however frequently it may be observed, is at all *essential* to even the rapid and fatal development of tubercle. But while this is admitted, it is quite as apparent that the respiratory function becomes more or less impaired, either habitually, or at the near approach of phthisis. There is, evidently, a period when these variations are so slight that no physical or rational exploration can detect them; but when the diathesis is more marked, or the precipitation of active disease nearer, the signs of respiratory derangement are too evident to admit of doubt or misapprehension.

The special and evident change which occurs, consists in *impaired power of expansion.* At a more or less early period, the muscles concerned in the active expansion of the chest seem to lose a portion of their power, and the chest expands imperfectly and irregularly. In consequence of this, the *ordi-*

* Observations on Tuberculous Consumption. London, 1841.

nary breathing capacity is diminished, the respiratory murmur becomes more or less weakened, and, at the same time, wavy and even jerking. These changes in the respiratory murmur are readily perceived by auscultation, and the diminished capacity may not only be inferred from the condition of respiration, but positively demonstrated by the movements of the chest. I have long been in the habit of observing these modifications of the respiratory function, and regard them as decidedly the most characteristic of all the signs supposed to indicate the existence of this state of the constitution. It should be remarked, however, that these signs are more readily recognized in what will hereafter be described as the *precursory* stage of phthisis; but it is equally true that they exist, in a minor degree, in the fully developed tuberculous constitution. Dr. Theophilus Thompson* has pointed out the existence of *wavy* inspiration prior to the development of tubercles; and it is the more satisfactory to myself, from the fact that I had often observed it before being aware of this author's researches. I can not, however, with Dr. Thompson, ascribe it to an exudation about the terminal bronchial tubes and areolar tissue, but am inclined to believe that it arises, at least in many instances, from weakened respiratory action, depending on impaired energy of the muscular and nervous systems, and is, therefore, purely functional. That the deposits mentioned may take place is not denied, and it is quite possible they may cause the sign in question; but it appears to me equally evident that the imperfect expansion and interrupted respiration depend, in a certain class of cases, on functional derangements.

The pulmonary system, embracing the areolar tissue and capillaries, partakes of the same defects that belong to these structures in the tuberculous constitution generally; hence, it may be assumed that the capillaries of the lungs are comparatively weak and attenuated, and the areolar tissue coarse and inelastic. To this we may add a weak right heart and probably deteriorated blood; all of which tend to a disordered circulation, but especially so when the deficient expansion,

* Clinical Lectures on Pulmonary Consumption.

previously described, becomes one of the elements of disorder. When, therefore, the respiratory action becomes weak and incomplete, congestion of the pulmonary capillaries, or even inflammation, is liable to occur under the influence of exciting causes. And the occurrence of congestion, simple or inflammatory, speedily induces tubercular exudations, and thus ushers in active disease. We thus see how the combination of circumstances made up of structural and functional defects, tend to develop local disease, and to convert a constitutional affection into a fatal pulmonary lesion.

SECTION IV.

STATE OF THE CIRCULATION.

The vascular system in the tuberculous constitution is more or less defective in organization and functions. Mr. Ancell* observes that there is a visible tenuity in the coats of the arterial and capillary systems, and hence these vessels are deficient in contractility, while the veins are weak and inelastic. To this may be added, that the fibers of the heart are proportionably weak and deficient in contractility, giving rise to a slow and sluggish circulation.

It has been affirmed by Dr. J. S. Campbell,† as the result of direct experiment, that the capillaries of the lungs are smaller in the tuberculous constitution than in others. This opinion is based on certain experiments, in which he injected a colored material through the pulmonary artery, and it was found that in those evincing a tuberculous tendency the coloring matter did not pass, while the finer material went freely to the left side of the heart. The author believes these experiments warrant the conclusion that the pulmonic capillaries are of smaller dimensions in the tuberculous constitution, and therefore can

* Treatise on Tuberculosis. London, 1852.

† Observations on Tuberculous Consumption. London, 1841.

not transmit particles of the same diameter that would readily pass those of ordinary size.

The structural modifications of the vascular system, especially the capillaries and heart, are doubtless sufficient to impress the system in a very important manner; and if we add to this the weak and defective condition of the areolar tissue, which serves as the matrix for the distribution of the capillary vessels, it will be manifest that important modifications of the vascular system and of the circulation will readily occur. There can be no doubt that the tenuity of the vessels, and the inefficient support which they receive from the investing tissues, greatly favor the mechanical processes of endos- and exosmosis, thus giving rise to the ready deposition and absorption witnessed in this constitution. The natural tendencies, therefore, of the circulatory function, is to congestive action, ready exudation, and rapid absorption.

SECTION V.

STATE OF THE GLANDS.

The glandular structures are generally of normal size, and in some instances manifest more than natural activity. I have already referred to the facility with which deposit and absorption take place, and this same activity pervades the glandular actions generally. Where the scrofulous element predominates, the lymphatic glands seem to possess undue development, and to take on excitement with great facility; and in the pure tuberculous constitution there is evidently the same crude structure and function connected with the chyliferous system and its appendages. It is probable, however, that the modifications met with in connection with the glandular system are explained, at least in part, by the peculiarities of the capillary and areolar tissues already mentioned. Hypertrophy of the thyroid body has no evident connection with the diathesis under consideration. The alleged hypertrophy of the liver

(*Rostan, Parola*) has been generally admitted; and there is some reason to believe that this gland is crudely enlarged, independent of the fatty deposit which often occurs in advanced stages.

SECTION VI.

CONDITION OF THE NERVOUS FUNCTION.

The nervous system in the tuberculous constitution possesses an average degree of tonicity below the healthy standard; that is to say, its powers of endurance are evidently inferior to those of a different conformation. This remark, however, applies mainly to the organic forces; indeed, the defects, if any exist, in the cerebro-spinal system, especially with reference to the intellectual faculties, are much less obvious than in the organic system.

There is reason to believe that the original structure of the nervous system is not specially defective; indeed, the large amount of albuminous material (*probably*) existing in the blood, would be quite sufficient to furnish materials in abundance for the formation of nervous structures. But if the various constitutional defects previously noticed exist, especially changes in the nutritive system, functional disorder of the nervous system will necessarily ensue. Irregular action, consisting of alternate excitement and depression, is very constantly observed, which is more evident in the organic than intellectual acts. Thus the occasional copious watery and otherwise altered secretions, irregular distribution of blood, and above all, the rapid changes in deposit and absorption, point to the condition of innervation; for notwithstanding other functions and conditions are concerned in these acts, (especially the state of the blood,) yet the sudden transitions under the influence of ordinary stimuli, indicate that the nervous system is materially involved. Indeed, the large influence exercised by the nervous system over the nutritive function, may serve as a basis for, at least, a plausible conjecture that the organic nervous force is materially at fault in the tuberculous constitution.

SECTION VII.

ANIMAL HEAT.

If we admit the physiological law that the development of animal heat bears a relation to the red corpuscles, (which are probably deficient in this constitution,) the conclusion will be irresistible that the calorific power is necessarily reduced. And this inference is fully sustained by observation. I have constantly observed, in the tuberculous constitution, manifestations of an inordinate sensibility to a reduced temperature; and so prominent and constant is this condition, that it becomes, as we shall see hereafter, an important feature in the history of phthisis. A sluggish circulation, altered blood properties, and weak innervation, will invariably fail to produce the normal amount of animal heat, except when febrile or inflammatory action supervenes. Hence, the characteristic of the tuberculous constitution in this relation is imperfect development of animal heat.

CONCLUSION.

The various modifications of structure and function which have been mentioned in the preceding remarks, as characteristic of the tuberculous constitution, are not invariably present; on the contrary, where the hereditary taint is comparatively slight, requiring the intervention of some exciting cause to develop the disease, the evidences of an imperfect or peculiar organism may be either entirely wanting, or but partially manifested. Hence, we must not always expect to find the full development of the external signs said to characterize this peculiar constitution; nor, in their absence, are we authorized to conclude that a predisposition to disease does not exist. But these vices of constitution may be safely regarded as an accurate measure of the intensity of the predisposition; and hence they afford an element of prognosis, possessing great intrinsic importance.

II.

PRIMARY MORBID CHANGES.

CHAPTER II.

THE PRECURSORY STAGE OF PHTHISIS, OR TUBERCULOID CONDITION.

We come now to consider a stage of morbid action intermediate to the tubercular constitution, on the one hand, and the local deposit of tubercle, on the other. The mere *constitutional* condition, embracing certain structural and functional deviations from the ordinary physiological type, and, therefore, not a stage of perfect health, is, nevertheless, short of positive morbid action, as that term is generally received. It consists, in fact, of certain irregular actions, exhibiting deficiencies and excesses, but not a clear and evident establishment of a well-defined disease, tending to progressive increment, and therefore, not giving to the patient the sense of morbid action. But there is another condition, which I have denominated the *precursory stage of phthisis*, which is characterized by decided morbid action, and yet is anterior to the deposit of tubercles.

In the precursory stage of phthisis, we observe a more marked departure from the physiological state than belongs to the mere constitutional predisposition; thus, the system loses weight, the strength diminishes, the secretions become still more variable, and calorification and innervation sink below the natural standard. In addition to these evidences of morbid action, there is, in a large proportion of examples, more or less

disease of the fauces, occasional chills, with slight febrile movements, and often variable digestion. This state of the system becomes permanent, and is not, like the mere constitutional predisposition, variable in its manifestations; nay, more, it is progressive, and if not arrested by appropriate treatment, surely and steadily advances to tubercular deposits.

The pathology of this precursory stage, doubtless, consists in those preliminary acts which accompany the formation, and precede the local development of tubercles; and the evident derangement embraces changes in the nutritive function, varying in intensity, according to the natural force of the disease, and the accidental circumstances which surround the patient.

Dr. Cotton makes the interesting observation, that we are too much inclined to regard *phthisis* and *tubercle* as the same thing, whereas the former represents a morbid state of the general system, and the latter merely the local manifestation of that general disorder. Doubtless, this remark is strictly true; indeed, the precursory stage of phthisis represents this morbid condition preceding the deposit of tubercle; and this state is, in fact, veritable *phthisis;* but it is not associated with the deposit of tubercles. It is evidently of the highest importance that this stage should be recognized, for it is, in fact, the most curable period of the disease; and the reader is referred to that part of this treatise in which the signs and symptoms representing this stage of phthisis are fully detailed.

CONCLUSION.

I think there can be no reasonable doubt that there exists a condition of the system, anterior to the development of tubercle, which is a well-defined state of disease, constituting, indeed, the first stage of phthisis. It is characterized by certain conditions, the natural course of which is to progressive increase, and it is, therefore, truly a morbid state. The mere constitutional predisposition, although not representing the

true physiological type, is, nevertheless, not open disease; and hence the obvious difference between the conditions which have been described. One constitutes a *tendency* to disease, while the other is already a morbid state.

We are not prepared, at this point, to enter into a full consideration of the intimate nature of this precursory stage, for that would involve the main question as to the essential nature of phthisis. Nevertheless, it may be remarked, that there is evidently a disturbance of the nutritive functions; a diminution of the vital powers of the system, including a certain degree of disturbance of innervation, circulation, and respiration. These disturbances may exist for a considerable length of time without the occurrence of tubercular deposits; or, in favorable cases, this precursory morbid state may be relieved, and thus the local affection may be entirely avoided.

The recognition of the precursory stage of phthisis coincides with the general opinion of pathologists, that *phthisis*, taken in its broadest sense, is a *constitutional* disease. But, in addition to this mere accordance with the received doctrine of the profession, the full recognition of this stage of the disease will serve more forcibly to arrest the attention of practitioners, and to induce patients thus early to submit to systematic treatment. In a future chapter the symptomatology of precursory phthisis will be fully discussed, while its essential character will be considered in connection with the general nature of tuberculosis.

III.

SECONDARY PATHOLOGICAL ANATOMY.

CHAPTER III.

TUBERCULAR DEPOSITS.

SECTION I.

PHYSICAL CHARACTERS OF TUBERCLE.

The physical characters of Tubercle vary in form, color, and consistence, with the different varieties of the deposit. At the moment of exudation, tuberculous matter is probably fluid; but at this early period it is difficult, if not impossible, to make accurate and reliable observations. Tuberculous matter is clearly an exudation from the capillary vessels; but whether it occurs in the form of a simple fluid, or whether there is a liquid blastema containing nuclei which become developed into more or less perfect cells, may reasonably admit of doubt. The earliest stage of the deposit has been described by some observers as exhibiting a clouded aspect, with stellated points, which ultimately coalesce and form the solid deposit. Dr. Baillie* was the first to describe, in the following language, the infiltration which occurs in connection with the formation of tubercle:

"In cutting into the lungs, a considerable portion of their structure sometimes appears to be changed into a whitish, soft

* Morbid Anatomy. London.

matter, somewhat intermediate between a solid and a fluid, like a scrofulous gland just beginning to suppurate. This appearance is, I believe, produced by scrofulous matter being deposited in the cellular substance of a certain portion of the lungs, and advancing toward suppuration. It seems to be the same matter with that of tubercle, but only diffused uniformly over a considerable portion of the lungs, while tubercle is circumscribed."

Doubtless, what Dr. Baillie thus describes as fluid tubercle, is the exudation of the tuberculoid material, from which the solid substance is ultimately formed, and not, as he supposed, an incipient state of suppuration. It corresponds, therefore, to the "juice of cancer," and may be justly termed the *juice of tubercle.* It is probable, however, that the amount as well as character of this fluid is different in the two principal forms of tubercle, namely, the gray and the yellow, and that in the former it partakes more nearly of the character of inflammatory exudation.

If, however, the formation of tuberculous matter bears any relationship to other exudations, we may safely assume that its primary form is a liquid blastema, perhaps containing nuclei, from which the tubercle-cells are ultimately developed. When first recognized, however, as solid bodies, tubercles may be described as small, rounded masses, not larger than a pin's head, of a yellowish or grayish color, and varying in consistence from complete softness to almost cartilaginous hardness; usually, however, somewhat friable, and presenting a granular surface when cut. In form, it may be spherical or somewhat angular; but Rokitansky describes it as being more or less branched at its circumference. It exists in disseminated particles, or in aggregated masses. The form, color, and consistence vary with the different varieties, to which I refer for a further account of these peculiarities.

SECTION II.

VARIETIES OF TUBERCLE.

Two principal varieties of tubercles have been so constantly recognized and described by pathological anatomists, that they must be made the basis of our classifications, although, without precautions, it will lead to erroneous conclusions. These two varieties embrace the gray and the yellow.

1. *Gray or Semi-transparent Variety.*—Andral describes these bodies as being grayish or at times reddish, and varying in consistence from a soft structure to almost cartilaginous hardness. It is remarked by Rokitansky, that smaller, softer, and more transparent bodies are often found interspersed among the larger; which may, I think, fairly be regarded as merely an earlier stage of the same substance.

In size, the gray tubercles are variable, depending, no doubt, on the stage of development. The minutest form (as shown by Rokitansky's observation) is a mere transparent granule, which may be microscopic, and this enlarges, according to the laws of cell-growth, until several of these aggregated constitute the gray granulation or semi-transparent tubercle. The ordinary size is that of a millet-seed; but occasionally it appears in aggregated masses as large as a pea. It is usually somewhat tough, and, as the term indicates, more or less transparent, and when cut, its surface exhibits a comparatively smooth aspect. It exists mainly in the form of *miliary* tubercles, or disseminated deposits, scarcely, if at all, in aggregated masses of any considerable size.

2. *Yellow or Crude Tubercle.*—The yellow or *crude* variety (which might properly be styled *true tubercle*) is of a yellowish hue, opaque, of rounded or angular form, varying in size from hemp seed to that of the common pea, with a tendency to coalesce in larger masses. It is somewhat friable or cheese-like in consistence, readily breaking up on pressure, and its cut surface presenting a granular aspect.

These are the varieties of tubercle as described by systematic

writers, and which, in very general terms, may be called the *gray* and the *yellow*, or the semi-transparent and the opaque. It may be fairly questioned, however, whether these products in fact belong to the same class, or whether they are not radically distinct in origin, essential characters, and ultimate tendency. This question will be more fully discussed hereafter; but it may be remarked here, that the ultimate tendencies of these two varieties of morbid products seem so widely different that they can scarcely be assumed to represent the same species of exudation. Thus, while the *yellow* variety naturally tends to softening and elimination, the *gray* as constantly undergoes a retrogressive action, and never softens, except as a result of its possible transformation into the former species, or by its becoming involved in the general process of disintegration, when the two classes co-exist. Hence, according to this view, there is but one species of true tubercle, which is the opaque or yellow form.

SECTION III.

FORMS OF TUBERCLE.

1. *Miliary Tubercles*—This form occurs as disseminated or isolated tubercles, about the size of a pin's head, or millet-seed, and may be either the gray or yellow variety—the gray being the most common. They have been called "gray granulations;" and, as already stated, it is a question whether that term is not made to include morbid products not essentially tubercular. These bodies constitute the *miliary* tubercles of Laennec and Bayle; the *disseminated* tubercles of Gendrin; the *simple* tubercles of Lombard and Home.

2. *Aggregated Tubercles.*—Tubercles often become *aggregated* so as to form large masses, which are made up of a simple aggregation of the elementary deposit. These masses are mostly of the yellow variety, and denote an aggravated form of constitutional disease. Softening readily occurs where these masses exist, and large cavities are thus speedily formed.

3. *Tubercular Infiltration.*—There are some examples in which the *whole texture* seems so completely occupied with the deposit, that it has received the name of *infiltration*. In the lungs it doubtless occupies the *areolar* tissue, conjointly with the air-cells, and thus, by copious and uniform deposition, renders the part a mass of tuberculous matter, which might be properly designated *tuberculous hepatization*. In consequence of a deposit of black pulmonary matter, the indurated portion exhibits a mottled aspect, or assumes a gray or greenish hue; and, like ordinary hepatization, the torn surface is quite granular. This condition occurs in what is known as acute or rapid phthisis. The infiltration may be either gray or yellow. It is probable, however, that what has been by some termed *gray* infiltration, is, in fact, an *inflammatory* deposit, and therefore not tubercular. Laennec describes a *gelatiniform* or albuminous deposit, which he thought was ultimately transformed into the crude or yellow, but which Rokitansky regards as an indication of a tendency to resolution.

4. *Tubercular Dust.*—This is a still more minutely comminuted deposit than the preceding, and is, indeed, so exceedingly attenuated that it has been denominated *dust*. So exceedingly minute and delicate are these particles, that their pressure, even when congregated in masses, does not always obliterate the vessels; and hence Rilliet and Barthez have discovered drops of blood forced from the mass by pressure. Tubercular dust is, indeed, merely a form in which the particles deposited are exceedingly minute.

SECTION IV.

HISTOLOGY OF TUBERCLE.

The minute anatomy of tubercle presents points of great interest, as illustrating its character and tendencies; and although some of these points are not definitely and conclusively determined, (as is shown by the discrepancies which exist

among microscopists,) yet enough is known to enable us to state with precision the essential elements which enter into the anatomical composition of these bodies. True or essential tubercle embraces three anatomical elements: 1. An amorphous hyaline stroma; 2. Granules; and 3. Tubercle-cells.

1. *The Amorphous Stroma.*—This substance, which is the matrix in which the essential elements of tubercle are deposited, is described by Vogel* as perfectly resembling fibrin, and exhibits the same chemical reactions. This statement, however, evidently conveys an erroneous impression, for, if it perfectly resembles coagulated fibrin, it must necessarily reveal the elements which characterize fibrin, and which would render it no longer *amorphous.* The fact is, this stroma or matrix is an albuminous pabulum, or *cytoblastema*, in which the granules and cells are formed, and doubtless affords nutriment for those structures. In the earliest stage of appreciable tubercle this stroma is present, and may, indeed, be regarded as the initial step in the morbid process. Acetic acid and alkalies produce a marked effect on the stroma, gradually rendering it less distinct, until it finally disappears.

2. *The Granules.*—All observers agree that tuberculous matter contains numerous minute granules. These molecular bodies are exceedingly minute; they vary in size, according to Lebert, from $\frac{1}{1600}$th to $\frac{1}{1800}$th of a line in diameter, and are often too small to admit of admeasurement. They consist of three different classes: 1. A protein compound, insoluble in acids, alkalies, or ether. 2. Fatty granules, soluble in boiling ether. 3. Calcareous salts, carbonate and phosphate of lime, soluble in acids. These molecules are round, occur in clusters or masses, and exhibit a slight shade of color—grayish or brown. They often surround the tubercle-cell, as well as pervade it internally. They greatly increase when softening occurs.

3. *Tubercle-cells.*—Microscopic observers are not agreed as to the exact appearances of the cells found in connection with tubercles. Some describe them as containing nuclei, while

* Pathological Anatomy, etc.

others have not been able to verify the existence of such bodies. Lebert describes a tubercle-cell which he regards as peculiar, and as being characteristic of that product. According to his observations, these tubercle-cells present an irregular form, without nuclei, but contain molecular granules. These cells he believes to be peculiar to tubercle, and therefore distinguishes it from all other morbid products. Gerber proceeds a step further, and describes four classes, varying in vitality: granular tubercle, cytoblast tubercle, cell tubercle, and the filament tubercle. Gruby describes the tubercle-cells as of large size, being much larger than the pus-cell. On the contrary, Mr. Simon has denied the presence of cells as essential to the existence of tubercles.

Wedl describes tubercles as consisting of molecules, flocculent masses, nuclei, irregular granular corpuscles, and nucleated cells.

These discrepancies doubtless arise from examinations having been made of different varieties of deposits, or different stages of development; and, again, while the substance was being acted on by different chemical reagents. This latter condition is capable of varying the results of microscopic examinations in a very remarkable manner. But when the true yellow tubercle is examined with an instrument of good defining power, the results will exhibit a remarkable degree of uniformity.

Tubercle-cells vary somewhat in size, but as a general rule they range from the $\frac{1}{400}$th to $\frac{1}{300}$th of a line in diameter. When the deposit is quite mature, or softening has commenced, the cells present a larger size. Their outline is mostly irregular, being angular or fragmentary, but in some instances exhibiting a spherical form. The cell consists of a distinct cell-wall, containing from three to twelve, or even more, spherical granules; and apparently the same class of granular bodies exist around the cells, imbedded in the cytoblastema.

Chemical reagents modify these appearances in a very remarkable manner. Thus, weak acetic acid renders the cell more transparent, and some of the granules disappear; ammonia dissolves the corpuscles, more or less, according to its con-

centration; while caustic potash completely holds them in solution. In the *calcareous* granules the particles are irregular in outline and dimensions, often intermixed with crystals of cholesterine. It may be added, also, that black pigmentary matter is sometimes intermixed with the tubercular deposit.

In regard to the presence of *nuclei*, or true cytoblasts, in the tubercle-cell, as already intimated, observers are not agreed. While a majority of the most reliable histologists concur in the opinion that the intra-cellular bodies are *granules*, and not *cytoblasts*, a few, of equal reputation, including Rokitansky, Vogel, Gulliver, and Wedl, describe well-defined nuclei as occasionally, though not constantly, present. Among these may be particularly mentioned Vogel, who describes and figures tubercle-cells as containing, under some circumstances, distinct and unequivocal nuclei, and nucleoli. It is not a little remarkable that so distinguished an observer as Vogel should differ so widely from others equally accurate in histological investigations. But, notwithstanding the authority of his opinion, it would be illogical to admit it in opposition to such conclusive testimony as exists on the subject. I have examined tubercle-cells in every stage and variety, aided by the best instruments, and have never been able to verify, in a single instance, the presence of a nucleus. I can but agree, therefore, with Lebert, Bennett, and the majority of microscopists, who deny the existence of nuclei, and regard the cell as containing only granules. In addition to these demonstrative evidences, it will be apparent, when we consider the nature of tubercle, that, *à priori*, it must necessarily consist of bodies widely different from nucleated cells. Indeed, no two classes of structures could be more dissimilar than the heterologous formations which contain nucleated cells, and those which we regard as tubercular deposits. It is quite possible that the *occasional* presence of organic cells, depending altogether on accidental circumstances, or existing in products not actually tubercular, and constituting no part of true tubercle, has given rise to the opinion entertained by Vogel, Gulliver, and a few others.

In addition to these characteristic elements of tubercle, others quite constant, but not essential, are observed, among which

are epithelial-cells, pus-cells, blood, oil globules, cholesterine, and other less constant substances. It will be observed, however, that some of these (as the pus-cells) belong to the stage of softening, and no doubt discrepancies have arisen from descriptions applied indifferently to the solid and softened states.

Variations of Structure in the different Forms.—The elements which have been described as characteristic of tubercle, vary somewhat in the different varieties, as well as the stages of the deposits. The first deposit is probably the amorphous cytoblastema, and immediately succeeding this, or simultaneously with it, the granules also appear; while the cells are of more gradual growth, conforming, in that respect, to the general development of organic tissues.

The histological elements differ, however, in the two principal varieties. Thus, in the yellow variety, the protein compounds, granules, and fat, predominate, which render it soft and friable, while in the gray formations, the granular element is much less abundant, which places the cells in more immediate juxtaposition, giving the structure its hardness and transparency. It is abundantly evident that the predominance of granules in the yellow, and of cells in the gray, explains the characteristic tendency of the former to softening, and the latter to remain stationary, or even undergo a retrogressive action.

CONCLUSION.

The essential pathological character of tubercle, as well as its relation to the tissues in which it is deposited, have been variously explained by different observers. One party contend that it is an essential or heterologous morbid product, being wholly unlike the tissues in which it is deposited; while another class believe that it is strictly homologous, and is merely a retrograde metamorphosis of the elementary structures of the part. Several distinguished pathologists have regarded the formation as a process analogous to inflammation, among whom stand pre-eminent Reinhardt and Schroeder Van der Kolk.

The latter, however, believes that the deposit takes place in the epithelia of the air-vesicles, which become detached and converted into tubercle. Lebert considers that the tubercle-corpuscle is specific, and the local disease, therefore, is unlike all other morbid products. The opinion of Virchow is intermediate, in relation to the two parties; or rather, it embraces both views, in the explanation of the constitutional and local disease. He recognizes a general or constitutional disease, which he terms *scrofulosis*, and this leads to the local deposit, which is styled *tuberculosis*. And although the local changes consist in a retrograde metamorphosis of the tissues of the part, it is induced by the constitutional affection.

It is difficult to decide many of the ultimate questions started by pathologists in relation to the formation of tubercle; but, at the same time, thanks to the indefatigable researches of numerous observers, we are able to offer a reasonable explanation of the process. If tubercle is simply a retrograde metamorphosis of pre-existing tissues, without a specific exudation, it is essentially a local disease independent of a constitutional dyscrasia; but, as already stated, Virchow admits both conditions, although he regards the local change as an altered state of the structures of the part.

The histology of tubercle reveals peculiar cells, destitute of nuclei, and wholly unlike the corpuscles of any other product, healthy or morbid, and there is no direct evidence that they constitute a degraded state of any pre-existing tissue. The tubercular deposit may, indeed, take place *in* the air-cells, as believed by Schroeder Van der Kolk, Sieveking, and many other pathologists; but this fact, if true, does not establish the additional opinion, that tubercle-corpuscles are merely changed epithelia. The fact, that they are unlike all other cells, affords a reasonable ground for the opinion that they are *sui generis*, and hence not a changed structure.

It is a question whether tubercle admits of a microscopic diagnosis. Wedl* remarks that if a pathological new-formation contains the elements of tubercle, and nothing else, it is

* Pathological Histology.

purely tubercular new-formation. And this, it appears to me, is the key to the microscopic diagnosis of tubercle. If the substance consists of the elements described as constituting the characteristics of tubercle, and is destitute of blood-vessels and a fibrous tissue, the substance can be nothing else than tubercle.

Morbid anatomists, from the days of Baillie to the present period, have described a fluid deposit as the primary state of tubercle; and this has been called, by recent writers, the amorphous hyaline stroma in which tubercle is formed. It would appear, indeed, that this amorphous fluid is the true pabulum of tubercle—in other words, it is the morbid exudation in which the peculiar corpuscles constituting tubercle arise. The character of this exudation determines the nature of the subsequent growth or development of the morbid substance; and, indeed, we observe that the same laws of development obtain here as elsewhere. Thus, during ordinary inflammatory action, the exudation consists of fibrin, and the result is a growth corresponding with that element. In the cancerous cachexia, the exudation is of a peculiar character, which gives rise to cancer-cells. Indeed, the blastema or *cancer-juice* performs the same office in the development of malignant growths that the amorphous hyaline stroma does in the tubercular condition; the same laws of exudation and development of morbid growth pertain evidently to the two conditions, the special difference consisting in the elementary character of the exudation.

According to this view, *tubercle* is an essentially morbid and *specific* exudation, appearing first in a fluid condition, in which the tubercle-cell is developed, and is entirely independent in its formation of the surrounding tissues. And it is immaterial whether this tuberculous exudation takes place in the epithelia, as supposed by some, in the simple areolar tissue, or on free surfaces; for if the epithelial cells be the seat of exudation, they are completely destroyed, no vestige of their structure remaining. I would not deny that the nuclei of epithelia, as believed by Van der Kolk, might be nourished by the tuberculous fluid into tubercular cells; nor would this fact change the bearings of the main question. The *pabulum* must determine the character of the growth, independent of surrounding tissues; hence,

inflammatory exudation gives rise to false membrane; the cancerous exudation to cancer-cells; the tuberculous exudation to tubercle-cells; and so on, with all morbid exudations.

SECTION V.

CHEMISTRY OF TUBERCLE.

The importance of a correct chemical analysis of tubercular matter is too obvious to admit of doubt; but we are obliged to confess, in the beginning of our investigations, that the numerous discrepancies which exist leave the subject incomplete, and present results in many respects unsatisfactory. These discrepancies arise in part from the inherent difficulties of the subject, and in part from the varying character of the materials analyzed. Some analyses have been made from hard, others from softened tubercles; some from what is known as scrofulous deposits, others from gray granulations. These facts are sufficient to account for some of the discrepancies arising from chemical investigations, and for which due allowances must be made. I shall endeavor to reduce these differences as nearly as possible to general results, and thus to exhibit what is actually known on the subject.

It is quite apparent that the different microscopic elements which enter into the composition of tubercle will yield different chemical results; thus, the amorphous stroma, the granules, and the tubercle-cells exhibit different chemical reactions under the microscope. The amorphous stroma is rendered pale, and finally disappears, under the influence of acetic acid and caustic alkalies; the protein granules are not soluble in acids, ether, or alkalies; while those of a fatty nature are soluble in ether. Cells containing nuclei are more or less soluble in acetic acid, and completely so in caustic alkalies* It will thus be seen that the several organic constituents, when examined sepa-

* Vogel.

rately, must necessarily yield different results; but as this delicacy of chemical manipulation is difficult, if not impossible, we look only to the analysis of all the constituents, in the aggregate, which are found in tubercle.

As a first and general proposition it may be affirmed, that tubercle, in its ordinary forms, consists largely of animal matter. Thus Thénard found solid tubercle to consist of 98.05 animal matter; chloride of sodium, phosphate of lime, carbonate of lime, 1.85; and some traces of oxide of iron. Hecht found in six grammes of tuberculous matter: albumen, 1 gramme, 4 decigr.; fibrin, 2 grammes, 8 decigr.; gluten, 1 gramme, 2 decigr. Preuss found 19.5 per cent. of solid matter, 80.5 water; the solid portion consisted of an animal matter which gave the reactions of casein, a fatty substance containing cholesterine, and a small quantity of salts.* The nature of the *animal* matter is a subject of dispute.

ANALYSIS OF SOLID TUBERCLE.

Let us turn first to the ultimate or elementary analysis. The following result was obtained by Scherer, in an analysis of crude tubercle :†

Carbon	53.888	= 100
Hydrogen	7.112	
Nitrogen	17.237	
Oxygen	21.767	
	100.004	

The formula for this analysis is thus expressed: C_{43}, H_{35}, N_6, O_{13}. The analysis of tubercle obtained from different parts of the body, according to Scherer, exhibits a remarkable uniformity of composition, as will be seen by the following table.‡

Tubercle from the lung	C_{43}	H_{35}	N_6	O_{13}
Tubercle from the liver	C_{45}	H_{36}	N_6	O_{13}
Tubercle from the peritoneum	C_{46}	H_{36}	N_6	O_{13}
Tubercle from the brain	C_{46}	H_{37}	N_6	O_{13}
Tubercle from the mesentery	C_{46}	H_{38}	N_6	O_{13}

* Glover on Scrofula. † Simon's Chemistry. ‡ Ancell.

The following results were obtained by Dr. Glover, in a series of analyses:*

	C.	H.	N.	O.
1. Crude granular mesenteric tubercle.....	54.97	6.63	12.31	26.09
2. Crude granular mesenteric tubercle.....	56.40	.....	15.56	.....
3. Crude tubercle from lung.....	53.43	6.64	14.02	25.91

It will be observed that these analyses furnish a close resemblance to the composition of the so-called protein compounds, and, therefore, that tubercle bears a relation to protein. Taking Liebig's formula as the basis of the hypothetical substance denominated *protein*, we have the following:

$$C_{48} \quad H_{36} \quad N_6 \quad O_{14}$$

Albumen, however, being the basis of those substances known as "protein compounds," constitutes the proper physiological product with which we may compare the pathological substance known as tubercle. The following is the composition of albumen, as given by Scherer and Mulder:

	Scherer.	Mulder.
Carbon	54.9	53.5
Hydrogen	7.0	7.0
Nitrogen	15.7	15.5
Oxygen, Sulphur, Phosphorus	22.4	22.0, 1.6, 0.4
	100.0	100.0

It will be observed that, taking Scherer's analyses for comparison, there are marked differences between the elementary composition of tubercle and albumen, which will be the more evident when brought into juxtaposition, thus:

	Albumen.	Tubercle.
Carbon	54.9	53.888
Hydrogen	7.0	7.112
Nitrogen	15.7	17.237
Oxygen (Mulder)	22.0	21.767
Sulphur (Mulder)	1.6	.....
Phosphorus (Mulder)	0.4	.....

* Pathology, etc., Scrofula.

There are differences between the physiological and pathological products in their proportions of carbon, hydrogen, nitrogen, and oxygen, but these constituents are doubtless liable to variations in the different forms and stages of the tuberculous deposits, so that the results are less significant than might at first view appear. It will be remarked, however, that the morbid substance contains neither phosphorus nor sulphur, both of which enter into the composition of physiological albumen. Tubercle, however, contrary to our *à priori* conclusions, contains a larger proportion of nitrogen than albumen, a fact which may ultimately assume a greater degree of importance than is at present attached to it.

Proximate Analysis.—As previously stated, Thénard, at an early period, analyzed crude tubercles, with the following results:

Animal matter	98.15
Muriate of soda, Phosphate of lime, Carbonate of lime	1.85
Oxide of iron	traces
	100.00

According to Hecht, of Strasburg, six grammes yielded the following results:

	Gramme.	Decigrammes.
Albumen	1	4
Gelatin	1	2
Fibrin	1	8
Water (or loss)	1	6
	6	0

These analyses, however, are far from conveying a definite idea of the proximate constituents of tubercle. The more recent and complete observations are those of Scherer, Glover, and Preuss.

SCHERER'S ANALYSIS.

1000 parts of solid tubercular masses, found in the abdomen, yielded:

Water	893.82
Solid residue	106.18

Fat	25.40
Casein and alcoholic extract	12.39
Pyin and watery extract	6.19
Salts	7.43
Crude tubercular matter	54.55

SIMON'S ANALYSIS.

100 parts contained:

Water	84.27
Fat containing cholesterine	1.40
Spirit extract with salts	1.52
Caseous matter with water extract	1.14
Water extract and salts	3.80
Insoluble constituents	4.44

PREUSS'S ANALYSIS.

In 1000 parts were found:

Water		799.50
Residue of the pulmonary tissue, composed of—		
Gelatin obtained by boiling	13.497	
Substances furnishing no more gelatin	49.106	
Fatty matter	2.697	
		65.30
Tubercular matter, containing:		
A. Substance soluble in boiling alcohol—		
1. Cholesterine	6.685	
B. Substances soluble in cold alcohol and water—		
2. Oleate of soda	18.269	
3. Chloride of sodium 4. Lactate of soda 5. Sulphate of soda 6. An intermediate substance	11.48	
C. Substances soluble in water and not in alcohol—		
7. Casein 8. Chloride of sodium 9. Sulphate of soda 10. Phosphate of soda	10.690	
D. Substances insoluble in alcohol and water—		
11. Casein altered by heat 12. Oxide of iron 13. Phosphate of lime 14. Carbonate of lime 15. Magnesia 16. Soda	88.108	135.20
		1000.00

LEGENDRE'S ANALYSIS.

In 100 parts

Water	66.67
Albumen soluble in water	5.08
Cholesterine	14.38
Gelatin	.25
Subphosphate of lime	.75
Fatty matter	1.70
Membrane and coagulated albumen	11.07
Loss	1
	100.00

LASSAIGNES' ANALYSIS.

In 100 parts of tubercle from lungs of a horse:

Animal matter	40
Subphosphate of lime	35
Carbonate of lime	9
Salts soluble in water	16
	100

WRIGHT'S ANALYSIS.*

The two following analyses give the mean result of numerous examinations of matured (cheesy) tubercle:

Fatty matter with oil globules	15.9
Gelatin	6.4
Phosphates, Sulphates, Muriates of lime and soda	11.2
Carbonate of lime	a trace.
Albuminous matter with fibrin	65.2
	98.7

Fatty matter with oil globules	7.4
Gelatin	11.8
Phosphates, Sulphates, Muriates of lime and soda	2.5
Albuminous matter	76.9
	98.6

* Med. Times, vol. xi.

ANALYSIS OF SOFTENED TUBERCLE.

But few analyses of softened tubercle have been made. The authority of Lehmann is quoted to establish the fact that the protein-elements gradually lose their phosphorus and sulphur. It is generally affirmed that in proportion to the advance of the process of softening is the *increase* of fatty matter. L'Hertier observed the presence of albumen, fatty matter, fibrin, and carbonate of lime; while, according to Boudet, the tuberculous matter becomes alkaline.* The development of fat is evidently the most notable change which takes place during the process of softening, and the change has been compared to *fatty degeneration.*

ANALYSIS OF CRETACEOUS TUBERCLE.

According to the analysis made by Boudet, calcareous tubercles contain 70 per cent. of soluble salts, viz.: chloride of sodium, phosphate and sulphate of soda. He found but a small amount of carbonate of lime. This result, however, is not in accordance with the observations of others, and is probably incorrect in reference to the existence of so large a proportion of soluble salts. The following are the most reliable analyses:

ANALYSIS BY SCHERER.

Organic matter	20.10
Phosphate of lime	69.92
Carbonate of lime	9.09
Chlorate of sodium, phosphate and sulph. soda	0.89
	100.00

ANALYSIS BY L'HERTIER.

Animal matter	5 to 9 parts.
Phosphate of lime Carbonate of lime	95 to 91 parts.

Many additional analyses might be given, but these are sufficient to indicate the true constitution of cretaceous tubercles.

* Ancell, *loc. cit.*

It may be remarked, however, that some observers have found, at times, a preponderance of the carbonate of lime, and again, of both the carbonate and phosphate, with ammonio-magnesian phosphate. It is stated, on the authority of Lehmann, that these concretions frequently contain cholesterine. It appears, however, to be well established that the phosphate of lime predominates, with generally a large proportion of the carbonate. An analysis made by Simon gave the following results in 100 parts:

Earthy phosphates	87.2
Carbonate of lime	11.5
Soluble salts	0.65

The organic remains are variable, but always exceedingly small.

CONCLUSION.

It will be remarked that the preceding analyses are far from being uniform, and hence the subject can not be considered definitely settled. Nevertheless, the most accurate organic chemists have succeeded in determining the existence of certain constituents, the presence of which can not be doubted, and may, therefore, be regarded as composing a part of tubercles. Nor is it surprising that an absolute want of uniformity should exist; for it is obvious that the composition of these albuminous or protein bodies are liable to considerable variations even in the same essential product, and, therefore, while the *general* characters remain nearly identical, the individual constituents will be found to vary in their proportions. This will be more apparent when we bring into a compact form the substances which have *certainly* been found, as will be seen in the following arrangement:

Thénard found: muriate of soda, phosphate of lime, carbonate of lime, a trace of iron.

Hecht found: albumen, gelatin, fibrin.

Scherer found: fat, casein, pyin.

Simon found: fat, containing cholesterin, caseous matter.

Preuss found: carbonate of lime, phosphate of lime, oleate of soda, chloride of sodium, lactate of soda, sulphate of soda, casein, oxide of iron, magnesia, soda.

Legendre found: cholesterin, gelatin, fatty matter.

F. Boudet found: casein, gelatin, cholesterin, oleic acid, margaric acid, lactic acid, saponified fat, cerebric acid.

Güterboch found: *a peculiar substance*, (not observed by other chemists,) pyin, phymatine, fat, albumen.

Glover found: pyin, muco-extractive, *a peculiar extract*, fats.

Chevallier and Lassaigne found: xanthocystine.

So far as reliance can be placed on the results of chemical analysis, we may regard the following substances as entering more or less constantly into solid tubercular deposits:

1. Albumen. 2. Casein. 3. Fibrin? 4. Pyin. 5. Fatty matter. 6. Salts of soda and lime. 7. A peculiar substance, (*Tuberculin?*)

It is abundantly evident that the organic *basis* of solid tubercle is a protein compound, bearing a relationship to albumen and casein, but it is probable that true *fibrin* does not exist in this morbid product. The intimate relationship existing between fibrin and albumen might readily induce a mere chemist to give the former title to the latter. It is not, however, by chemical tests alone that we can recognize the presence of true fibrin; on the contrary, it is the *vital* actions, including spontaneous coagulation and ultimate organization, which can decide the question. It is probable, therefore, that fibrin does not exist in tubercle, while its congeners, albumen and casein, constitute the true basis. *Casein*, which is so nearly allied to albumen, has been recognized by Scherer, Simon, Preuss, and Boudet. Güterboch and Glover have detected *pyin*. All these, it will be remarked, belong to the so-called protein series, and bear a relationship to each other and to organic lymph. It is abundantly established, also, that fatty matters, in various but demonstrable forms, are always present; these consist of simple fat, saponified fat, and cholesterin. Gelatin has been detected by Hecht, Legendre, and Boudet.

It appears that several protein compounds have been detected by chemists; but they have not fully decided which of these constitutes the true basis of tubercle. It is believed by many that *albumen* is the essential organic element, while others regard it as being either true or modified *casein*. Mr. Ancell* is of opinion, that it bears a close analogy to casein, if it is not identical with that substance. In support of this view is the important fact, that tubercle contains neither *phosphorus* nor *sulphur*, and the same is true of casein, except that a small proportion of sulphur is present; while albumen is rich in both these elements. It seems probable, therefore, that the organic substance met with in tubercle is more nearly allied to casein than to albumen. It is proper to add, however, that the action of reagents (such as heat) show also the presence of albumen; but it is probably in a changed or degraded form, exhibiting merely coagulation by heat.

The fatty substances are quite abundant in tubercle, and increase with the process of maturity and degeneration. The following table will show the relative proportion of fatty matter as detected by different chemists:

Scherer.....	25	parts fat in 1000.
Simon.....	1.40	" " containing cholesterin in 100.
Legendre.....	14.38	cholesterin } in 100.
	1.70	fatty matter }

The relation of tubercular deposits to fat are further shown by the observations of Guillot, that the substance of the lung which had been consolidated by tubercles, yielded, when dried, from forty to fifty-two per cent. of fat. The same condition has been observed in other forms of consolidation, such as pneumonia, and in the fœtal lung. These facts have suggested the idea that the tubercular deposits bear a relation to fatty degeneration; and this view is further strengthened by the researches of physiologists, which prove that albumen may be converted into fat.

* Tuberculosis, etc.

The occasional presence of gelatin is not a very significant fact; it merely shows a degeneration of the tissues.

Finally, it is evident, that the chemical analysis of tubercle expresses but a secondary result, and throws no light whatever on the primary change. The fluid exudation, which constitutes the pabulum of tubercle, has not and can not be analyzed; and it is only the solid substance, which has grown into textural form, that comes within the range of chemical reagents. And while, therefore, the nature of these ultimate growths possess great intrinsic importance, they not only fail to elucidate the essential nature of the process by which they are formed, but they are equally remote from revealing the laws by which the morbid growth is regulated. The fact, that tubercle is a *protein* compound, does not establish its essential nature; for the same result, in a general sense, would apply to almost every morbid growth of the body.

CHAPTER IV.

CONDITION OF THE BLOOD.

The condition of the blood, whether viewed as a primary or secondary disease, is of great importance in tuberculous affections. This fluid furnishes the blastema for all tissues and organic products, healthy and morbid; and any departure from a state of health, whether the cause or sequence of the original disease, can not fail to influence both the constitutional and local affections.

In an examination of the state of the blood in phthisis pulmonalis, we are, unfortunately, without sufficient data to determine its condition in the *precursory* stage of the disease; indeed, the observations which have been made on this subject have reference exclusively to the condition of the circulating fluid *after* the development of tubercles. This obvious deficiency, however, may be, to some extent at least, overlooked; for what is observed in the stage of tubercular deposits, is probably merely an advanced state of what existed prior to the formation of tubercles; and we have only to consider, therefore, that the elementary changes found after the supervention of local disease, is but a further development of the early condition. Hence, although we have to regret this want of knowledge in regard to the precursory stage, it is probably less important than might at first appear, and indications for treatment may be safely drawn from the more advanced condition.

It is proper further to remark, that many of the analyses have been made from cases in which external *scrofulous* disease existed; and it becomes a question how far this condition is to

be received as a fair representative of the true tuberculous state of the system.

But a more serious defect is found in the fact, that *venous* blood alone has been subject to analysis and examination; and although it may be assumed that this portion of the sanguineous fluid can be taken as a fair type of the whole, yet there is reason to apprehend that differences exist. And although it can not be affirmed that an analysis of arterial blood, even that of the aorta, would throw any additional light on the nature of tuberculous disease; yet, when we reflect that it is the arterial blood which furnishes the nutriment for the different organs and tissues, and that this nutrition is evidently disturbed in tuberculosis, we can not but regret that the fluid more immediately producing these important changes should not have been the subject of examination.

SECTION I.

PHYSICAL PROPERTIES OF THE BLOOD.

The observations which have been made in reference to the physical properties of the blood in scrofula and incipient phthisis, are comparatively few and unimportant, but they are sufficient to demonstrate that its general constitution is impoverished. This is evinced by its imperfect coagulation and excess of water-qualities, which clearly demonstrate its impaired vitality. Coagulation is usually sufficiently prompt, but the clot is small, and, at times, loose in its texture, while the serum is decidedly in excess. The most evident physical change, therefore, is an excess of the watery portion; the size of the clot and its firmness of contraction present considerable variations, and, therefore, are not constant. According to Dubois, (d'Amiens,) the blood coagulates slowly, and the clot is small and diffluent, the serum thin, and, at times, of a red color; and Mr. Phillips states that the clot was usually small and soft, and the serum large. Some of the older writers affirm that the

blood assumes a brighter hue than natural; and although we have not the data to determine that question with certainty, yet it has appeared to me, that when the deposits exist, a lighter hue is observed. No attempt to form a *buffy* coat is ever witnessed except when local inflammation is present; but I have observed a gelatinous appearance of the surface which was probably albuminous. It is worthy of remark that so few patients are now bled in these affections, that we have seldom good opportunities to judge of the physical changes in the blood.

SECTION II.

MICROSCOPIC APPEARANCES OF THE BLOOD.

At an early period of my investigations into diseases of a tuberculoid character, I sought to satisfy myself in regard to the alleged deviations of the corpuscles from a healthy condition; but now, after some years of investigation, I must confess that the results have not been conclusive or satisfactory. The only deviation which seemed to occur, consisted in the occasional increase of the white corpuscles, and a corresponding diminution of the red.

It is proper to state, however, the observations which have been made by others. Dr. Balman found the colorless corpuscles notably increased, sometimes amounting to seventy and eighty in the field of a quarter of an inch object-glass. These corpuscles varied greatly in dimensions, some being less than half the size of the red corpuscles, while a majority exceeded the diameter of the latter. Nasse and Popp have made observations nearly similar. M. Dubois observed both classes of corpuscles. He describes the red as appearing irregular and notched, and so nearly transparent in the center as to give the appearance of wheels. The coloring matter also appeared as if separated, or loosely adherent to the corpuscles, and the serum sometimes being of a rose color. Lebert represents the red corpuscles as lighter than natural, with some degree of

irregularity in the outline; and Mr. Nicholson confirms the same observation. Dr. Glover found the red corpuscles irregular in the outline, star-shaped, and sometimes studded with granules; but he does not regard this appearance as necessarily abnormal.

Mr. Ancell remarks that his own observations on the blood corpuscles of tuberculous subjects, before the development of local disease, have led to the conclusion that they are paler, of more irregular outline, and more speedily undergo anomalous changes than healthy blood.

A careful examination of this subject has induced me to believe that the microscopic observations of tuberculous blood possess but little interest, and have established no special point, except the increased quantity of the white corpuscles and diminution of the red. This is an interesting fact, which the pathologist will not fail to remember. The other changes are merely incidental, and therefore possess no special significance.

SECTION III.

CHEMICAL COMPOSITION OF THE BLOOD.

We now enter upon a wider, and, perhaps, more tangible field; at least it may be affirmed that the results of chemical analyses of the blood in the tuberculous condition now occupy a large share of the attention of pathologists, and may ultimately lead to highly important results. These analyses have been made during either incipient or confirmed phthisis, or open scrofulous disease; and the blood used has been invariably *venous*.

It may be stated in advance, that the principal changes in the blood in this disease, as made out by the most competent chemists, are the following: increase of water, increase of albumen, and diminution of red corpuscles. Other changes doubtless occur, as will be seen hereafter, but they are not so well defined as the preceding.

Dr. Frick,* of Baltimore, has analyzed the blood during the

* American Journal of Medical Science.

existence of crude tubercles, and the following are the results of four cases, together with what he regards as the standard of health.

No. of cases.	Solids in 1000 grains.	Water in 1000 grains.	Fibrin.	Red Corpuscles.	Solids of the Serum.	Ditto proportionate to the whole solids.	Iron.	Lime.	Chlorides of Soda and Potassa.	Phosphates of Soda and Potassa.
1	212.631	789.369	3.395	125.645	86.546	87.23	.564	.272	2.530	.336
2	199.666	800.334	2.688	111.453	85.525	90.30	.487	.257	5.632	.197
3	200.602	799.398	2.862	117.480	80.260	84.31	.512	.276	4.822	.203
4	207.007	802.993	2.159	104.600	100.248	101.46	.416	.283	2.910	.351
Mean	204.976	798.021	2.776	114.794	88.144	90.82	.494	.277	3.973	.271
Health	208.622	791.378	2.952	127.426	78.244	———	.582	.183	4.882	.874

It will be remarked that, in the above analysis, the principal changes consist of a notable increase of the solids of the serum, increase of water, and diminution of red corpuscles; also, a decrease of the chlorides and phosphates of soda and potassa. Dr. Frick has obtained one result, however, which has not been demonstrated by others, namely, an *increase* of lime.

The following results were obtained by Andral and Gavarret, in the analysis of twenty-two cases:

	Water.	Solid Residue.	Fibrin.	Corpuscles.	Solid residue of serum.
Maxima.....	845.8	225.0	5.9	122.1	105.4
Minima.....	775.0	154.2	2.1	76.7	65.1
Mean.....	809.7	190.3	4.4	100.5	85.3
Health.....	890.0 (?)	210.0	3.0	127.0	80.0

These analyses lose much of their value from the fact that neither the condition of the patients nor stage and complications of the disease are mentioned; but, notwithstanding these defects, they show such a remarkable uniformity in the diminution of the corpuscles and moderate increase of albumen, that they may be regarded as furnishing a fair view of what occurs in phthisis. They indicate, however, an increase of fibrin, which probably represents a pathological state separate from simple tuberculosis.

The following tables are from Becquerel and Rodier:

EXAMINATION OF FIVE MEN, CONTRASTED WITH HEALTH.

	In phthisis.	In health.
Water	794.8	779.0
Solid constituents	205.2	———
Fibrin	4.8	2.2
Fat	1.554	1.60
Albumen	66.2	69.4
Corpuscles	125.0	141.1
Extractive matter and salts	7.7	6.8

RESULTS IN FOUR WOMEN:

	In phthisis.	In health.
Water	796.8	791.1
Solid constituents	203.2	———
Fibrin	4.0	2.2
Fat	1.729	1.62
Albumen	70.5	70.5
Corpuscles	119.4	127.2
Extractive matter and salts	7.6	7.4

In these analyses the results are slightly different from some others, arising, in part, from the authors adopting different standards of health. Thus the fibrin shows a greater increase than properly belongs to *incipient* phthisis, while the albumen is but slightly augmented in males, and not at all in females.

The following table exhibits the analyses by Dr. Karl Popp:*

Sex. Age.	Amount of water in 1000 parts.	Fibrin.	Blood corpuscles.	Residue of serum.
1. Male.....22	806.628	4.068	123.816	65.517
2. Male.....22	801.933	5.400	107.038	85.629
3. Male.....22	818.005	5.161	94.791	81.543
4. Male.....22	786.926	1.864	125.526	85.684
5. Male.....23	801.087	5.434	107.489	85.990
6. Male.....24	802.299	6-101	80.996	110.604
7. Male.....26	1. 841.573	2.620	84.678	71.129
	2. 827.282	10.736	91.045	70.937
8. Female...26	791.569	2.306	125.615	80.508
9. Male.....27	800.174	3.475	108.162	87.189
10. Male.....27	771.136	2.129	151.663	75.072
11. Male.....28	812.203	4.862	96.282	86.653
12. Male.....28	810.848	8.305	95.183	85.664

* Ranking's Abstract. Am. ed., p. 267.

Sex. Age.	Amount of water in 1000 parts.	Fibrin.	Blood corpuscles.	Residue of serum.
13. Male.....36	819.094	3.294	76.695	100.917
14. Male.....38	810.923	6.228	117.863	64.986
15. Male.....39	845.872	5.302	68.584	80.242
16. Male.....40	806.000	7.438	103.858	82.704
17. Male.....46	821.729	6.124	85.011	87.136
18. Male.....46	825.429	5.428	83.528	85.615
19. Male.....48	828.252	3.334	94.660	73.754
20. Male.....50	1. 784.582	5.782	125.290	84.346
	2. 802.100	5.098	116.530	76.272
21. Male.....51	835.641	2.750	———	———
22. Male.....53	790.442	4.803	114.389	90.366
23. Male.....54	801.723	3.790	126.289	68.198
24. Male.....57	1. 813.413	3.845	104.618	78.124
	2. 854.290	4.009	78.002	63.699

The preceding table exhibits a remarkable increase in the proportion of fibrin, reaching, in one instance, as high as ten parts to the thousand.

The following is Elsner's analysis in incipient phthisis.*

Water	803.404
Fibrin	3.443
Fat, from fibrin	0.153
Fat, from other constituents	0.643
Albumen	102.100
Globulin	74.948
Hæmatin	2.466
Extractive matter, salts, and sugar	11.258

Analysis of two fatal cases by J. F. Simon; one in the second stage, the other in the third stage, with night-sweats and fever, to which is appended the standard of health.

	2d stage.	3d stage.	Health.
Water	807.500	825.200	791.900
Solid residue	192.500	174.800	208.100
Fibrin	4.600	6.500	2.011
Fat	2.350	4.200	1.978
Albumen	98.360	90.350	75.590
Globulin	71.230	61.110	105.165
Hæmatin	3.110	2.690	7.181
Extractives and salts	9.350	8.000	14.174

* Ranking's Abstract. Am. ed., p. 268.

In these analyses, the notable increase of fibrin, albumen, and fats, with a diminution of globulin, hæmatin, solid residue, extractives and salts, will not fail to arrest attention.

The analysis of *scrofulous* blood deserves to be mentioned in this connection. Dr. Glover* obtained the following mean results in eleven males and six females:

	Males.	Females.
Solids	208.5	203.845
Fibrin	3.132	3.585
Solids of serum	87.60	85.28
Globules	117.32	114.87

In the examinations made by Mr. Nicholson, the following results, the mean of twelve cases, were obtained from scrofula in its various stages:

Corpuscles	82.12
Fibrin	2.22
Dissolved substances in serum	79.06
Water	836.6

Summary of analyses by different observers, embracing the principal constituents:

	Fibrin.	Red corpuscles.	Albumen.	Fat.	Salts and extractives.
Simon....4	to 6.500	63 to 74.340	90 to 98.360	2 to 4.200	8 to 9.354
Frick....2	to 3.395	104 to 125.645	80 to 100.248	——	——
Andral & Gavarret...2	to 5.9	76 to 122.1	65 to 105.4	——	——
Becquerel & Rodier..	4.8	125.0	66.2	1.554	7.7
Popp....1.864	to 10.736	78 to 151.663	63 to 110.604	——	——
Elsner....	3.443	77.414	102.100	0.796	11.258

The above summary exhibits a wide range between the minima and maxima results; but, instead of casting doubts on the accuracy of the observations, it only serves to show that the different stages and varying conditions of patients give rise to corresponding variations in the constitution of the blood.

The examinations made by Mr. Phillips showed the corpuscles diminished, and, in a majority of cases, the fibrin was below the healthy standard, while the albumen was generally in excess. Becquerel and Rodier, and Mr. Phillips found the

* Pathology and Treatment of Scrofula, etc.

salts increased. In sixty-seven cases examined by Mr. Phillips, the proportion of salts was generally in excess, in some instances nearly double the healthy standard. According to Schultz, the blood was found to be *less* alkaline than natural, which was thus determined: in a healthy state the blood requires two drops of acetous acid to neutralize one drachm, whereas in one scrofulous subject *one* drop of the acid neutralized *four* drachms of blood; and in another case of scrofula the serum was quite neutral.

CONCLUSION.

A careful examination of the preceding analyses will be sufficient to indicate some of the most obvious changes of the blood which take place in tuberculous disease. It will be remarked, that in reference to some points, chemists are nearly uniformly agreed, while, in other respects, discrepancies exist. These doubts and difficulties arise, at least in part, from the inherent difficulties of the subject; nor is it probable that any future researches, however faithful and minute they may be, will arrive at uniformity in every particular. All observers agree, however, that the red corpuscles are uniformly and considerably diminished in quantity; and, if we may trust the microscopic observations of Dubois, Lebert, Glover, and Ancell, they are also more or less changed in configuration, and, therefore, in their vital properties. But our views in regard to their *vital* changes must be rather analogical and inferential, than positive and demonstrative. In addition to this, it is to be remarked that the observations of Balman, Nasse, and Popp show a decided increase of the white corpuscles; and this statement corresponds with my own observations.

The proportion of fibrin, as reported in some of the analyses, must be received with a certain degree of reservation. Some represent the cipher as being *above* the natural standard, while others believe it to fall below. Thus Simon represents the proportion in two cases respectively as 4.600 and 6.500, while

he regards 2.104 as the normal standard. Andral and Gavarret, in their twenty-two cases, give the mean of 4.4, the healthy standard being 3.0. Becquerel and Rodier give the proportion as 4.8 in males, and 4.0 in females, the healthy standard being 2.2 in both sexes. Popp found it as low as 1.864, and as high as 10.736.

These statements have induced the belief that fibrin is actually in excess in phthisis. But we have additional testimony which clearly contradicts the statement contained in the preceding examples. In Dr. Frick's analysis of *incipient* phthisis, the mean of the fibrin is stated at 2.776, the healthy standard being 2.952. The examinations by Mr. Nicholson and Mr. Phillips indicate a diminution of fibrin, and Popp found it as low as 1.864. To these may be added others whose authority goes to confirm the opinion that, at an early period, the fibrin is slightly diminished. The probable cause of the discrepancy will doubtless be found in the stage of the disease when the examinations were instituted. Thus, when local inflammation supervenes, (which is so common as the disease advances,) the proportion of fibrin must necessarily increase; and there can be no reasonable doubt that such was the case in at least some of the examples furnished by Andral and Gavarret, and Becquerel and Rodier. In the examples given by Becquerel and Rodier, the blood was drawn to relieve hemorrhages, fibrile action, and even inflammation. The two analyses by Simon, in which such a noted increase of fibrin existed, were equally fallacious, the first being in the *second* stage, and the other in the *third*, the patient suffering with fever and night-sweats.

These examples, and such analyses, can not be regarded as analogous to what occurs in simple and uncomplicated cases of phthisis; and we feel fully warranted, from all the facts before us, to express the conviction, that they clearly indicate a reduced quantity of fibrin as the characteristic state in incipient phthisis, prior to the supervention of inflammation. I do not wish to intimate that this reduction is very large; on the contrary, it seems quite evident that the change is generally small, though probably nearly, if not quite, constant.

It should be remarked, also, that there is not only a diminu-

tion, but probably likewise a *depraved* state of fibrin, as shown by its frequent imperfect coagulation.

In regard to the *albumen*, it is conceded by nearly all observers that its proportion is increased. Some estimate it as high as 100 parts in the 1000; and it has been seldom found as low as the natural standard. No positive deduction can be made in reference to its quality; but it is a fair inference that, like fibrin, the albumen sinks below the normal vitality.

The watery portion of the blood is sensibly augmented, for, notwithstanding the increase of albumen, the red corpuscles and whole solid constituents are so far diminished as to give a preponderance to the watery element.

It remains a question as to the increase or diminution of *fat*. According to the analyses of Simon, the fat is increased. He adopted, as the healthy standard, 2.346; while he found, in two cases of phthisis respectively, 2.350 and 4.200. These, however, as previously stated, were advanced cases, and, therefore, can not be received as indications of what occurs at an earlier period; nevertheless, they do show the ultimate increase of fat in an advanced stage of the disease. According to Becquerel and Rodier, there was a mere fractional *decrease* of fats; thus, in males, the fat in health being 1.60, in phthisis it was 1.554; and in females the healthy standard was 1.62, while in disease it was 1.729—shades of differences too minute to be of any practical value. It is probable, however, judging from the best data in our possession, that the fatty matters are somewhat increased, and especially in an advanced stage; and, as we shall see hereafter, there is also a tendency to the accumulation of fat in particular organs.

According to Dr. Frick, iron, the chlorides and phosphates of soda and potassa, were diminished, but *lime* was increased. The testimony of chemists on these points is not uniform. Phillips, Rodier and Becquerel, and others, found the salts increased, while L'Hertier states that the earthy salts are diminished, and Schultz mentions that the blood was either neutral or less alkaline than natural; while, in the observations of Glover and Nicholson, these constituents were nearly normal. These facts show that the question in relation to the

alkaline constitution of the blood in tuberculous disease is still unsettled; and, perhaps, much of the contrariety of opinion arises from the constantly varying state of the salts, as the result of medicine, food, and disease.

We are now prepared to make a general summary of the results which have been obtained by chemical analysis of the blood in tuberculous disease. The following statement may be regarded as the sum of our knowledge on the subject:

1. Red corpuscles deficient in number, and probably altered in properties.
2. Albumen increased, and apparently depraved in quality.
3. Fibrin slightly deficient, and probably depraved in quality, in incipient phthisis; increased when local inflammation supervenes.
4. White corpuscles increased.
5. Fats increased.
6. Water considerably increased.
7. The condition of the saline elements, and all other constituents, not positively known.

It will at once be perceived that blood of the above quality represents a depraved circulating fluid, which necessarily possesses a low state of vitality.

SECTION IV.

STATE OF THE CHYLE AND LYMPH.

We possess no positive and definite knowledge of the condition of chyle and lymph in tuberculous disease. The few observations which have been made, have reference to the state of these fluids after the disease has proved fatal. Schultz has represented the chyle as deficient in granules, these bodies being imperfectly formed, and the fluid itself having lost some of its plasticity. These are changes which we would readily surmise to have occurred both in chyle and lymph; but we are not authorized, from the few and imperfect experiments which

have been made, to say it has been demonstrated. If we admit the agency of the mesenteric and lymphatic glands in the elaboration of chyle and lymph, the disease of these structures must necessarily imply an imperfectly formed vital fluid; and that such imperfection exists, all the phenomena of the disease indicate, but the nature of the change has not been demonstrated.

CHAPTER V.

STATE OF THE SECRETIONS.

Our knowledge of the chemical constitution of the secretions, as they habitually occur in tuberculous diseases, is necessarily limited. We can, indeed, perceive the alienations from a normal condition, and, to a certain extent, the chemical changes are known; but still our information on these intricate subjects is far from being definite or satisfactory. Many of the most accurate observations have been made on scrofulous subjects, and each one must be his own judge how far this state represents tuberculous disease.

The condition of the *biliary* secretion varies with the peculiarities of individuals, as well as the stage of the disease. In some examples, no appreciable derangement exists, especially during the earlier stages of the disease, and it is only when the vital powers generally fail, that manifest disorder of this secretion occurs. But in other cases, especially in the *bilious temperament*, the hepatic secretion becomes early and almost constantly deranged throughout all the stages of the disease, which, no doubt, exercises an important influence over the general course of the constitutional and local affection.

When phthisis is fully established, the secretion of bile evidently partakes of the general disorder. In addition to this general influence, there is evidently a reciprocal relationship existing between the pulmonary and hepatic secretions; and as the local affection of the lungs increases, the liver will necessarily take on increased or modified action; and hence, at this advanced period, when the blood is anæmic, almost constant derangement, more or less marked, may be anticipated. The

investigations, however, which throw light on this subject, have been comparatively few, and amount to little more than vague generalities. In one example Chevallier found the bile of a brownish yellow color, containing 2% of dried residue, of which 0.83 was biliary sugar. Chevallier believed the bile in cases of phthisis to contain but little fat.* Le Pelletier, Bordeau, and Garrod found the bile deficient in consistence, and to contain small proportions of resin and coloring matter. Lehmann considers the bile generally, but not invariably, poor in solid constituents in phthisis. Gorup-Besanez found the bile of ordinary consistence; while Frerichs always found it attenuated, except when fatty liver was complicated with the tuberculosis. Both these observers found the bile *dense* when fatty liver existed.†

The analysis by Frerichs furnishes the following results in phthisis and scrofula:

BILE IN SCROFULA.

	1	2	3
Water	96.94	96.00	96.95
Solid constituents	3.06	4.00	3.05
Bilate of soda	2.18	2.81	1.78
Fat	0.09	0.20	1.21
Mucus, protein-compounds and salts	0.71	0.99	1.06

BILE IN TUBERCULOSIS WITH FATTY LIVER, WITH THE HEALTHY PROPORTIONS OF THE SAME ELEMENTS.

	1	2
Water	84.77	91.00
Solid constituents	15.03	9.00
Bilate of soda	8.32	9.94
Fat	0.25	0.09
Mucus, protein-compounds and salts	6.46	2.97

* Simon's Animal Chemistry.

† Lehmann.

HEALTHY BILE, (FRERICHS.)

	1	2
Water	86.00	85.92
Solid constituents	14.00	14.08
Bilate of soda	10.22	9.14
Cholesterin	0.16	0.26
Margarin and olein	0.32	0.92
Mucus	2.66	2.98
Chloride of sodium	0.25	0.20
Tribasic phosphate of soda	0.20	0.25
Basic phosphate of lime, " " magnesia	0.18	0.28
Sulphate of lime	0.02	0.04
Peroxide of iron	traces.	traces.

It will be observed from these analyses that nothing definite has been established in relation to the secretion of bile in tuberculosis. There appears, however, to be a slight diminution of fat; and, in advanced cases, free from fatty liver, the solid constituents are diminished. The secretion of bile from anæmic blood, and in general debility of the system, must, of necessity, exhibit a thin or watery condition; but, beyond these general results, nothing has been discovered in this secretion which elucidates the nature of the tuberculous process.

The *urinary secretion* admits of more ready and accurate analysis than the other secretions, and hence its more frequent examination. It has been stated that the special character of urine in phthisis is an excess of water, and consequently a low specific gravity, a small proportion of urea, and frequently a predominance of the phosphates and lithates, in the form of white sediment.* The examination by Becquerel in scrofulous cases, showed that the constituents varied with the stage of the disease. When much debility was present, the urine was of low specific gravity—1010—pale, and in a few instances contained a small proportion of albumen. But in another class, in which there was little debility, he found the secretion diminished in quantity, of higher color, greater specific gravity, acid reaction, and deposition of uric acid.†

* Ancell, Tuberculosis, etc.

† Séméotique des Urines.

Dr. Glover* examined the urine in nine cases of scrofula. The results which he obtained I have arranged in tabular form, for the purpose of exhibiting at one view the proportion of the different constituents.

	Water.	Solids.	Uric acid.	Urea.	Incin. salts.	Residual solids.	Spe. gr.	Quan.	Acid.
Case 1.	954.40	45.60	00.70	10.50	10.35	24.05	1022	44	"
" 2.	981.15	18.85	00.70	4.50	8.00	5.65	1012	63	"
" 3.	945.80	54.20	00.50	12.40	15.15	26.15	1025	27½	"
" 4.	950.50	49.50	00.70	17.00	10.70	21.10	1023	27	"
" 5.	955.40	44.60	00.22	18.00	11.40	14.98	1024.5	19¼	"
" 6.	968.00	32.00	00.55	6.90	8.00	16.55	1016	59½	"
" 7.	962.00	37.70	00.15	11.90	7.50	18.15	1019	30	"
" 8.	981.91	18.10	00.50	3.50	2.10	12.00	1010	55	"
" 9.	956.05	43.50	00.30	11.50	6.60	25.10	1020	17½	"
Mean	961.69	36.22	00.48	10.68	8.85	18.19	1019	38	

It will be remarked that the results, so far as they appear in the above table, do not exhibit any special modification, except a smaller proportion of uric acid than natural. We may safely assume, however, that Dr. Glover's analyses do not show any obvious departure from the normal state. It is true he does not give an analysis of the separate salts, which leaves a doubt as to the relative proportion of each.

Dr. J. F. Simon† remarks, that in a majority of cases of phthisis after febrile symptoms become continuous, the urine assumes the inflammatory type, has an acid reaction, the usual specific gravity, and at times rises higher. But in the early stages, he found all the constituents nearly normal. In the second stage, when considerable hemoptysis occurred, he found the urine *anæmic.*

Ancell observes that the state of the urine, as observed by himself, corresponds with, and is the measure of the low vitality of the blood and tissues. It is evident from these various statements that the secretion of urine is influenced more directly by the presence or absence of fever, and the degree of debility, than any specific condition arising from the state of tuberculosis.

* Pathology and Treatment of Scrofula. † Animal Chemistry.

The following analyses, given by Simon, were both in an advanced stage:

(1)	Water	975.95	grains.
	Solid constituents	24.05	
	Urea	9.00	
	Uric acid	1.25	
	Specific gravity	1014.7	
	Quantity	16.2	oz.

(2)	Water	935.92	grains.
	Solid constituents	64.08	
	Urea	23.90	
	Uric acid	2.40	
	Fixed salts	10.85	
	Specific gravity	1026.6	

Of the 10.85 parts of salts, 1.3 were earthy phosphates, while the sulphates formed but a small part.

Dr. Golding Bird made the following analysis in the case of a man aged twenty-four, in the early stage of phthisis, before softening:

Water	19,125	grains.
Solids	936	
Urea	328.5	
Uric acid	4.5	
Specific gravity	1020	
Quantity	45	oz.

Dr. Balman* examined the urine in thirty-two cases of *scrofula*. In these cases it presented a pale color, generally depositing a "very light, filmy sediment;" the acid reaction was slightly weaker than natural, and in two instances it was neutral. Its specific gravity was 1012. In nineteen of the cases he found crystals of the *oxalate of lime*, in ten of which they were very abundant. The specific gravity of that which contained crystals was 1020; in one instance as low as 1005. In the thirteen cases without oxalates, he found *four* with excess of *phosphates*.

It appears, from the observations of Dr. Balman, that oxalate

* Researches and Observations on Scrofulous Diseases.

of lime existed in the proportion of 38 per cent. in various affections; whereas, in the scrofulous gland cases that deposit was detected in the proportion of 74 per cent., and in phthisis 40 per cent. The next most frequent appearance of the oxalic deposits was in affections of the skin, amounting, in those diseases, to 66 per cent.

It was found, also, that the oxalate of lime and excess of phosphates rarely co-existed; and Dr. Balman is of opinion that these substances do not frequently alternate.

Finally, the only notable result from these analyses is the apparent increase of uric acid, as given by Simon, Becquerel, and Schönlein, and the large proportion of oxalate of lime, as observed by Dr. Balman. Dr. Glover's analysis, however, gives a different result in relation to uric acid.

It will be remarked that these analyses, for the most part, have been made either in an advanced stage of the disease or in scrofulous subjects, neither of which will probably represent what occurs in the earlier stages of phthisis. The observations of Becquerel, although numerous and interesting, relate to the advanced stage. He found, however, that after the disease passed the first stage, the urine often had a high specific gravity, was reduced in quantity, and of high color; all of which indicated a febrile state, and that the local disease was extending. As debility advanced, the urine became anæmic.

But little has been determined in relation to the actual state of the *cutaneous* and *mucous* secretions in the tuberculous condition. It is certainly true, however, that these secretions are often performed with undue activity, and again sink below the normal standard; indeed, the irregularity of action, which pertains to the functions so generally in this diathesis, is especially evident in the state of the skin. The watery state of the blood, and the modified condition of the capillaries, necessarily favor free cutaneous transpiration under particular circumstances, and again as readily recede to the opposite extreme. It is in this condition, also, that we witness *partial* perspiration, partaking, at times, of the condition known as *clammy*. The mucous secretions are equally variable, but our knowledge of their changes is very incomplete. It must be admitted, however, that we have

no positive knowledge of any special changes which occur in the composition of the fluids during the existence of the tuberculous diathesis.

The condition of the *adipose* secretions evidently undergoes important changes, the most obvious of which relate to the rapid fluctuations which often occur, especially in the diathetic and precursory conditions. It will often be observed that young subjects predisposed to scrofulous and tuberculous affections, rapidly lose and gain their adipose material, showing the ready absorption and deposition which take place in such constitutions. These functional changes, however, probably simply indicate a state of the system in which depression is readily induced; for, notwithstanding the belief that the fatty substances belonging to the tuberculous constitution are different from those found in healthy systems, there is, in fact, no evidence to sustain that opinion. There can be no doubt, indeed, that fat and the fatty acids sustain an intimate relationship to nutrition, in a general sense; but we are unable to determine any special fact in the relation of this substance to the tuberculous process, and hence it is merely the physiological changes to which, in this connection, our attention is directed.

The *menstrual* secretion is liable to important changes. In the advanced stages of tuberculosis it becomes suppressed, and in the earlier periods it is often irregular. And in the mere tuberculous constitution, or the incipient stages of the disease, this secretion is liable to become suppressed, and to act as an inducing cause of tubercular deposits. There can be no doubt that the menstrual secretion bears an important and intimate relationship to tuberculosis; and a knowledge of this fact is of great value to the practitioner in the treatment of the disease, and also in preventing its access. In all persons, especially young females, in the slightest degree predisposed to tuberculosis, the menstrual function should be carefully observed, and all its irregularities as speedily as possible removed.

CHAPTER VI.

DEPOSIT OF TUBERCLE.

SECTION I.

TISSUES IN WHICH THE PRIMARY DEPOSIT TAKES PLACE.

It was announced by Magendie, in 1821, and Schroeder Van der Kolk, in 1826, that the primary seat of tubercle of the lungs was the terminal portion of the air passages; and the latter, in 1852, published additional observations confirmatory of the first opinion. Magendie describes the earliest tubercular deposits as consisting of yellowish material located in the air-cells; at times it appeared limited to a few of the cells, but usually occupied an entire lobule. This tubercular matter appeared to be secreted by the pulmonary capillaries, and was generally adherent to the vessels, but was sometimes movable. He never observed the gray granules preceding the true yellow tubercle.*

It is the opinion of Schroeder Van der Kolk, that the tubercular matter is imbibed by the epithelial cells, which enlarge, are finally cast off, and rupture, and thus give rise to the smaller or true *tubercle-cell*. This process Van der Kolk regards as analogous to *hepatization* of the lungs; but as he considers tubercle to be of inflammatory origin, the analogy which he seeks to establish must be considered purely hypothetical. Henlé, Virchow, Addison, Sieveking, Radclyffe Hall, and others, entertain views essentially similar to those of Shroeder Van der Kolk, at least so far as relates to the location of tubercle in the epithe-

* Journal de Physiologie, 1821.

lial cells. It is well known, also, that Dr. Carswell held the opinion, that the mucous tissue was the seat of tubercle, which he demonstrated with great care and ability. Mr. Gulliver observed tubercular matter occupying the interior of the air vesicles, but at the same time also the inter-vesicular areolar tissue. According to Mr. Rainy's observations, tuberculous matter is secreted into the air-cells and inter-cellular passages; and in either case the deposits compress the adjacent vessels, the parietes of which disappear.

Rokitansky divides tubercles into two classes—interstitial tubercular granulations, and tubercular infiltration. The interstitial granulations are seated in the "interstitial cellular tissue, between the lobules and air-cells, and on the walls of the air-cells themselves;" and may form a prominence on the internal surface of the air-vesicle by pushing the membrane before it. These granulations, therefore, do not occupy the interior of the vesicles. The infiltrated tubercle, on the contrary, is deposited *within* the air-vesicles, as a result of "croupous pneumonia," the deposit being changed, under the influence of the tubercular dyscrasia, into yellow tubercle. Like Van der Kolk, he regards the process as analogous to *hepatization*. According to Andral,* the primary deposit of tubercle may be observed in the form of whitish points on the surface of lobules, or within their substance, which sometimes multiply and become united, occupying entire lobes in the form of large masses. In other examples, the inter-lobular cellular tissue becomes the seat of a reddish infiltration, in which tubercles appear in the form of isolated white points. Hence Andral concludes that tuberculous matter is secreted indifferently in the terminal bronchial tubes, the air-cells, and the inter-vesicular and inter-lobular areolar tissue—being equally seated in the mucous and areolar tissues. In addition to this, Andral has clearly described the existence of tubercles in the lymphatic vessels of the lungs, the groin, and in the thoracic duct. Lebert is of opinion that tubercle is most commonly deposited in the areolar tissue, but that it is also observed in the air-vesicles and capillary bronchial tubes.

* Medical Clinic.

The most obvious conclusion which can be drawn from the numerous experiments and observations on this subject, is, that tubercular exudation, like that process in general, tends to a free surface; and hence the morbid deposit will appear in the air-cells, and on the surface of serous membranes surrounding viscera. There is but little tendency, however, to tuberculization of the skin, although it has been observed. But it is equally true that parenchymatous structures of viscera, such as the liver and brain, become the seat of tubercles; and there is no sufficient reason why the same result may not occur in the lungs. Indeed, all vascular tissues may become the seat of tubercular deposits, although they manifest a preference for particular organs and structures. The change observed in the epithelial cells is probably due to an altered nutrition of the part following the exudation; and hence no specific agency is exercised by those bodies in the formation of tubercle. It is true, the tuberculous material may be attracted by and deposited in the epithelia; but it is not an act of elaboration in that structure, but is rather an accidental deposit.

SECTION II.

MODE OF DEPOSIT OF TUBERCLE.

The deposit of tubercle being essentially an exudation from the capillary vessels, the only important question relates to the degree of action with which it is associated; whether, in other words, the process is analogous to simple secretion, or whether it is associated with congestion or inflammation.

Vogel describes the tissues surrounding tubercular deposits as being in a natural condition; they are neither altered nor displaced, but the deposits seem merely to fill the interstices, without modifying the adjacent textures. A still more minute description has been given by Mr. Rainy, who states that the capillaries are comparatively healthy, which is strongly contrasted with the irregular condition, dilated and tortuous course,

pursued by the same vessels when proceeding to fibrinous or inflammatory deposits. According to this view, there is no evident increase of action (inflammatory or congestive) in the capillaries, giving rise to tubercular effusion; nor does obstruction in the vessels occur until the accumulation increases so as to produce mechanical compression.

Schroeder Van der Kolk is of opinion that a plastic material is exuded into the air-vesicles, and that it is absorbed by the epithelial cells, which enlarge and are cast off from the membrane, and thus constitute the tubercular substance. The process by which epithelial cells are transformed into tubercles is regarded as analogous to glandular secretion, which, however, he considers similar to the process of *hepatization*. It is evident, from the whole tenor of Schroeder Van der Kolk's description, that he regards the process of tuberculization as analogous to inflammation. When the tubercular masses enlarge, they compress the vessels of the air-vesicles, the local exudation ceases, and, in consequence of the loss of fluids, the mass acquires additional firmness, which renders it stationary until softening supervenes.

Nearly similar views have been expressed by Virchow. According to this observer, the epithelial cells enlarge by endogenous formation, and finally break up into a granular detritus, in which shriveled and irregular tubercle-cells, as described by Lebert, are formed. This process, according to Virchow, is effected through a disturbance of the nutrition of the part, constituting an altered exudation, either inflammatory or an analogous affection. It will be remarked that both Virchow and Schroeder Van der Kolk regard the formation of tubercle as a process of exudation, in some sense analogous to inflammation, although they do not give it that name, but rather refer it to the class of secretions. But the idea embraces a morbid exudation, through the agency of which the epithelial cells undergo tuberculization.

Dr. Sieveking goes a step beyond Virchow and Scroeder Van der Kolk. He asserts, as the result of his own observations, that the local and molecular changes in the vascular system, connected with the formation of tubercle, are characteristic

of inflammatory action, as shown by the enlargement of vessels and the presence of exudation-cells. It is declared by Dr. Sieveking, that he has observed, in all stages of the local deposit, the air-vesicles filled with tubercle, surrounded or invested with exudation-corpuscles. He distinguishes, however, between this inflammatory process and the true tubercular exudation; one is merely the accompanying phenomenon and incidental change, while the other is the essential morbid product. He does not regard tubercle as a growth, nor is it identical with the effusions of blood-constituents resulting from exalted action; and, on the other hand, the epithelial cells form no part of the new product.*

Andral, at one period, expressed the opinion that an active sanguineous congestion preceded tubercular deposits; but in a subsequent note he adds, that he no longer regards hyperæmia as a necessary part of the morbid action. On the contrary, he considers the whole process a mere perversion of secretion, which may be connected with local irritation or it may be independent of any such change in the vessels.†

In reviewing all the facts which have been developed in this connection, it seems to me sufficiently evident that the process of tubercular exudation, or formation, bears no direct relationship to inflammation. Nor is the evidence sufficient to prove, notwithstanding the high authority of Virchow and Schroeder Van der Kolk, that the process consists of a transformation of the epithelial cells into tubercle, or that they are in any sense connected with the formation of that substance. In relation to the analogy existing between inflammation and the tuberculizing process, the microscopic and chemical constitution of tubercle afford abundant evidence that it is not the product of a high grade of action, or, in other words, that it is not of inflammatory origin. For, notwithstanding the declaration of Dr. Sieveking, that he observed exudation-corpuscles to be present, they do not enter into the composition of tubercles, and, therefore, must be regarded as purely accidental. Indeed, making

* British and Foreign Med. Ch. Rev., April, 1853.

† Med. Clinic.

all due allowances for the constitutional influence, it must still be admitted that if inflammation were truly present, as the basis of the process, there would necessarily occur more definite signs of the existence of that morbid state than the presence of a few bodies bearing the form of exudation-corpuscles.

The only conclusion, it seems to me, which can be deduced from the known facts is, that the exudation is a *specific* act, and the product a compound *sui generis;* and hence, that it is neither the legitimate result of inflammation nor congestion, and that it is not necessarily accompanied by either of these elementary lesions of circulation. The mode of deposit, therefore, in its elementary character, bears a closer relationship to glandular secretion than to any other known action; but the whole process, as well as the resulting deposit, I regard as essentially specific, and, therefore, unlike all other actions and products.

SECTION III.

RELATION OF THE BLOOD-VESSELS TO TUBERCULAR DEPOSITS.

It appears to be a fair inference that the tubercular material is secreted from the capillaries of the pulmonary artery. The relation of these vessels to the air-cells, and the chief deposits occurring in those structures, favors the belief that the pulmonary vessels furnish the morbid material; and if this supposition be true, it disproves the opinion that tubercle is simply a lesion of nutrition, for the nutritive function belongs essentially to the bronchial arteries. The function of the pulmonary artery is to convey venous blood to the air-vesicles; and as this variety of blood is not destined to perform nutritive acts, it becomes impossible to connect the physiological textural changes with the capillaries belonging to this system of vessels. And hence, the deposits of tubercular matter must be regarded as a new act, and not a perversion of an ordinary function. We are not authorized to conclude, however, that the capillary vessels of the bronchial arteries are incapable of depositing tubercular

material; for the fact, that the morbid deposits are met with in the bronchial glands, which are supplied with blood by these vessels, is conclusive that these arteries may furnish the material. It seems sufficiently evident, however, that the great mass of the morbid material is received through the medium of the venous blood, and is thus eliminated by the pulmonic capillaries.

The ultimate relation, however, of the blood-vessels of the lungs, pulmonary and bronchial, to the different stages of tubercular deposit and transformations, has not been clearly demonstrated, although certain facts have been made known which throw some light on the subject. It has been demonstrated by Dr. Stark, Schroeder Van der Kolk, and others, that blood-vessels, in the vicinity of tubercular masses, become obliterated, not only by compression, but also by coagulated substances internally, and that this occurs not alone in capillaries, but likewise in vessels of considerable size. And it is remarked by Hasse, that when the pulmonary vessels become obliterated they are replaced by others from the general or aortic system, which is effected by enlargement and new connections of the bronchial arteries. In this manner the intercostal and mammary arteries, by the formation of new branches, establish connections with the obstructed lung. When this communication is formed, the injections thrown into the pulmonary artery pass into the intercostals, and the pulmonary artery can be injected from the aorta, so that blood may be returned to the heart by the intercostal and pulmonary veins. These views are based largely on the observations of Schroeder Van der Kolk; but Hasse expresses the opinion that these anastomoses are not constant, and the systems of vessels generally remain distinct.

According to the observations of M. Guillot, the new vessels are at first independent, but finally anastomose with the systemic circulation, and contain bright or arterialized blood. According to this observer, the adventitious vessels are arranged as a network around the tubercular deposits, which are primarily independent, (like the formation of vessels in the embryo,) but finally anastomose with branches of the bronchial arteries. When, how-

ever, adhesions have taken place or cavities formed, the newly-developed vessels communicate with the mammary and intercostal arteries. According to this view, the adventitious vessels can not supply the place of the obstructed pulmonary capillaries, and, therefore, do not contribute to the decarbonization of the blood. The same observer believes, also, that tubercles soften more rapidly when the new vessels are numerous; and as these vessels multiply proportionally to the extent of softening and obstruction, they ultimately supply the principal circulation of a considerable portion of the pulmonary organ. Hence, M. Guillot observes, the arterial circulation becomes increased as the deposits are more extensive and the obstacle greater. The capacity for arterial blood increases, while the venous proportionally diminishes.

These considerations (if they ultimately prove correct) present an important view of the process of tuberculization. It would be out of place here to anticipate a discussion of the nature of tuberculosis, (which belongs to a future chapter;) but it is desirable barely to allude to the curious fact just mentioned. If the observations of Guillot are not erroneous, the arterial system of vessels ultimately largely predominates, which would harmonize with the destructive deposits progressively increasing, and the inflammatory action which so constantly takes place. But the question at once arises, how can the adventitious arterial capillaries supply the place, or perform the function of the true pulmonic vessels? It is difficult to conceive how the newly-formed vessels can be so arranged as to supply the function of those obliterated capillaries which belonged to the pulmonary artery. Still it does appear that, by some process, arterialization of the blood goes on *perfectly*, even in the most extreme cases; which is evinced by the florid countenance of the patient, even when the lungs have become extensively solidified. There is something very peculiar in these cases. Patients, even far advanced in phthisis, with extensive cavities in both lungs, and large consolidations, with a pulse of one hundred and twenty, and forty respirations to the minute, with constant dyspnœa and exceedingly deficient expansion of the chest, will, nevertheless, exhibit florid cheeks and lips, and the

whole aspect will indicate perfect (even *hyper*) arterialization of the blood. It will not be a sufficient explanation to say, that the frequency of respiratory movements or the diminished quantity of blood compensate for the degree of obstruction; for the increase is only one-fourth in favor of respiration, (thirty respirations being the physiological ratio of a pulse of one hundred and twenty,) while the pulmonary obstruction and the defective expansion would certainly reduce the capacity of the lungs much more than this *one-fourth* excess of respirations would supply. Hence it appears, that the arterialization is even more perfect than in health, notwithstanding the large obstruction and obliteration of the pulmonary capillaries. Let me suggest, then, without attempting more, does not this condition indicate an increased capacity of the lungs for oxygen? It appears to me a fair induction, that a largely-augmented affinity exists between the lungs and the oxygen of the air, by which the latter produces an unusual and even morbid effect. It is certainly true that the same amount of obstruction resulting from ordinary pneumonic consolidation is attended by signs of highly carbonized blood.

And it may be further remarked, that, independent of the formation of new vessels, the oxygen may, from the morbid condition of the parts, attain an increased affinity for the blood, so that arterialization takes place in a rapid manner. Indeed, this hypothesis seems necessary to account for the phenomena, whether adventitious vessels be formed or not; for in either case there is evident pulmonic obstruction, which, under ordinary circumstances, always interferes with the complete oxygenization of the blood.

SECTION IV.

MODE OF ENLARGEMENT OF TUBERCLES.

The various views which have been entertained respecting the nature and structure of tubercles, have become the basis of different theories in regard to their growth or increase of

size. Some consider tubercle as absolutely dead matter, and therefore incapable of growth by intussusception, such as characterizes living or organic bodies; while others believe that these morbid products possess a low grade of vitality, and that their increase may be regulated by the laws which govern vital actions. It seems evident, however, that the only mode of growth which can be admitted is one of a modified character, such as belongs to organic bodies whose vital actions have suffered a certain degree of degradation. The microscopic constitution of tubercle clearly shows that it possesses some degree of vitality; and all the phenomena connected with its natural history tend to confirm this opinion. It necessarily follows, therefore, that the mode of growth of a body having even a low grade of vitality, but a definite cell-organization, must necessarily differ, to some extent, from that which prevails in mere minerals. The cells and granules which make up the microscopic composition of tubercle doubtless possess two properties essential to organic bodies, namely, endosmosis and assimilation; and by virtue of these powers, the primary tuberculous particle is capable of attracting to itself analogous bodies, and these, in turn, attract others, until the growth is completed.

The size of the largest tubercle-cells are of such dimensions as to forbid the idea that, as such, they pass through the vascular parietes; and, as a necessary consequence, their growth must be extra-vascular. In accordance with well-defined histological laws, the tubercle-granules are the *cytoblasts* around which the ultimate *cell* becomes developed; and it is evident that the granules must constitute the primary condition, and that the cell-formation is the completion of the epigenesis. So far as facts or principles can throw any light on this subject, we have no ground to assume that the formation of tubercle differs, in any essential manner, from the development of other low-grade tissues, except it is in regard to the character of the blastema which becomes its pabulum; nor is there any more reason to doubt that its subsequent enlargement is regulated by the ordinary laws of vitality, and therefore a distinct *growth*, modified by the character of the materials and the state of the

prevailing diathesis. But, in drawing these conclusions, I wish to observe, that it does not necessarily follow that tubercle is similar to any other product, or that it does not differ from all others in its nature and tendencies.

After the exudation of the tuberculous *blastema*, the production of granules, or *cytoblasts*, constitutes the initial step in the formation of tubercles, and the second is the growth of cell-membrane around the granules; and thus the process goes on, granule upon granule being deposited, and cell after cell formed, until the ultimate development is attained. Thus, although the extension or aggregation of masses is due to external or peripheral deposit, yet the process is by no means similar to that of mere accretion, which belongs to inorganic bodies; for, in tubercle, there is a continuous cell-growth, and not mere aggregation of previously-formed particles, and which, by the usual laws of analogous formations, exhibits indubitable evidences of vital action. Nor is this cell-action limited to mere extension, for it evidently continues to operate, by absorbing nutritive material, which sustains the mass for a limited period, until finally, its vitality being exhausted, disintegration results.

According to this view, tubercles are, in fact, organic bodies; but, in making this statement, it must be connected with the fact that their vitality is of a grade so low that vessels can not form in the new structures. They are, therefore, organic, but non-vascular bodies.

This view of the mode of enlargement of tubercle necessarily rejects the theory that they consist of metamorphosed epithelia, or any form of retrograde morphology. These theories, although supported by high authority and numerous experiments, are, nevertheless, partly conjectural; and they are so contrary to any well-known pathological epigenesis, that they must fail to receive general sanction. We might, indeed, admit most that has been actually observed on this subject, and still reject the theory as a whole; for the fact that the epithelia are thrown off, and appear mingled with the tubercular formation, proves only that the morbid action has disturbed this part of the structure, and caused the destruction of the cells. And admit-

ting, further, that tuberculous matter may be found in the epithelia, it would still be far from proving that it is formed by these cells.

SECTION V.

RELATIONSHIP OF GRAY AND YELLOW TUBERCLE.

Different views are entertained by pathologists in regard to the relationship which exists between the gray and yellow varieties of tubercle. Some regard them as simply different stages of the same deposit, the gray being the nascent phase of the yellow; others believe they constitute entirely distinct species; while a third opinion denies to the gray variety a position among tubercular deposits. Laennec, it is well known, regarded the gray semi-transparent granules as the *first stage* of tubercle, and that they were ultimately developed into the yellow or crude variety. Similar opinions are held by Louis, Walshe, and many others. Rokitansky formerly held that these varieties were entirely dissimilar; but he appears to have changed his views, and now regards the gray as being transformed into the yellow. Vogel admits the occasional transformation of gray into yellow tubercle, but states that the latter may occur independent of the former. Hasse, on the contrary, considers the gray bodies as the result of inflammatory action *around* tubercular softened masses; but as he declares that they occur only in the advanced stage of tuberculosis, *after* softening, it is clear he had in view something different from what we are now considering. M. Bayle, who originally described these gray granulations, evidently regarded them as different from ordinary or yellow tubercles. Andral considers these granules as indurated or hypertrophied air-cells, the result of inflammation, and therefore not true tubercles.

Dr. Campbell adopts the opinion that gray granulations are different from yellow tubercle, and, among other evidences, adduces the effects of chemical reagents on the two varieties. Thus, yellow tubercles are readily dissolved by pure liquor

potassa, forming a clear, saponaceous solution; but the same agent fails to dissolve granulations, producing only a slight degree of softening and enlargement. Dr. Blakiston has shown, by numerous cases, that granulations arise from inflammation; and Mr. Ancell makes the same admission, presuming, however, that the deposits arise from tuberculous blood; but he adds that they may occur without inflammation. Dr. Williams denominates gray tubercles *cacoplastic* deposits, and compares them to the effusions which occur in chronic or subacute arachnitis, peritonitis, and pleuritis; while yellow tubercle he regards as entirely *aplastic* in its constitution.

My own observations, based on the general and local symptoms, and post-mortem examinations, have resulted in the conviction that gray semi-transparent granules are inflammatory products, and, therefore, different from yellow tubercle.

Thus, I have never witnessed these granules except in association with evidences of inflammatory action, more or less intense. A number of examples confirming this opinion have come under my immediate observation, in which the diagnosis was made during life, and the pathology confirmed by examinations after death. It would be out of place to enter here fully into the history of these cases; but I may observe that they were associated with decided evidences of inflammatory action during life, such as chills and fever, together with cough, and more or less increase in the respiratory movements. After death, the granules were found scattered throughout the pulmonary tissue, occupying equally the lower portion of the lungs. In addition to this, the general pulmonary structures gave evident marks of increased vascularity, which was further confirmatory evidence of the inflammatory nature of the deposits.

In these examples we have evidences of inflammation furnished by the symptoms during life, appearances after death, and the anatomical seat of the deposits. In relation to the last point, it is a well-known law of tubercular deposits, that they begin nearly always at the apex and extend downward; while in these inflammatory granulations the lower portion of the lungs becomes often more completely studded than the apices. In addition to this, it is well known that exactly similar granules

are deposited in other parts, as the effect of unequivocal inflammation. This is witnessed in tubercular meningitis of the brain pleura and peritoneum. These examples furnish indubitable evidences that such granules arise from inflammatory action.

Even Louis admits that there is a substance greatly resembling the gray, but less firm, which is never transformed into yellow tubercle; and he further says that the gray matter of the upper lobes appears to be the product of chronic inflammation.

It is freely admitted that the grade of action which produces gray granulations is often very low, but, nevertheless, is made up of vascular irritation; while, in its higher grade of action, a distinct febrile disease is developed, which has been described by some writers under the name of *acute phthisis*.

It is, doubtless, true that all these products bear a certain relationship to each other, in their essential characters, although they may differ in their causes and terminations. Thus, active inflammation occurring in a subject free from diathetic taint, will give rise to organizable lymph; but the same morbid action, either differing in degree (subacute) or occurring in a depraved constitution, will give rise to a lower grade of plastic deposits, such as the semi-transparent granules; while the mere act of secretion, independent of inflammation, is capable of causing yellow tubercular deposits when the diathesis becomes fully developed.

In the examples, then, of granulations, the products are *below* the degree of vitality which characterizes fully organizable lymph, but *above* that of common tubercles; the result, therefore, is, that while they are not capable of becoming vascular or fully organized, they possess a sufficient degree of vitality, at least in many examples, to resist decomposition.

The tendency of the granules is certainly not to speedy disintegration. It is true, however, according to my observations, that some examples do advance to softening. I have watched the course of cases in which the early symptoms indicated ordinary granular inflammation, but finally signs of softening were superadded. In such cases the post-mortem examinations have revealed tuberculous masses, varying in size from a pea to that

of an almond, softened in the center, and sometimes forming small cavities; but they differed from ordinary tubercular deposits by being scattered throughout the lungs, occupying equally the lower portions.

The history and terminations of these cases have induced me to believe, that when the vitality is continuously lowered, and the semi-plastic product increased, it may finally pass into softening, presenting the ordinary characters of crude tubercles.

CHAPTER VII.

CHANGES WHICH OCCUR IN TUBERCULAR DEPOSITS.

THE natural tendency of crude tubercles is to softening and elimination; while the gray variety may undergo slight contraction and remain stationary. The possible condition of both varieties, as a primary or secondary action, is absorption. The following divisions, therefore, deserve attention:

1. Absorption prior to consolidation.
2. Absorption after softening.
3. Contraction, or a stationary condition.
4. Softening with elimination.
5. Cretaceous transformation.

SECTION I.

ABSORPTION PRIOR TO CONSOLIDATION.

Tubercle being deposited in a fluid state, absorption must be regarded as a possible event. It is true we have no demonstrative evidence of that result, nor will it, in the nature of things, admit of such elucidation; but there are certain analogical and clinical considerations which favor the supposition that, at least, tubercular *blastema* may be absorbed instead of becoming consolidated. In the broadest view of the subject, it is a fair inference that a substance which is susceptible of transmission through the walls of one set of capillaries, may return to the circulation through another class. We have no

conclusive evidence that tuberculous blastema becomes immediately concrete; and if the material remains fluid for even a limited period, it would but obey the ordinary laws of the animal economy to re-enter the circulation by endosmotic action. Nor is it beyond the limits of possibility that such a process may be carried on for a considerable time, and thus delay or entirely prevent the accumulation of the morbid material. When the tuberculous predisposition is not very intense, or if favorable influences are brought to act on the patient, there is no sufficient reason why tuberculous exudation, like the inflammatory, may not be absorbed.

The clinical evidences of absorption deserve special attention. It can not have escaped the observation of those much engaged in the treatment of phthisis, that the precursory stage of the disease may be well marked, embracing emaciation, cough, febricula, hemorrhage, and even certain physical signs, and yet the disease, instead of advancing, may be made to recede, with ultimate suspension of all the morbid phenomena. It is difficult to conceive that all these signs and symptoms can exist without some degree of exudation; and if we advance beyond this, the existence of some form of crackling, will clearly evince the occurrence of local disease. The so-called dry crackling, pulmonary crumpling, and cogged-wheel sounds, represent deposits in an early stage; but it is undetermined how far they may indicate a state of fluidity. It will be remembered, however, that these signs are often evanescent; that is, in an early stage of development, they are heard with one inspiration, and disappear the next. It is difficult to conceive how these fluctuations could occur if the sign depended entirely on solid tubercles; but if we admit the presence of a liquid, the explanation becomes easy and natural. Again, I have often heard a sound precisely like the forcible expansion of air-cells, or pulmonary tissues amid an adhesive fluid—a sound softer than a crepitus and less defined than dry crackling—and which conveyed precisely the idea of expansion occurring amid an adhesive exudation. And while I would not attach undue importance to an observation of this character, still, taken in connection with the other phenomena, and having observed it very

often, I can not avoid regarding it as indicative of tuberculous exudation.

If, then, any of these signs and symptoms warrant the conclusion that they arise from fluid tuberculous material, the additional fact that they may be made to disappear completely and permanently, is evidence sufficiently conclusive that absorption may take place. It can not be doubted, indeed, that all these evidences of disease, including even dry crackling, disappear; and it is far more probable that absorption would take place while the blastema remains fluid, than that, after consolidation, liquefaction would be followed by removal of the substance. It is not denied, however, that, under some circumstances, this latter process may occur; but at the same time, it must be regarded as a much less probable event.

SECTION II.

ABSORPTION AFTER SOFTENING.

A majority of pathologists have denied or doubted the possibility of the absorption of softened tubercular matter; but there is sufficient evidence that such results do, at least occasionally, occur. Hasse remarks that cicatrized cavities being free from tubercles in their vicinity, indicate that the deposits have been absorbed and not expectorated. Andral, Walshe, Carswell, and Ancell, regard the absorption of crude tubercles as a possible event. Andral gives examples in which cartilaginous or fibrous deposits, not unlike those found in obliterated cavities, were met with; but as the bronchial tubes could not be traced to them, he supposed they were not the remains of tubercular cavities, but probably the result of inflammation. It is a fair question, however, whether these masses, at least in some of the cases, were not in fact the remnants of tubercular cavities; and this opinion is rendered the more probable by the presence of tubercles, in some of the examples, in other portions of the pulmonary tissue. And if these deposits occupied

former tubercular caverns, it follows that the softened material had been absorbed and not eliminated, for there were no connecting tubes through which it could have escaped.

There is sufficient evidence, however, that some degree of absorption does take place in those examples in which cretaceous matter remains. Here, it is evident, the animal matter constituting the true tubercular material was absorbed, leaving a partial cavity more or less filled with earthy substance. In many of these cases the openings into the bronchial tubes are closed, which forbids the idea that the tubercular matter was entirely eliminated; while in others there is no evidence of bronchial openings ever having taken place, so that absorption was the only mode by which the tubercles disappeared. Hasse is of opinion that in these cases the tubercular mass is surrounded by a thin isolating crust of organizable lymph, and when it comes in contact with the newly-formed vessels, absorption of the organic portion takes place.* The same author is of opinion that a majority of these concretions originate in small and closed cavities. Indeed, it seems quite certain that a *closed* cavity is requisite to produce cretaceous matter; for so long as they remain in free communication with the bronchial tubes, no accumulation, of any character, can take place. Calcareous masses, therefore, can be deposited only when the tubes have been closed, or when absorption takes place without bronchial communications. A fact which would seem conclusive on this subject is, that calcareous transformation of tubercle is met with in other organs, so that absorption necessarily took place. Thus, Rokitansky states that tuberculous chalky concretions, invested by a fibrous sac, are met with in the kidneys.

It might be further argued that tuberculous matter is absorbed in certain cases of scrofulous swellings. In some of these examples, resolution and complete disappearance of the swelling takes place, especially under the influence of iodine; and, as there is little doubt that some of these swellings contain tuberculous matter, we have additional evidence of the powers of

* Path. Anat., Am. Ed., p. 321.

the vessels to absorb such material. It seems scarcely necessary, however, to pursue this line of argument further. There is no physiological reason why fluid tubercular matter may not, under favorable circumstances, be absorbed; nor is there any insuperable objection to the idea that liquefaction and absorption may take place, when the mass is in connection with blood-vessels, in precisely the same manner that any other adventitious deposit is removed. In other words, the removal of softened tubercle does not necessarily imply an ulcerative process, but, on the contrary, simply physiological absorption, without destruction of the surrounding tissues.

But while it is admitted that absorption may thus take place, the occurrence of an ulcerative action, with inflammation and exudation in the surrounding tissues, will often entirely prevent that result. Indeed, the obliteration of the blood-vessels, as shown by Stark, Guillot, and most other observers, prevents direct contact with a vascular tissue, and, therefore, absorption becomes an impossibility. The only method, therefore, by which the adventitious material can escape is by opening into the bronchial tubes, and elimination by expectoration.

SECTION III.

CONTRACTION, OR STATIONARY CONDITION.

Pathological anatomists describe a certain degree of contraction in some forms of tubercle, which renders the mass stationary in its condition. It is evident, however, that these descriptions apply exclusively to the *gray* variety, which, by a process of retrogression, is reduced to a semi-cartilaginous condition. There is nothing to prove, however, that yellow or crude tubercle undergoes this change; indeed, the only transformation known to take place in the latter variety is that of liquefaction; for the histological elements being of a class insusceptible of any advance in the scale of vitality, the slightest retrograde movement invariably terminates in disintegration.

If, therefore, we exclude the gray variety from the class of true tubercle, there is no form remaining which is capable of contraction or assuming a permanently stationary condition. Doubtless in some forms of even yellow tubercle, where the masses are small and scattered, their integrity may be maintained, under favorable circumstances, for a considerable period; but this can not be regarded as more than a temporary state, liable to be interrupted by adverse circumstances, or even the lapse of time.

SECTION IV.

SOFTENING AND ELIMINATION.

The destructive tendency of tubercle, in fully developed cases, is shown by the process of softening, and the disorganizing effects on surrounding tissues. The exact nature of the process of softening is still unsettled, though all agree that the mass becomes dead animal matter. Laennec believed the softening commenced in the center of the tubercular mass; and the same view has more recently been maintained by Rokitansky and others. In opposition to this opinion, Lombard, Hope, Andral, Carswell and others teach, that the process of destruction commences externally. Those who suppose the act of softening begins in the center of tubercles, ascribe it to a natural tendency to disintegration, in consequence of its low grade of vitality; while others attribute the external change to the influences of pus and serum, which result from inflammation set up around the deposit. Dr. Carswell attributes the *apparent* central softening to the opening of bronchial tubes, the deposit having taken place on their inner surface, and leaving a central canal. Vogel* describes softening as commencing in the *amorphous stroma*, which liquefies, the elementary granules then separate, the cells and cytoblasts are liberated, break up, and form a sort of emulsion with the fluids.

* Path. Anat.

A little attention to the histological elements and essential character of tubercle, will enable us to form correct views on this subject. It will be borne in mind that tubercles are made up of more or less imperfect cells, which are capable of exercising, for a brief period and to a limited extent, the functions of nutrition and self-preservation; but, inasmuch as this cell action is of an imperfect character, the vitality of the tubercular formation sinks still lower, and the cell action becomes mere imbibition, with a destructive rather than nutritive tendency. The consequence is, the cells become distended, the whole mass is rendered more friable, granular, and fatty, until finally the changes cause complete disintegration.

Now, it is evident this process pervades, more or less, the *whole mass;* but in its nascent state will be more prominent at some points than others; perhaps more commonly in the center. In the language of Rokitansky, the softening consists in the solution and disintegration of the solid ground-work of the tubercle; and he might have added, it completes the death or destruction of the deposit. The elements undergo progressive changes; the cells at first enlarge, but finally burst, liquefy, and disappear; the granules contract, and the whole mass is destitute of the slightest remains of vitality.

The agency of peripheral inflammation in the production of this softening is exceedingly problematical. During the deposition of tubercle the blood-vessels do not necessarily, nor commonly take on any action beyond that of moderate hyperæmia; and there is no evidence that inflammation takes place around the mass, except as a sequence of the softening, or as an occasional complication. There may be examples in which the tubercle acts as a foreign body, causing excitement and inflammation, especially when the parts are preternaturally sensitive; but this is not the ordinary course, and it is far more probable that when inflammatory action arises independent of and anterior to softening, it depends on idiopathic causes, such as exposure, or any of the ordinary conditions capable of increasing or originating pulmonic inflammation. When, however, inflammation does arise, it necessarily speedily destroys the vitality of tubercle by cutting off its connection with a healthy

tissue; and the products of inflammation, pus and serum, tend, as a general rule, to hasten the solution of the tubercular mass.

While we admit, therefore, that tubercle occasionally softens externally, as the result of inflammation, we regard that process as altogether accidental, and consequently its true or legitimate disintegration must be ascribed to the action of its own component elements, which, by virtue of their low organization and limited duration, tend to speedy destruction *per se*. The immediate contact of tubercle-cells with a vascular tissue serves to perpetuate their existence, as well as increase, so long as those tissues remain normal; and, for the same reason, the central portions, being farthest removed from the vascular influence, will be the first to feel the effects of age, and hence softening begins in the midst of the mass.

The softening of tubercles is a destructive act which, as suggested by Mandl, sustains a close relationship to *fatty degeneration*. There is an evident increase of oil globules, proportioned to the degree of softening, which clearly suggests the idea of a degenerative process of the fatty nature. Dr. C. Radclyffe Hall has observed the fatty transformation in connection with the epithelial cells and the adjacent blood-vessels. Rokitansky and Virchow have made similar observations bearing on this subject, showing the increase of fat during the process of tubercular softening.

The same process of *softening* affects the adjacent pulmonary tissues, by which an excavation is formed, and the bronchial tubes opened. As the tubercular deposits take place within the capillary bronchi, the process of softening extends through the whole structure, and, by ulcerative action, the tubes are opened and the pulmonary substance more or less destroyed. This destructive action is often associated with a low grade of inflammation, and a deposition of degraded lymph; and hence the tubercular matter and imperfectly developed fibrin simultaneously soften, and each contribute to the destructive process by which cavities are formed. It is, in fact, a process of *tuberculous inflammatory softening*.

SECTION V.

CRETACEOUS TRANSFORMATION.

The cretaceous transformation is essentially a curative process; but examples have frequently come under my observation, in which the disease ultimately proved fatal, notwithstanding the extensive formation of cretaceous substance. I have known patients expectorate cretaceous tubercles without any amelioration of the symptoms, the disease maintaining its inveteracy to a fatal termination. But in a majority of cases in which the evidences of cure are found post mortem, the tubercles have undergone the cretaceous transformation. And the fact that patients die while expectorating earthy masses does not invalidate the general idea that the process is one of cure. Thus certain tubercular masses may be undergoing a curative cretaceous transformation, while other and more extensive portions of the lungs are subjected to simple softening, and hence the disease ultimately proves fatal. This view explains the fact that patients who die of tubercular disease of the lungs, often exhibit portions healed or rendered inactive by the cretaceous change.

The chemical analysis of cretaceous tubercle shows that the animal matter becomes absorbed, while the earthy or inorganic materials remain. The relative proportion of the organic and inorganic substances in the two forms of tubercle becomes exactly reversed when the cretaceous change occurs; which is doubtless due to the absorption of the organic, while the vessels are incapable of taking up the inorganic. Pathologists speak of this change as absorption of the organic elements while the deposition of the inorganic continues, and thus replaces the former substance. According to this view, the earthy material is an independent secretion, continuing after the deposit of the ordinary tubercular matter has ceased. It is far more probable, however, that the whole mass is deposited in the usual form and composition of tubercle, and that the ulterior changes result from the absorption of the fluid ele-

ments, while the earthy substance, being incapable of re-entering the vessels, remains in the cavity.

According to Hasse, the calcareous transformation is often preceded by an inflammatory effusion, which takes place in the adjacent pulmonary cells, the texture finally shrivels, and ultimately the tubercular mass is surrounded by a thin crust, the vessels of which absorb the fluid portions, and leave the earthy concretion. Rokitansky entertains a somewhat similar view; and he observes that the concretion is seated either in obliterated pulmonary tissue or a fibro-cellular capsule. It can hardly be presumed, however, that inflammatory action is essential to this form of tubercular transformation; on the contrary, the surrounding capsule probably results from an effort at repair, consequent upon the improvement in the function of nutrition.

The process of absorption takes place very gradually, the mass becoming progressively more dense, and finally reaching even stony hardness. Masses are often ejected during fits of coughing, which possess the hardness and density of the most compact bone. These bodies are frequently as large as a pea, and exhibit various angular projections.

It has been denied by Rayer, (and doubtless justly,) that the cretaceous deposits are always the result of softened tubercles, but that they are often the remains of small deposits of pus. The observations apply to both man and animals; but it is probable that when the mass is situated near the apex of the lungs, it generally represents one phase of tubercle. The history of individual cases, when attainable, will often determine the question. It should be remembered, also, that concretions occur in the follicles of the tonsils, which may be mistaken for those of pulmonary origin.

CHAPTER VIII.

CHANGES CONSEQUENT UPON SOFTENING AND ELIMINATION OF TUBERCLES.

The changes which occur in connection with the softening of tubercles are numerous and important, exhibiting the destructive tendency of the disease, and the comparatively feeble powers of the *vis medicatrix naturæ*. We no longer witness the simple exudation which marked the beginning of the deposit, but a new and destructive action is set up, altogether different from that which existed in the primary stage.

SECTION I.

CHANGES IN THE PULMONARY TISSUE.

When a small tubercular mass softens, the cavity or softened structure is of oval form, (the size corresponding with the mass itself,) and contains merely the debris of the tubercle, without bronchial communication. Very speedily, however, a new and different action occurs in the surrounding tissue; a soft membraniform substance lines the cavity, and the pulmonary substance becomes dense, softened, and usually of a grayish color; while the air-cells, terminal bronchial tubes, and blood-vessels suffer progressive obstruction. The morbid action obliterates, more or less extensively, the small blood-vessels of the part, but their coats are not destroyed. The bronchial tubes, however, become involved in the destructive process, and thus

communications between the tubercular cavities and the air-passages, are readily established. The soft membrane which lines the cavities can not, however, arrest the morbid process. Fresh supplies of tuberculous material, and inflammatory exudation, speedily take place; the whole structure softens, the membrane is detached, and thus the cavity enlarges. Again, however, a new, soft, and pultaceous membrane forms, as if to oppose its feeble barrier to the progress of the destructive action; but again it is cast off, as new portions of tubercle and exudation matter soften. As the cavities enlarge, the adjacent pulmonary structure usually becomes more and more condensed by the peculiar deposits, until the parts are completely solidified, and no longer crepitate. The tissues, however, adjoining the tubercular cavities exhibit different conditions; they may be nearly or quite healthy, or contain tubercular, melanotic, and inflammatory deposits. The color is usually grayish, but the deposition of melanotic matter may impart a darker hue, and occasionally a reddish mass will be found, not unlike that which belongs to pneumonia. The condition of the pseudo-membrane lining the cavity is quite variable; when the progress is slow, and the disease remains for a time stationary, the membrane assumes a more dense character, approximating the permanent tissues; but when the progress is rapid, it is quite soft, and sometimes scarcely perceptible.

As vomicæ enlarge, the outline becomes more irregular; different cavities often communicate, and by burrowing into the pulmonary tissue, anfractuosities are formed, rendering the whole extremely irregular in shape. It happens occasionally, however, that cavities of considerable size maintain the oval form. The size of excavations necessarily varies with the stage of development, ranging from the smallest softened particle to the greater portion of an entire lobe, as a single or several united cavities. The apex of the lungs being the usual seat of tubercles, that portion is the first to soften, and, consequently, becomes the primary seat of cavities; the disease spreading downward, but being less advanced in the lower portions. Thus we often meet with softened tubercles at the apex, solid masses below, and still lower, healthy lung-tissue. The cavities

may be single or numerous, according to the original deposits, and the rapidity of softening; but, in fatal cases, they are nearly always necessarily multiplied. The cavities are found at times empty, again they contain pus, softened tubercles, and portions of detached pulmonary tissue; and the whole varying in color and other sensible qualities, according to accidental circumstances. When pus is recent and tolerably pure, the contents will be yellowish; but if long retained, it becomes greenish. When the walls continue decomposing rapidly, the fluid becomes less consistent, and is more or less of a grayish aspect; and, not unfrequently, the whole is tinged of a reddish hue by the effusion of blood. The odor is frequently peculiar, but not often offensive; and when the latter condition exists, it suggests the idea of partial decomposition of the fluid itself, or a gangrenous condition of the parietes of the cavity.

The actual condition of the walls of caverns vary with different examples of the disease. As already remarked, there is, in a certain proportion, a false membrane, soft, unorganized, and from time to time cast off by the crumbling walls. Louis met with this membrane in *three-fourths* of his cases. Laennec witnessed examples in which the pulmonary tissues (smooth, and nearly healthy) constituted the walls, and a single example of the kind occurred in Louis's cases. As a rule, the surrounding pulmonary tissue (varying in extent) is indurated, and of grayish color, the condensation arising from a deposit seemingly of the character of gray granulations; crude tubercles and melanotic matter may occupy the same structures. In other examples, a gelatinous infiltration, red or colorless, takes place, intermixed with the other deposits. In still other examples, *red* hepatization, the result of a higher grade of action, is witnessed. These red masses often occupy cells somewhat removed from the tubercular deposits. Hasse calls this deposit *gelatin*, which, solidifying, becomes reddish, and imparts a firm and sometimes finely-granulated condition to the part. It has seemed to me, however, that these reddened masses, instead of being *gelatinous*, were, in fact, the *fibrinous* product of a higher grade of inflammatory action, constituting red hepatization.

In certain cases, and especially where a curative tendency

exists, the false membrane assumes a higher grade of vitality, may reach a considerable degree of thickness, and is even susceptible of organization. Where, however, the disease is arrested only for a time, this membrane becomes more dense, often semi-cartilaginous or fibro-cellular; and when the tendency to repair is still greater, the inner surface assumes a smooth, velvety aspect, simulating mucous tissue, continuous with the bronchial membrane, and which may become vascular. The vessels which form in this new structure are, according to some observations, (Guillot,) continuous with the aortic circulation, and their minute distribution, in the form of the velvety or villous tufts, brings the blood into contact with the atmospheric air. This process, rendered *permanent*, is necessarily a curative action.

Pulmonary cavities are often traversed by bands, which consist, in some instances, of altered and condensed lung-tissue, and in others, of compressed and obliterated branches of the pulmonary artery. The condensed lung-tissue is occasionally permeated by blood-vessels; and the arterial branches at times are not completely closed, and hence destruction of their walls may cause copious and often fatal hemorrhage. The bronchial vessels are found in the walls of caverns, obliterated, and presenting the appearance of whitish-yellow bands, more or less branched.—(Rokitansky.)

Finally, the destructive action which invades the pulmonary tissues, may be properly styled *inflammatory softening;* for the process clearly involves more or less inflammation, with exudations varying with the state of the tuberculous *dyscrasia*, and the intensity of the local disease. As a rule, however, the nature of the morbid action does not admit of organization, but manifests almost exclusively a destructive tendency.

SECTION II.

CONDITION OF THE BRONCHI.

When tubercles first soften no communication exists between the cavity and the bronchial tubes; but as the destructive process advances, the bronchi become involved, and ultimately opened. The morbid action seems to be not unlike that which determines the change in tubercles; but it is evident that some altered state of the tubes must have occurred anterior to the process of softening, which could not take place so long as their vitality remained unimpaired. The capillary or membranous tubes suffer first, and the vitality of these may be impaired by mere pressure, or by the deposition of tubercular matter within the tubes, occupying their parietes or mucous membrane. The tubes may become obstructed by compression, plugging with tubercular or other matter, and liquefy as the process of softening takes place, by which they are abruptly cut off, and form communications with the caverns. Not unfrequently the extremity of the open tube becomes hypertrophied, and the membranes exhibit inflammatory redness. Several tubes usually open into a single cavity. At times the bronchi become obstructed by the accumulation of viscid mucus, tuberculous matter, or other impediments, which prevent, for a limited period, the elimination of the contents of the caverns.

Condition of the Nerves.—We have the authority of Schroeder Van der Kolk for the assertion that the nerves which can be traced to the wall of a cavern become swollen, the neurilemma reddened, and as they pass on are lost in the general destructive action, or become converted into condensed bodies not unlike the areolar tissue. Mr. Swan and Schroeder Van der Kolk have witnessed examples in which the pneumogastric nerve was reddened and thickened; but in many examples no change could be perceived.

SECTION III.

CONDITION OF THE PLEURA.

When the tubercular deposits are deep seated, the pleura pulmonalis is in no way affected; but when the morbid action reaches the surface, that membrane becomes the seat of disease. In many instances the inflammatory action extends to the pleura, causing exudation of lymph, more or less extensive, and producing corresponding adhesions. So frequent is this result witnessed, that in one hundred and twelve subjects, Louis found the pleura free from adhesion in a single instance only. The inflammatory action, in its beginning, corresponds pretty accurately with the subjacent pulmonary caverns; but when once established, it extends beyond these local changes, and finally may occupy the greater portion of the membrane. The lymph which is thrown out varies in different cases, thus varying the character of the adhesion. This is sometimes firm and compact; at others loose and imperfect; while in very old examples the two membranes become almost completely blended, with more or less change of structure, through which the costal vessels pass to the lungs. These fibrinous exudations may become the seat of tubercular deposits.

These pleuritic exudations and adhesions often constitute the boundary of tubercular cavities, and they take place before an opening can be formed in the membrane, and hence pneumothorax is a rare event. In some examples, however, the ulcerative action rapidly penetrates the pleura, the contents of the cavern escape into the sac, and almost certainly fatal inflammation ensues. And, singularly enough, these perforations are much more frequently connected with small deposits, but which are situated near the surface of the lung.

It is asserted by many that the pleura is often the seat of tubercular deposits; and we are not permitted to doubt that the false membrane resulting from inflammation may contain tubercles; but, independent of inflammation, I am inclined to regard the deposit of true tubercle as comparatively rare.

That rounded granulations, (not unlike the granulations of Bayle,) may occur, is abundantly evident; but it is not equally certain that crude yellow tubercle is often met with on the surface of the pleura. The pleuritis is necessarily modified in its character and products when the tuberculous diathesis exists, but this is very different from the simple secretion of yellow tubercle. I apprehend that the formation of true tubercle on the serous membranes is a much more rare event than many have supposed, and that the products of inflammation (mere granulations) have often been mistaken for true tubercles. The testimony of Rilliet and Barthez is the most decided in favor of the existence of yellow tubercles in the pleura of children, independent of inflammation. These deposits have been seen on the free and attached surfaces, denominated intra and extra-pleural tubercles.

According to the observations of Fournet, tubercular deposits may take place primarily in the pleuritic false membrane, and ultimately extend to the lungs. It seems probable, however, that the term *extension* conveys an incorrect idea; for it is difficult to conceive on what pathological law the tubercular inflammation of the pleura could be propagated to the adjacent pulmonic structure. Nor is it at all conceivable that the pleura would become the point of primary attack, without a similar or greater predisposition on the part of the lungs. It is far more probable that the examples in which these observations were made, constituted a class of cases in which the tuberculous constitutional predisposition was present, and in which the usual tendency to the lungs existed; but, in consequence of the development of intercurrent *pleurisy*, that morbid action hastened the deposit in the false membrane, thus taking precedence of the affection of the lungs. And, as the diathesis continued, (augmented doubtless by the inflammation,) deposits finally occurred in the lungs, not by *extension* from the pleura, but derived from the primary source.

CHAPTER IX.

DISTRIBUTION OF TUBERCLE.

THE question most definitely and conclusively settled, in regard to the seat of tubercle, is, that the apices of the lungs constitute its common and almost invariable primary location. In nearly all instances, the deposits take place at the apices first; though, when the disease progresses rapidly, a considerable portion of the tissue becomes speedily invaded. In the earlier periods the deposits are more frequently deeply seated in the pulmonary tissue, but in other examples they are found immediately under the pleura. True tubercles are found in the lower portion only as the result of *extension* from above downward, or as secondary to pneumonia. In many of the examples in which tubercular deposits are reported to have occurred in the inferior lobes, it is probable the morbid substance was the semi-transparent granules, which, in truth, arise from inflammation. So constantly, indeed, is the deposit of true tubercle limited to the apices, that Louis declares he never met with large cavities in the lower lobes. It must be stated, however, that Louis found two cases in one hundred and twenty-three, in which the deposits existed alone in the lower lobes. But this fact, instead of disturbing the general law recognized, serves to establish the belief that deposits in the lower portions of the lungs are infinitely rare.

Dr. Hughes found, in two hundred and fifty cases, the upper lobe to be the seat in two hundred and thirty-seven, and in only one instance were the deposits limited to the inferior portion.

In regard to the comparative frequency of the deposits in the right and left lungs, professional opinion is divided. Accord-

ing to the observations of Laennec, the right lung is the most frequently affected. Louis, on the contrary, inclined to believe the left more liable to the first invasion: thus, of thirty-eight cases in which the superior lobes were disorganized, twenty-eight were on the left side; and of eight cases of perforation, only one was on the right side. The same observer remarks further, that he met with the deposits five times limited to the left, and only twice to the right side.

Hasse states, that in the cases of phthisis which occurred at Leipsic, in 1839, he found the right side the most frequently affected.

The cases observed by Dr. Cless gave the result of forty-five right, and thirty left; and Dr. Hughes (Guy's Hospital Reports) gives one hundred and sixteen cases of left, to eighty-nine of the right side. In a vast majority of examples, however, both lungs are involved; thus, Dr. Green gives the following results in one hundred and twelve cases in children:

Both lungs	101
Right lung only	3
Left lung only	8

The following are the results of ninety-eight cases which came under my own observation:

Right lung only	28
Left lung only	20
Both lungs	50
	98

In addition to this, a majority of the fifty cases in which the disease occupied both lungs, were most advanced in the right, which is evidence that it commenced earliest where it had made most progress. It would appear, therefore, from these observations, that tubercular deposits are most frequent in the *right* lung; but the difference is too inconsiderable to render the observation of any material service either in diagnosis or treatment.

CHAPTER X.

SECONDARY AND INTERCURRENT LESIONS.

HAVING described the primary tubercular deposits, and the changes incident to their different stages and conditions, we are prepared to consider those secondary lesions, and, also, the intercurrent diseases, which exercise such important influences over the course of phthisis. The *secondary* lesions are those which arise directly from the tubercular deposits, modified by the constitutional derangement, and which involve the adjacent pulmonary tissues. The *intercurrent* diseases include mainly the inflammatory affections, which arise from general causes, but are of frequent occurrence, and exercise an important influence over the progress of phthisis; and hence, although purely incidental, deserve to be mentioned in this connection.

SECTION I.

PNEUMONIA IN ITS RELATIONS TO PHTHISIS.

The inflammatory affections of the substance of the lungs present different aspects, and exhibit very different etiological relations, as we consider them intercurrent or secondary, giving rise to three separate forms of disease, which may be thus expressed: 1. Idiopathic, or intercurrent tubercular pneumonia; 2. Secondary tubercular pneumonia; 3. Hypostatic pneumonia.

1. *Idiopathic or Intercurrent Tubercular Pneumonia.*—This form of pneumonic inflammation occurs as an *intercurrent* affection in phthisis, but is the product of general causes, (such as ordidinarily induce pneumonia,) and, therefore, does not arise from, although it is modified by, the tubercular deposit. Idiopathic tubercular pneumonia, therefore, may proceed from any of the common exciting causes which produce the disease in persons otherwise healthy, such as exposure to cold and damp atmosphere; and hence the disease is most liable to arise, in our own climate, during the cold and variable weather of winter and spring. The disease, under these circumstances, partakes so far of the common characteristics of pneumonia as to be ushered in with a chill, to produce general fever, and to develop the ordinary physical signs of pulmonary inflammation. It is, however, modified in many examples in regard to location, and frequently occupies the superior or middle lobes. And the same observation may be made in reference to the disease, when it occurs in the diathetic state of the system, for here, also, the inflammation is prone to seize on the apices or middle lobes, in preference to the lower portion. I am inclined to agree with Dr. Walshe, that pneumonia, limited to the anterior portion of the apex, is, in a majority of cases, tuberculous; but, it must be admitted, that exceptional cases occur.

It may fairly become a question whether this variety of inflammation, seizing, as it does, on the apex, is not excited by the local deposits, instead of general causes, and is, therefore, simply a sequence of tubercles. We can not, however, admit such a view, and for two reasons: first, the same location is observed in the mere *diathesis*, anterior to the development of tubercles; and, secondly, the local inflammation occurring around tubercles produces, in general, different pathological products from those arising from the idiopathic disease. I have already described the gray induration proceeding from inflammatory deposits around tubercles; and, to establish the distinction, it need only be added now, that the idiopathic form produces red hepatization, such as arises in uncomplicated pneumonia. It seems a fair conclusion, therefore, that tuberculous pneumonia exhibits a decided preference for the superior

portion of the lungs, and that, too, whether it occurs in the diathetic state, or when tubercles have been deposited in the lungs.

It must not be inferred, however, that idiopathic tuberculous pneumonia is *always* limited to the superior lobes, for, in a fair but variable proportion of cases, the disease becomes general, and, therefore, occupies the base. The determining cause is, doubtless, the force of the exciting agent, as well as the constitutional predisposition; but, whatever may be the predominating influence, general pneumonia may unquestionably become an intercurrent affection in the course of tubercular disease. There is still another question, however, arising in the same connection, namely, whether, after the deposit of tubercles, inflammation ever occurs in the lower lobes, without, at the same time, affecting the tuberculous portion? It is a fair inference that the presence of tubercles will *always* invite inflammation to that part, so that the lower lobes can not become separately or exclusively involved.

It is not fully determined in what stage of tubercular deposits intercurrent pneumonia is most liable to occur, that is, whether it is most common before or after softening. My own impression is, (perhaps contrary to the opinion of many,) that it is a much more common event during the crude than softened condition. True tuberculous or secondary inflammation, belongs to the stage of softening, but the idiopathic variety becomes the concomitant of the stage of solid tubercle.

It has been observed that tuberculous pneumonia is not commonly fatal; but this unexpected fact must be received with some limitation, for it is abundantly evident that if the disease becomes *general*, involving the lower lobes, there is a probability of even increased mortality. The low grade of mortality, therefore, applies to the disease when it is absolutely limited to the superior portion, and when the grade of action is comparatively low. But we have the authority of Louis, Andral, Walshe, etc., for the observation that the mortality and mean duration of the disease is even less than in the strictly idiopathic form; and, with the limitations mentioned, I can fully coincide with the observation of Louis, that such pneumonia

is almost invariably curable; and with Walshe, that the most rapid cases of resolution are of this class.

Nor is it difficult to assign a reason for this comparatively mild character of idiopathic tubercular pneumonia. We can easily perceive that the lowered vitality of the lung and the degraded character of the products (being much below common organizable lymph) would preclude that excessive action which occurs in healthy constitutions, and which is so prone to destructive effects. Indeed, a moderate degree of inflammatory action, in this state of vitality, would scarcely more than bring the diseased process up to the healthy standard, or, at least, so little exceed the physiological state that the powers of life would not become endangered by over-action.

And it may be further remarked, that the pernicious influence of this form of inflammation over the progress of local tuberculization has probably been greatly exaggerated, if not entirely mistaken. It is not very uncommon for inflammatory action to occur, pass through its regular stages, and leave the tubercular deposits without material modification. And, indeed, may it not be true that inflammation is, to a certain extent, incompatible with tuberculous disease, and that the latter is held in abeyance by the former? One is altered action, inducing, as its product, plastic fibrin, the other a state of depressed vitality, giving rise to non-organizable deposits. The two conditions appear to be incompatible, and one may, to some extent, control the other.

The pneumonia which occurs in connection with tubercle is marked by varying degrees of extent as well as intensity. Thus, it is lobar, lobular, and vesicular, and produces red, gray, or whitish consolidation. The red consolidation represents acute action, while the gray or whitish is the result of chronic disease. It is often observed that portions of the lungs become consolidated, as in chronic pneumonia, while the central part of the solidified mass may contain softened tubercles.

A form of pneumonic inflammation is described by Hasse, under the name of "*Acute Tuberculosis of the Lungs*," which, it appears to me, has given rise to very great misapprehension. According to this author, the *primary* form of the disease is

characterized by the deposit of numerous miliary tubercles, varying in size from the head of a pin to a millet-seed, and uniformly diffused from apex to base. The disease runs its course in from three to six weeks, and more frequently occurs in young persons, especially males, from eighteen to twenty-five years of age. Post-mortem examinations reveal the lungs tumefied, gorged with serum and blood, and slightly softened; and the so-called tubercles are surrounded to the extent of a line by inflamed or consolidated pulmonary parenchyma. The examples of this character which have come under my observation have been so clearly pneumonic, (*pulmonary granulations,*) that I do not hesitate to class it with *pneumonia*, occurring in a modified or diathetic constitution, whether positively tubercular, or merely one of depressed vitality. A more detailed account of this affection will be found under the head of acute phthisis.

It will be found, also, that the pneumonic granulations may co-exist with true or yellow tubercle. Thus, while the yellow variety occupies the apex, the granular deposits are met with in the lower portions; and, in fact, the two classes of deposits not only occupy different positions, but represent independent constitutional and local lesions.

Chronic pneumonia, (as that term is generally understood,) developed as an intercurrent tubercular affection, presents characteristics different from the granular form just described. The consolidated portion varies in color from red to gray, (depending on the duration and degree of acuteness,) the latter being the most common; is free from granulations, is tough, solid, has a smooth surface, without exudation of serum on incision; the corresponding bronchial tubes often become plugged with solid matter. Moreover, it is located in the lower portion of the lungs, and spreads from below upward, thus obeying the laws governing, in general, the development of ordinary pneumonia. These facts leave no room to doubt that such pneumonia is the product of causes independent of the mechanical irritation of tubercles; but, at the same time, it is inflammation in a tuberculous constitution, and, therefore, modified in its course and results.

2. *Secondary Tubercular Pneumonia.*—By the term *secondary*

tubercular pneumonia, I mean a form of inflammation which arises from the irritation produced by the tubercular deposits, as they undergo various changes, but wholly independent of general causes. Allusion has already been made to the state of the pulmonary tissue around tubercles, crude or softened, and but little need now be added. It may be remarked, however, that this form of inflammation is nearly always *chronic*, and rarely becomes acute except when *general* causes are superadded to those of a local character. In a certain proportion of cases, however, the inflammatory action, secondary to tubercular deposits, assumes so much acuteness as to cause red consolidation, and, therefore, constitutes acute secondary pneumonia. This form is manifested by certain general symptoms, consisting mainly of increase of fever, flushing of the face, greatly aggravated cough, at times rusty sputa, or the sputa may be simply glairy or viscid. The occurrence of pure blood is not unfrequently witnessed, where cavities exist; but when the tubercles have not softened, the rusty sputa is more frequent. However, there are many cases in which no blood appears in the sputa; so that if we look to that symptom with much confidence, serious errors may result.

The ultimate effects of this secondary disease are various. It often degenerates into chronic pneumonia, with induration caused by grayish induration-matter; or it may be resolved without leaving any permanent lesion. It is a question how far it affects tubercular deposits; but it may be affirmed, with much confidence, that inflammatory action has less tendency to increase the deposits than our *à priori* reasoning would lead us to conclude. We know, indeed, that pneumonia surrounding the deposits, is comparatively easily resolved; and hence the conclusion, that it neither hastens softening, nor promotes deposits. In all probability its exalted action rather limits or suspends the tubercular exudation, and substitutes one of a higher and more harmless grade. Indeed, if the exudation arising from inflammation can reach the point of organization, the new vessels coming in contact with the tubercular masses would be the surest means of absorption and ultimate cure. It is by no means certain that the exalted action of inflamma-

tion may not thus aid essentially in closing tubercular cavities, and, therefore, when restrained within proper limits, becomes a curative process.

3. *Hypostatic Tubercular Pneumonia.*—It appears from the concurrent observations of Louis, Andral, and others, that pneumonia often precedes death from phthisis only a few days. It was observed by Louis in twenty-three cases in the first stage, and eighteen in the second, of his one hundred and twenty-three cases, and preceded death only a short time. The disease was characterized by pain in many of the cases, viscid but not rusty sputa, dullness on percussion, and crepitant râle; and on post-mortem examination true hepatization was found, which left no doubt as to the nature of the disease. It was observed, also, that it occupied almost constantly the lower lobes, more or less extensively. Of the eighteen hepatized cases, nine occupied from a half to three-fourths of the pulmonary structures, while the remaining nine presented merely small, disseminated masses.

This form of pneumonia, which precedes death only a few days, is regarded by most writers (following Louis) as intercurrent disease, bearing a relationship to the tuberculous condition, but still not wholly dependent on that state. The fact that it occurs in the lower lobes indicates its independent character, or that it does not spring directly from the irritating effects of the tubercular deposits.

In opposition, however, to the opinion that this is simple pneumonia, modified by the tuberculous constitution, I need mention only a few of the palpable facts connected with its development. Thus, it occurs only a few days prior to death—is generally found in the inferior lobes—and, finally, is precisely similar to what occurs in other diseases of a low grade and long duration. These facts leave no doubt in my mind that the disease is *hypostatic* in its production, and depends on the gradually failing powers of life, and the ultimate stasis (partly by gravitation) of the pulmonary capillaries. The observation of Louis, (which we have all confirmed,) that other diseases of a low grade manifest the same tendency with equal frequency, is abundant evidence that the morbid change under consideration

has no special relationship to tubercles, but that it proceeds from debility, and, therefore, is simply *hypostatic*.

SECTION II.

PLEURISY.

It has been previously stated that tubercular deposits, when situated immediately under the pleura, may excite in that membrane localized inflammation; this, however, is often limited in extent, and usually progresses slowly, but finally, under long-continued excitement, may induce extensive adhesions. There is reason to believe, however, that the adhesions so commonly met with in phthisis are due rather to general and independent causes, than the mere mechanical irritation of adjacent tubercles. The evil results of intercurrent pleurisy are rather indirect than immediate; for although the co-existing excitement may promote tubercular deposits, yet the greatest evil is to be apprehended from the limitation of the thoracic movements growing out of pleuritic adhesions. There is, indeed, abundant reason to conclude that impaired thoracic movements, by diminishing the activity of the pulmonic circulation, will promote the deposition of tubercles.

It has occurred to me to observe, in many cases, that the extent of tubercular deposits was regulated by the pleuritic adhesions; and by tracing the history of the cases, it became evident that the pleurisy was the primary disease, and tubercles the sequence. I can not but conclude that the limitation of respiratory movements, resulting from pleuritic adhesions, exercised a very important influence over the local deposits, and, at least, giving a wider range of diffusion. In such examples I have often found the tubercles extending throughout the pulmonary tissue, and thus encroaching much more than usual on the inferior lobes.

But, independently of the effects of intercurrent pleurisy on the tubercular deposits, there are numerous examples in which

the inflammatory affection becomes chronic, with tubercular deposits in the membrane, which may be the immediate cause of death. It is not essential, however, that tubercles should be deposited in the pleura, for the intercurrent inflammation of that membrane may be produced by causes altogether independent of the local pulmonary disease, and give rise alone to the products of simple inflammation—lymph, serum, and pus. It is true, that, in a majority of cases, the lymph is of low vitality, and consequently the adhesions slight or absent, with a strong tendency to chronic effusions. It will be remarked, therefore, that intercurrent pleurisy may not only aggravate the primary disease, but become the immediate cause of death; and hence the necessity for early diagnosis and appropriate treatment.

We can scarcely assent, however, to the conclusions of Louis, when he asserts that, with one exception, he *never* knew it entirely cured! According to his observations, the symptoms may be palliated, and yet the patients finally die, and effusions, with false membrane, are found. There can be no doubt of the evil tendency of intercurrent pleurisy; but surely the view taken by Louis is entirely too grave.

SECTION III.

BRONCHITIS.

The occurrence of bronchitis, as an intercurrent affection in tuberculosis, is far less common than pneumonia or pleurisy. There is reason to believe, however, that it exercises a more pernicious influence over the progress of tubercles, than inflammation of the perenchymatous portion of the lungs, and that it is more frequently followed by an increase of deposits than when simple pneumonia occurs. This is probably due to the debilitating effects of bronchitis, and the capillary stasis (with lowered vitality) which necessarily follows. I have at this time under observation a case in which the supervention of bronchitis has left the patient with marked increase of dullness, evinc-

ing a rapid deposit of tubercular substance. As an inducing cause of tubercle, in the non-tuberculous constitution, bronchitis probably sustains a low position; but when the diathesis exists, or deposits have already taken place, the influence of bronchial inflammation is much to be dreaded. How common, indeed, is it to witness cases in which "taking cold" has aggravated all the symptoms, or frequently developed the disease with great rapidity.

The observations of Andral (*Medical Clinic*) go far to strengthen the opinion that bronchitis exercises an unfavorable influence in the tubercular constitution; and this view may, perhaps, afford some explanation of the influences of climate in the amelioration, in certain stages and conditions, of tubercular disease. In a cold and damp locality, in which bronchitis is produced, tubercular disease is peculiarly liable to be developed or aggravated; and that there may be some relationship between the bronchial disease and local deposits is, to say the least, extremely probable.

SECTION IV.

EMPHYSEMA.

As a secondary change, emphysema occurs, in a certain proportion of cases, seemingly as the result of a supplemental action to compensate for the obstruction resulting from the deposits of tubercles. Mr. Ancell (*Treatise on Tuberculosis*) is of opinion that emphysema occurs in the early stage of the tubercular deposit, and arises from a mechanical obstruction preventing the free exit of air from the cells. He assumes that, the inspiratory act being the strongest, air may be forced in beyond the point of obstruction, but the expiratory effort being less powerful, it is not expelled, becomes rarefied, and so dilates the cells.

This theory may be true in certain cases, but it evidently falls short of a full explanation of what occurs. In the first place,

emphysema is not produced alone in the early stage of tubercular deposits, nor is it limited to the cells corresponding with tubes which have been obstructed. On the contrary, it is a physical condition which may occur in an advanced state of the disease, especially when a cure has been effected, and, moreover, is usually found in that part of the lung which is free from tubercular deposits. When a large cavity has formed, involving the destruction of a considerable extent of pulmonary tissue, the vacuum must be supplied either by a sinking in of the thoracic parietes, or an expansion of the cells; and, as Hasse justly observes, the contraction of the walls being slow and difficult, the most ready and natural method of filling the space is by pulmonary expansion. Hence emphysema, in an advanced stage, is the result of an expansive force to fill a vacuum, and therefore serves only to supply what would otherwise be a physiological defect.

But a still more important condition which gives rise to emphysema, and that which exercises most influence over the tubercular deposit, arises in an early period, and is purely supplemental. Rokitansky observes that the superficial parts of the parenchyma, in the vicinity of tubercles, undergo vicarious emphysema, while the deep-seated portions become hyperemic and œdematous. When tubercles are deposited in considerable masses, it must necessarily happen that bronchial tubes, more or less extensively, become compressed or obliterated, thus causing collapse of those air-vesicles with which they communicate. In addition to this, it is admitted that tubercles are deposited *within* the tubes, so that this intra-mechanical obstruction could not fail to become an impediment to the admission of air, and, hence, the whole combined would be quite adequate to obliterate a portion of the cells. Following this condition, the adjacent sound parts take on increased action, dilate, and finally become *emphysematous*. It is also true that the mechanical effect of coughing tends largely to induce vesicular dilatation, and doubtless contributes to the production or increase of emphysema.

The most important practical fact bearing on the relationship of emphysema and tubercle is, that the two conditions manifest

an evident antagonism. Thus, in idiopathic emphysema tubercles are very rarely developed, and when it occurs in connection with tuberculosis, the dilated portion is free from deposits. These facts suggest an important relationship between dilatation of the air-cells and tubercular deposits, and that the former may, to some extent, aid in the cure of the latter. Whether this prophylactic and curative relationship be the result of a degree of compression exercised by the dilated cells on the capillary vessels, or whether it is due to a more general influence, resulting from a modification of hæmatosis, are unsolved questions. But whatever may be the rational explanation, the fact itself appears undoubted, and should not escape the attention of the practitioner.

SECTION V.

PULMONARY ŒDEMA.

Œdema of the pulmonic tissues, during the progress of tuberculosis, occasionally occurs, and offers considerable embarrassment to the respiratory function, by increasing the dyspnœa. It is an observation which most careful practitioners have made, that the degree of dyspnœa is quite variable in different cases, and does not seem always proportioned to the extent of tuberculization. We have often remarked, for example, that persons far advanced in phthisis, and, indeed, within a short time of dissolution, manifested but little dyspnœa, the respiratory movement at times, and when the patient was calm, not exceeding twenty-four to the minute. It is true there are various causes which must modify respiration; but, among the number, *œdema* is not to be overlooked. It occurs around the deposits, and more especially in the inferior and sound portions. This serous infiltration is usually associated with an advanced stage, and arises from capillary obstruction, and the changed condition of the blood; the latter state being essential to any considerable effusion. An examination of a tuberculous œdematous

lung gives the usual appearances: frothy serum follows an incision, with pale color, pitting, want of collapse—such as belong to that condition in general.

SECTION VI.

PULMONARY HEMORRHAGE.

Tubercular hemorrhage (excluding, of course, mere initial *hæmoptysis*) can scarcely be said to occur as a copious and alarming or fatal symptom, except when it proceeds from ulceration of an arterial vessel. As a rule, blood-vessels, traversing a cavity, become obliterated, so that even large branches cease to convey blood, and remain as solid cords or bands; but, in rare instances, the closure is incomplete, and ulceration causes fatal hemorrhage. A few cases are on record, also, in which branches of the pulmonary or bronchial arteries were perforated by adjacent tubercles, and fatal hemorrhage ensued. It is true, also, that the ulcerative action of the walls of vomicæ may reach large vessels, and cause copious hemorrhage. Ulceration of the bronchial tubes is assumed as another cause, but, it seems to me, infinitely rare.

In some examples which have come under my own observation, blood appeared to exude from the parietes of the caverns, giving rise daily to the elimination of several ounces of pure blood; but, in such cases, the hemorrhage does not become copious or fatal. Upon the whole, the most common cause of moderate hemorrhage in these examples is, the extension of the ulcerative action to vessels situated in the walls of the caverns; and, at times, an exudative process, arising from venous obstruction.

Pulmonary apoplexy, and passage of blood into the air-cells and bronchial tubes, resulting from congestion in the sound portion of the lungs, are conditions occasionally witnessed. In these examples there may be rupture of vessels and laceration of the pulmonary tissues, or mere engorgement and extravasation, without appreciable lesion of the structures.

SECTION VII.

PULMONARY GANGRENE.

A limited gangrenous condition occasionally occurs in tubercular caverns, or resulting from mechanical compression of blood-vessels. In rare cases, the blood-vessels of a portion of the pulmonary structure may become so completely and extensively compressed as to cause the death of the corresponding part, and thus a gangrenous condition, of considerable extent, may be produced. The most common form, however, is a limited extent of gangrene, formed by portions of a cavern becoming dead and sloughing. In such cases the sputa become offensive, as in ordinary gangrenous lungs. A very slight gangrenous condition of caverns is not very rare; nor does it always produce any serious results, but, on the contrary, is often of temporary duration, and subsides without great detriment to the patient.

IV.

THE TERTIARY LESIONS.

CHAPTER XI.

THE *primary* changes in tuberculosis are connected with, or dependent on, derangements of the metamorphosis of the tissues, or in the broadest sense, secondary assimilation; the *secondary* pathological anatomy consists in the deposit of tubercles within the pulmonary tissues; while beyond all these, there are certain *tertiary* lesions, involving the nutritive conditions of various organs, and consisting in atrophy of the normal structures, or adventitious deposits, separate and distinct from mere tubercle. These changes are observed in the organs of circulation, digestion, and secretion, involving especially the heart, liver, and alimentary canal.

SECTION I.

TERTIARY LESION OF THE ORGANS OF CIRCULATION.

The most important tertiary changes occurring in the organs of circulation consist in weakened action of the cardiac fibers, and attenuation of the capillary parietes. The atrophy of the heart is much more advanced than is generally supposed. In

cases of long standing the fibers become pale, attenuated, and weakened; hence dilatation of the right side is a very common result. Louis found it flaccid and soft in one-fifth of his cases, and in a large proportion it was from one-third to one-half less than the normal dimensions. In one hundred and twelve cases an enlargement was obvious in three only, which existed in the left ventricles. This statement is singularly at variance with the observations of Dr. Boyd, who found the average weight in one hundred and forty-one cases above the natural standard. Hasse regards hypertrophy and dilatation as of frequent occurrence; but Rokitansky very rarely found either of these conditions associated with phthisis.

These statements are contradictory, inconclusive, and, therefore, unsatisfactory. I believe, from my own observations, that the contractile power of the heart is weak, as a rule, even in the diathetic state; and that this condition is increased as the disease advances, modified, however, by the quantity of the circulating fluid. The early weakness of cardiac contraction (either diathetic or tubercular) is shown in the feeble pulse and impaired capillary action. A comparatively feeble pulse (with more or less frequency) is one of the most constant of the early symptoms, which may be, in fact, a result of organization; but the *tertiary* debility, to which I now allude, is still more marked, and is usually (if not invariably) dependent on weakened, but not generally softened, fiber. The heart is found *pale* but not *flabby;* and the absence of this latter condition has served to withdraw the attention of pathologists from the true state of the organ. The heart is generally small and contracted, which arises from the diminished quantity of blood; thus, the circulating fluid progressively diminishes, and the organ necessarily contracts, to adapt itself to the change. In this contracted state it is comparatively firm, with small cavities, and parietes of normal thickness. But it is abundantly evident that the thickness is maintained at the expense of general dimensions, and, therefore, there is a positive diminution of volume. If, on the contrary, the quantity of blood remains comparatively large, while the disease is still in progress, the heart necessarily yields to the pressure, and dilatation will

occur. It appears probable that dilatation would always predominate if the blood did not rapidly diminish in volume; but, as the quantity is progressively lessened, expansion of the heart is, necessarily, impossible. There are certain cases of tuberculosis in which the quantity of blood remains moderately large, although the quality is deteriorated, and it is in such cases that we witness the dilatation mentioned by several pathologists. It must not be assumed, however, that the heart is invariably diminished in volume, or weakened in all its parts; for examples are not wanting in which the right ventricle becomes somewhat hypertrophied, although the left may not partake of that condition.

The *capillaries* evidently become equally weakened, their walls attenuated, and functions perverted. This condition pertains to all the viscera and tissues, but is more conspicuous in the lungs, and membraniform structures. This depraved function, added to altered blood, induces impaired nutrition, attenuated and softened mucous membranes, exudation of serum, ready imbibition of crude materials, and imperfection of all the functions in which this great class of vessels are concerned. The ready imbibition of oxygen and elimination of carbon probably exercises no small influence over the progress of emaciation; while, in general terms, the great functions of endos- and exosmosis become so materially deranged, that fluids and gases too speedily find ingress or egress, and the constant disturbance of nutrition is thus maintained.

In addition to the ordinary changes of the heart, it is occasionally found to become *fatty*. In a majority of fatal cases of phthisis, but little fat surrounds the heart, that substance having been absorbed during the progressive emaciation. I have recently observed a case, however, (tuberculosis being associated with fatal intercurrent pneumonia of the left superior lobe,) in which the heart was surrounded with fat; and, at the same time, the superficial muscular fibers of the right ventricle exhibited incipient fatty transformation. Most pathologists have met with examples of fatty heart in chronic phthisis, very often coinciding with adipose deposits in the hepatic cells. In my own autopsies fatty heart has been seldom recognized in

tuberculosis, nor does it appear, from general observations, to be a common condition.

SECTION II.

TERTIARY DEPOSITS IN THE LIVER.

As a tertiary transformation, fatty liver stands quite prominent. Andral and Louis met with this condition in one-third of their cases; but Dr. Reid and Dr. Peacock, of England, found it only thirteen times in ninety-eight cases. According to Hasse the liver is, almost always, *very fatty;* and my own impressions, founded on many observations, have led to the conclusion that fatty deposits (often short of the usually recognized fatty liver) are very common, and constitute a peculiar and important lesion in phthisis. In a majority of cases of phthisis, the liver is found somewhat enlarged in volume, although not recognized as fatty. Dr. Boyd found it increased above its normal weight five and a half ounces in males, and seven ounces in females. This enlargement is usually ascribed to *scrofulous* deposits, but, it seems to me, that it is more frequently fatty than albuminoid.

The fatty liver presents the same anatomical and microscopical elements which belong to that condition when it occurs independently of tuberculosis; that is, the fat is deposited in the hepatic cells, the organ becomes enlarged, is of a light yellow or fawn color, exsanguineous, and when incised, greases the knife, and emits fluid fat on the application of heat. The analysis of Boudet furnished the following results:

FATTY LIVER.		NORMAL LIVER.	
1. Oleine and margarine fats, slightly acid	30.20	1. Saponifiable fat	1.60
2. Cholesterin	1.33	2. Cholesterin	.17
3. Dry animal matter	13.32	3. Dry animal matter	21.00
4. Water	55.15	4. Water	76.39

It has been shown, by the researches of Rilliet and Barthez,

that fatty liver occurs much less frequently in children than in adults. In three hundred and twelve cases they met with it in only twenty-three instances, not being, in fact, more frequent than in some other forms of disease.

The deposit of fat in the liver evidently points to an accumulation of adipose substance in the blood, or to its diminished consumption in the system. It occurs in quite opposite conditions; in one variety it takes place in corpulent persons, and those who are addicted to the use of alcoholic drinks; in other examples it is associated with emaciation and debility, as in cases of phthisis. The exact relationship (numerically and dynamically) of fatty liver to tuberculosis remains undetermined; nor can we, with the data before us, safely predicate any inferential opinions on this somewhat frequent tertiary change.

SECTION III.

TERTIARY EFFECTS ON THE FLUIDS.

The final influence of tuberculosis on the blood, lymph, chyle, and secretions, is most marked and important. The rapid metamorphosis of all the protein compounds of the body necessarily deposits in the blood a large debris of the decomposed tissues, which is eliminated through the liver, kidneys, lungs, and skin. In this way some of the secretions become surcharged with the effete materials; thus, the urine is often found loaded with the lithates, depositing copiously red sediment. The blood evidently becomes the recipient of much effete matter, which still further disqualifies it for the purposes of nutrition. Independently, therefore, of the ordinary changes of the blood in the relative proportion of its normal constituents, the addition of this debris of the tissues must necessarily exercise a highly pernicious influence over the functions generally. There is reason to believe, indeed, that some of the more marked of the advanced symptoms arise from the poisoned condition of the blood, among which we find diarrhœa, sweats,

failure of calorification, and generally diminished capillary action. It is true, some of these symptoms may seem to arise from causes independent of the blood; but, while this may be true in respect to some of those enumerated, there are others which, doubtless, depend on the changes in the blood, while those which arise from a different cause will become materially aggravated by the condition of the circulating fluid.

Nor is it probable that the lymphatic and lacteal fluids escape this contamination; for, although these vessels, in a normal state, possess the power of rejecting effete or non-nutritive substances, yet there is abundant evidence that when materially deranged, or when foreign substances exist in great quantities, the *selecting* power fails, and even poisons are freely admitted. It is true, that in common tuberculosis, the lymphatic glands do not become diseased, which might be regarded as evidence contrary to the opinion here advanced; but it must be remembered that the debris of tissues are not, like poisons, positive irritants, and, therefore, may not excite swelling or inflammation in the parts through which the foreign substances pass. This contamination of the fluids necessarily modifies all the tissues and vital actions of the system, gradually subverting one function after another, until they become incapable of sustaining life. The order in which the various functions fail presents some variety; but, it may be remarked, that primary and secondary assimilation are those which suffer in the most obvious manner, and which more immediately depress all other vital actions. The capillary vessels, in all their relations, become greatly deranged; and the nervous system of organic life evidently partakes largely of the morbid changes.

The ultimate morbid action which occurs in the digestive organs, especially in the mesenteric and intestinal glands, might, with propriety, be mentioned in connection with the tertiary lesions. There is reason to believe that these glands very generally become involved, not alone as a primary or even secondary disease, (in the form of tubercular deposits,) but in those more remote derangements connected with the last stage of phthisis, in which the elaborating acts of these structures almost entirely cease. Indeed, the whole alimentary tract suf-

fers more or less in the same manner, and from the same cause. And we might say further, that the entire glandular system, especially the intestinal and bronchial, becomes involved in this ultimate condition of tuberculosis.

These cursory remarks are designed merely to indicate the character and extent of what I consider the *tertiary* effects of tuberculosis, without any attempt to trace the lesions in detail. The pathologist, however, will find, in this subject, ample ground for reflection, if not a field for the exercise of therapeutical skill.

CHAPTER XII.

FORMS OR VARIETIES OF PHTHISIS.

THE modifications presented by phthisis are numerous and important; some of the most obvious of these depend on co-existing pathological states, such as inflammation, while the more general differences arise from peculiarities of constitution, modes of living, and other accidental conditions which modify the course of the disease.

It has appeared to me that the classifications of phthisis adopted by most writers, embrace distinctions which depend on peculiarities of constitution and accidental influence, rather than any inherent differences in the pathological changes. Thus Laennec describes five forms: 1. Regular manifest phthisis. 2. Irregular manifest phthisis. 3. Latent phthisis. 4. Acute phthisis. 5. Chronic phthisis. Sir James Clark makes the following divisions: 1. Acute phthisis. 2. Chronic phthisis. 3. Infantile phthisis. 4. Febrile phthisis. 5. Latent phthisis. Dr. Stokes describes six varieties: 1. Acute non-suppurative phthisis. 2. Acute suppurative. 3. Chronic progressive. 4. Chronic ulceration following pneumonia. 5. Tubercle consequent on chronic bronchitis. 6. Tubercle consequent on the cure of empyema. With the view to a greater simplification, Dr. Walshe and Dr. Williams, with many others, include all the varieties of phthisis under two heads, viz.: the acute and chronic forms.

These classifications are, in many respects, objectionable. Those of Laennec, Clark, and Stokes, are irregular, and are not based on any recognized etiological or pathological laws; while the divisions into acute and chronic fail to make the

distinctions which are found clinically to exist. Thus, the term *acute* has reference to duration and not grade of action; but it will be found that one class of cases, which pass rapidly through their stages, are of an inflammatory character, while another class, of equally short duration, depend on the great extent of tubercular deposition, without evidences of inflammation. Hence, this classification brings into the same group inflammatory and non-inflammatory phthisis.

In view of these facts, it has appeared to me that a correct classification will divide phthisis simply into the *inflammatory* and *non-inflammatory* varieties.

The non-inflammatory variety of phthisis, therefore, embraces all cases which are not, in their general course, associated with inflammation, except so far as that condition constitutes a part of the process of softening, but which does not become a leading element of the disease. This class would embrace what is ordinarily understood by the term *chronic* phthisis; and it includes, also, some examples of rapid march, which arise from immense deposits of tubercles, but independent of inflammation, either as an inducing cause, or co-existent pathological condition. The *duration* of these two forms is widely different; one will ordinarily run through a period of from one to three years, while the other may terminate in a few weeks or months.

Intercurrent inflammation may occur in a case of phthisis, and in due time subside, leaving the original affection to pursue its usual course. Such cases do not come under the head of inflammatory phthisis; on the contrary, it is only where the inflammatory action becomes persistent, and runs through the whole course of the disease, that the term inflammatory becomes applicable.

The inflammatory class embraces all forms of tuberculosis which have been induced by, or become early complicated with pneumonia, bronchitis, or pleurisy, the inflammatory condition becoming chronic, and running through the whole course of the disease. And it also embraces that form known as *gray granulations*, which has already been described as inflammatory in its character. In some of the examples of inflammatory phthisis, the deposits of tubercle will have taken place prior to

the supervention of inflammation; in such cases, the inflammatory affection is *intercurrent*, but in certain examples, its effects are permanent, and chronic pneumonia, bronchitis, or pleurisy are added to the original tuberculosis. Again, in the mere diathetic state, without tubercular deposits, the supervention of inflammation of the pulmonary tissues acts as an inducing cause, and tubercles are speedily deposited. In such cases the inflammation is *idiopathic*, but acting on a depraved constitution, the products are made up of the tubercular as well as the inflammatory exudations, the whole passing into a chronic state.

In addition, however, to the two principal varieties of phthisis mentioned, each of these becomes subject to subdivisions, which, although not constituting separate forms, are, nevertheless, modifications sufficiently important to require attention. The non-inflammatory variety, as already intimated, differs widely in duration; thus, while the ordinary examples run through a period of from one to three or more years, other cases will terminate fatally in a few months. This latter variety has been termed *acute;* but inasmuch as the rapid course of this class does not depend on inflammation, but on the extent of tubercular infiltration, it properly belongs to the non-inflammatory class. In this form, the pulmonary tissues become rapidly *infiltrated* with tubercles, and, as softening speedily takes place, numerous cavities form, which soon extend, involving so much of the structures of the part as necessarily to prove fatal.

The *laryngeal* form of phthisis is an important modification; but varies in the class to which it belongs. There is generally, however, inflammation (tubercular) of the fauces and larynx, extending, more or less, throughout the respiratory passages. In such examples the lungs are involved in the tubercular disease, either from the beginning, or as an ultimate result, but the inflammatory action is mainly, and often exclusively, restricted to the mucous membrane and glands. This form, therefore, constitutes a modification of the *inflammatory* variety, and might with propriety, at least in some cases, be classed as a *complication*. However, I believe there are cases of this form in which the disease *begins* in the fauces and air-passages, which renders it, in truth, a distinct variety of phthisis.

CHAPTER XIII.

NATURE OF PHTHISIS.

In approaching this part of our subject we are forcibly impressed with the numerous theories explanatory of the nature of tuberculous disease, which have been advanced by different observers. Hippocrates; Aristotle, and Galen were as busy in speculations as Rokitansky, Ancell, or Bennett; and while ancient medicine contained many crude and long since exploded dogmas, it is quite evident that modern refinement is often equally remote from the truth. In recent observations, however, numerous facts have been established which throw great light on the subject, although the generalizations are too often hasty, unwarranted, and illogical.

The theories of tuberculosis which are based on modern pathology usually refer the morbid action to some modification of the *nutritive* functions; but observers are not agreed as to the exact point of departure, nor do they concur in relation to the essential nature of the pathological changes. It is generally admitted, however, by most, if not all observers, that *emaciation* is usually an early and persistent symptom of the disease, and that the various consecutive lesions involve, directly or indirectly, the fluids, tissues, and functions concerned in primary and secondary assimilation. The following enumeration embraces the principal modern theories on this subject:

1. Impaired primary digestion.
2. Imperfect development of chyle.
3. Morbid states of the lymph.
4. Defective respiration.

5. Morbid states of the blood.
6. A specific poison.
7. Changes in the condition of albumen and fibrin.
8. Retrograde morphology.
9. Derangement of the organic nervous system.
10. Inflammation.

In commenting on these *ten* theories I shall state, as succinctly as possible, the principal facts and arguments on which they are based, together with such objections as may appear clear and undoubted.

SECTION I.

IMPAIRED PRIMARY DIGESTION.

The attention of modern pathologists has been forcibly directed to the derangements of primary digestion, as throwing light on the origin of phthisis; and many are of opinion that tuberculous disease consists, essentially, in some form of derangement of the digestive organs, whereby innutritious elements, deficient in quantity or defective in quality, are introduced into the circulation. Andral made the observation that dyspeptics were peculiarly prone to pulmonary affections. Dr. Dick entertains similar opinions, and details cases in which, according to his view, speedy disorganization of the lungs arose from gastric disturbance. Dr. Wilson Philip denominates one form of phthisis *dyspeptic*, on the supposition that the gastric derangement ultimately induces the pulmonary disease. Dr. T. J. Todd has also described (*Cyc. Prac. Med., art. Indigestion*) what he terms *strumous* dyspepsia. This author expresses the opinion that dyspepsia is a more characteristic feature of the strumous diathesis than any other; and that it is more to be relied on as indicative of that constitutional state than any of the external phenomena connected with the skin, hair, eyes, etc. He employs the following emphatic language on the subject: "Again, upon whatever temperament the disordered habit which we call scrofula may ingraft itself, we venture to say

that this form of dyspepsia will also there be found; and, therefore, being constantly present with it, preceding and accompanying the various symptoms which issue from it, it would be contrary to all reason to refuse it an important share in the development of this disordered habit, and in the production of the local affections which have hitherto too much engrossed the attention, to the exclusion of a proper consideration of the constitutional disease." The proximate cause of this Dr. Todd conceives to be obstruction of the portal system.

Long ago Willis, Wiseman, and Baumes attributed consumption to acidity of the fluids; and, more recently, Mr. Richard Carmichael, in an essay on scrofula, sought to locate the disease primarily in the digestive organs, the special derangement consisting in acidity. Dr. Hughes Bennett (*Treatise on Pulmonary Tuberculosis*) intimates that the peculiarity of phthisis arises from an excess of acidity in the alimentary canal, which ultimately interferes with digestion, so as to give a preponderance to the albumen. Dr. Bennett extends this idea, so as to indicate that there is a deficiency of oil, which, in connection with albumen, is essential to healthy nutrition, and, as a consequence, elementary molecules and nuclei are not formed, and hence abortive cell-growth follows.

Mr. Jonathan Hutchinson* has presented a very elaborate essay on this subject, with the view of establishing the fact that dyspepsia often precedes consumption. A tabulated view of fifty-six cases of consumption, taken from the out-door patients of the City Hospital for Diseases of the Chest, is given, in which, by careful interrogation, he ascertained the state of the digestive function prior to the beginning of the symptoms of consumption. After stating that, in a large majority of cases, established phthisis is associated with dyspepsia, characterized especially by difficult assimilation of *fatty* aliment, the author proceeds to describe that form which *precedes* the development of phthisis. Out of fifty-two patients who manifested symptoms of dyspepsia, the stomach derangement *preceded* the pulmonary disease in thirty-three. The special symptoms man-

* Medical Times and Gazette, April, 1853.

ifested in these cases were similar to those in the confirmed examples, namely, a distaste for fats, oils, and even sugar and alcohol. It is further added that, in forty-eight per cent. of the cases, a dislike for fats had existed throughout life. It was also remarked, as another characteristic feature, that *acidity*, manifested in eructations, occurred in a large proportion of cases. Dr. Hutchinson, however, states, that it is not every form of indigestion which leads to phthisis, but it is that variety in which there is an instinctive aversion to hydro-carbonaceous food, and the predominance of acidity; but finally concludes with the declaration that dyspepsia is a mere link in the chain, and that the "tubercular *dyscrasia* may be produced without any intervening stage of indigestion." But, notwithstanding this admission, the author immediately adds, "That dyscrasia consists, essentially, in a morbid state of the nutritive fluid, which state might be just as efficiently produced by withholding of the proper articles of food as by a refusal, on the part of the organs of digestion, to assimilate them." And, he adds, to one or the other of these two classes of influences, namely, errors of diet or incompetency of the chylopoietic viscera, phthisis must be referred.

It is not a little difficult to attach precise ideas to the language employed by most of these writers, nor is it easy to arrive at definite conclusions as to the opinions which they wish to convey. Thus, Dr. Todd observes that strumous dyspepsia *precedes* and *accompanies* the various symptoms, and that it can not be denied an important share in the development of the disordered habit. Yet he speaks of it as a characteristic feature of the *diathesis*. Again, Dr. Hutchinson intimates that a *peculiar* form of dyspepsia is present in most cases, and he observes that the withholding of food, no less than disorder of the chylopoietic viscera, may be productive of the disease; in other words, that dyspepsia is a mere link in the chain.

These declarations are sufficiently vague and indefinite. It would appear that the authors started out with the impression that dyspepsia was to be regarded as an essential *cause* of tubercular development; but, before reaching the end of the

narrative, perceived that it was more often an effect than a cause, and hence the ambiguity of the language employed.

I shall attempt to show, hereafter, that dyspepsia has acquired undue importance in explaining the nature and progress of phthisis; and will here merely remark, if it is intended to be established by those who claim so much importance for the derangements of primary digestion, as indicated by the authors quoted, that it is an essential and independent cause of tuberculosis, there is, evidently, a most important and mischievous error. That digestion often becomes deranged in tuberculous affections, no one can deny; but that it essentially occupies a higher position than that of a mere symptom, in a large proportion of cases, can, I think, be established by the clearest reasoning and the most indubitable facts.

SECTION II.

IMPERFECT DEVELOPMENT OF CHYLE.

The supposition that the tuberculous condition consists essentially in an imperfect development of chyle, is a theory very closely allied to that of deranged digestion; for it must be apparent that if primary assimilation is imperfectly performed, the chyle which is derived from that process will suffer to a proportional extent. Thus, Dr. Hughes Bennett dwells forcibly on the derangement of digestion, involving, especially, the development of acidity, and this acidity prevents the formation of the oily emulsion which is essential to the proper constitution of chyle. So, likewise, the theory of Schultz, that the chyle and lymph are especially at fault, admits a derangement of primary digestion, as furnishing the imperfectly developed chyle. According to Schultz, tuberculous disease consists in impaired digestion, which gives rise to incompletely-developed chyle granules and cells, and, consequently, incomplete elaboration of blood. Animals fed on oily substances were observed to exhibit imperfect chyle and blood, and the lungs were found collapsed,

bloodless, and with large quantities of oily particles deposited in their textures. When fed on starch alone, the same general changes were observed, except the deposit of oil globules.

Mr. John Simon has developed this idea by expressing the opinion that the scrofulous diathesis consists in some misdeveloped proteinous ingredient of the lymph and blood, the essential change consisting in the fibriniform consolidation and concretion of something which should remain fluid in the plasma of the blood.* Andral, also, refers scrofulous deposits to the lymph, either as a result of alteration or stagnation of the fluid itself, or a morbid condition of the vessels.

It is difficult, however, to develop this view of the subject with a precision at all approaching demonstration. The most that can be said is altogether of a general character, such as, that the process of development of the nutritive fluids is gradual and progressive from the lacteals to the lungs; that the cell-growth *commences* in the chyle, and if this formative process suffers in its development, it must necessarily follow that the entire circle becomes proportionately diseased. But it still remains to be shown why, on this theory, the morbid action results in tubercular deposits in the pulmonary or other tissues.

SECTION III.

MORBID CONDITION OF LYMPH.

Tuberculous and scrofulous diseases have often been ascribed to morbid states of the lymph. Among the older writers who advocated this view, we may mention Baumes, White, and Hufeland; and, among the modern, Andral, Schultz, and Simon. Schultz connected the lymphatic and chyliferous theories of tuberculosis, and he traces the disease to the imperfect formation of chyle and lymph granules and corpuscles. This opinion is largely based on the observation, which Schultz claims to

* General Pathology, p. 185.

have made, that in animals fed exclusively on oil or starch, (albuminous substances being withheld,) the chyle-granules are imperfectly formed, and, in their stead, fat globules appear; while, at the same time, and as a direct consequence of this, the blood plasma is imperfectly formed. It is hence inferred that the origin of the tuberculous process is primarily in the chyle and lymph, being associated with imperfect primary digestion, which induces disordered blood, and, finally, the deposition of tubercle. Andral has expressed the opinion that tubercles found in the lymphatic glands do not originate from the *blood-vessels* of the part, but that they are directly the result of an alteration of the lymph itself. Although this statement does not indicate the lymphatics as the general source of tubercle, yet it shows that, in the opinion of Andral, it is one source of that morbid deposit.

Mr. J. Simon has, more recently, adopted the lymphatic theory. In relation to the formation of tubercle, he says: "It occurs with an infinite preference in the lymph-glands and in the lungs; in the former, where lymph is brought in immediate relation with arterial blood; in the latter, when lymph (which is constantly accruing to the blood) first comes into immediate relation with the atmosphere."* According to this view, tubercle is precipitated from morbid lymph by the influence of the atmosphere.

SECTION IV.

DEFECTIVE RESPIRATION.

The importance of the respiratory function, and its direct association with the principal seat of tubercular deposits, has led to the opinion that the localization or even development of tubercles depended on defects in the structure or function of the lungs. Dr. Campbell (*loc. cit.*) attempted to show, by certain

* Lectures on General Pathology.

ingenious experiments, that the pulmonary capillaries were deficient in development, and hence readily admitted of local deposits.

But an attempt has been made to connect tuberculosis more directly with the function of respiration. Thus, Parola, an Italian author, conceives that tuberculosis arises from imperfect hematosis, depending on weakened respiratory action; and this condition induces engorgement of the lymphatic glands, and, as a consequence, imperfectly elaborated chyle, and finally, tuberculosis. The defective or impaired state of the respiratory function may arise from hereditary imperfection or acquired weakness; but, in either event, the final effect is manifest in the degradation of lymph and chyle, from which arises the local deposit of tubercles.

Nearly allied to this theory is that of Baudelocque, McCormac, and others, who ascribe tuberculosis to a deranged state of the blood, resulting from breathing an impure atmosphere. It is assumed that this imperfection of respiration deranges the fluids of the economy generally, and as the solids are formed from the fluids, the latter necessarily partake of the imperfections of the former. Thus the whole system becomes deranged, the formative process is imperfect, and tuberculosis results.

In surveying the several theories which ascribe tuberculosis to imperfection of the respiratory function, either in reference to the immediate function itself or the quality of air employed, one can readily perceive a certain degree of truth pervading them; but, on more careful analysis, it will be found that the circumstances under which the disease arises are too diversified to admit of this restricted etiology, and, therefore, the respiratory derangement must be regarded rather as occasional than constant and essential. Indeed, there are circumstances which indicate that a great extent of defective hematosis may not only fail to induce tuberculosis, but prove positively protective; for example, in diseases of the heart, which interfere with due oxygenation of the blood. However this may be, we feel at liberty to assert that no demonstrable evidence, in the present state of science, can be adduced to prove that either defective respiratory action, arrested development, or a vitiated atmosphere are

essential to the production of phthisis; on the contrary, there is reason to believe that, in the absence of all these supposed inducing causes, the disease often originates and rapidly progresses to a fatal termination.

SECTION V.

MORBID STATES OF THE BLOOD.

From the days of Christopher Bennet, 1654, to those of Rokitansky and Ancell, the blood has been regarded, by numerous authors, as the seat of tuberculous disease. Willis, in 1660, speculated on the *acidity* of the blood, as did also Wiseman, Bordeau, and Baumes; while, in recent times, we are taught by Rokitansky that a fibrinous dyscrasia is at the foundation of the mischief, and by Mr. Ancell that a more general disease of the constituent elements of the sanguineous fluid occurs.

Mr. Ancell's opinions are developed very elaborately, and with great ability.* According to his view, the punctum saliens is neither in the digestive organs, the chyle, lymph, nor in the respiratory function; but the disease begins in the *blood*, and from this morbid fluid the tubercular matter is secreted by the capillaries of the lungs and other parts. Mr. Ancell, therefore, discards the idea of a *diathesis* or cachexia, and regards tuberculosis as an *idiopathic blood-disease*. In adverting to the special changes which take place in the blood, Mr. Ancell expresses the opinion that the following points are pretty well settled:

1. Increase of water. 2. Increase of fibrin. 3. Diminution of the red corpuscles. 4. Increase of albumen. 5. Diminution of iron.

Speaking of the blood, Mr. Ancell offers the following explanation: "This fluid is the site of the process of absorption and deposition. However tuberculous it may be, so long as the balances between these processes are maintained, although the

* Treatise on Tuberculosis. London, 1852.

nutrition may be tuberculous, no tubercles are formed. Physiological chemistry appears to indicate, of the blastema as of the blood, that its pathological condition consists of some modification of the ultimate composition, or of the relation of its proteiniform or oleaginous constituents; their carbon, nitrogen, oxygen, or hydrogen, or some radical or primary compound, being deficient or in excess; the modification, whatever it may be, rendering it incapable of forming perfect nucleoli or germs of cells; or these, if formed, being inadequate to the perfect construction of the cell or fiber. Hence, instead of contributing to the formation and nutrition of fibers and cells, it becomes granular, and the granular matter is of a more solid structure than natural, less capable of dissipation or absorption, and more and more apt to accumulate in masses than the constituents of a healthy blastema. It thus becomes a foreign material, subject to chemical and physical changes." (P. 573.)

Mr. Ancell introduces much ingenious reasoning, and many important facts in support of his opinions; and it must be confessed, that the blood-changes evidently occupy an important position in the series of morbid actions which take place in tuberculosis. Nevertheless, a strictly inductive analysis of the facts which bear on the subject, leaves but little room to doubt that there is *something* anterior to, and different from, the mere blood-changes, to constitute either the tuberculous condition or the local deposits.

SECTION VI.

A SPECIFIC POISON.

Another theory, ascribing the disease to blood-origin, is proposed by Dr. Madden, (England,) in which he attempts to prove that phthisis arises from a specific poison in the blood, although the virus is not demonstrable. Mr. Ancell ascribes the disease to changes in the natural constituents of the blood, while Dr. Madden is of opinion that the blood-disease consists in the

presence of a distinct poison, on the influence of which all the subsequent changes depend.

Dr. Madden being unable to demonstrate the presence of this supposed virus, proceeds ingeniously to institute comparisons between the general symptoms of phthisis and those which arise from well-known and acknowledged poisons. He is of opinion that analogies are furnished by the poisonous effects of mercury, iodine, lead, spurred-rye, syphilis, the exanthemata, glanders, secondary abscesses following phlebitis, and the local effects of continued and periodical fevers. In all these affections, Dr. Madden traces certain similarities, such as fever, emaciation, deranged digestion, pains in the limbs, perversion of the functions of the skin, a small pulse, deranged secretions and excretions, and a weakened state of the whole system; to which certain organic changes succeed, such as affections of the eye, inflammation and ulceration of the larynx, formation of pustules or abscesses in the integuments and subjacent areolar tissue, affections of the brain, bones, joints, mucous tissue; while the important depurating organs—liver, kidneys, and lungs—are peculiarly liable to destructive alterations.

The phenomena of scrofula and phthisis, Dr. Madden believes, are closely analogous, if not identical, with those previously detailed. Thus, the fever, emaciation, deranged digestion, pains in the limbs, unnatural state of the skin, general weakness incident to phthisis, all bear a striking analogy to the same phenomena arising from the different varieties of poisoning enumerated. And again, the structural changes present striking similarities; thus, scrofula and phthisis, like poisons, are often associated with inflammation of the eye, ulceration of the trachea, affection of the absorbent glands, diseases of the bones and joints, affections of the brain, changes in the mucous tissue, together with local diseases of the lungs, liver, and kidneys. These similarities, the author believes, render it certain there is a common element belonging to all those affections, and that scrofula and phthisis are as much poison diseases as the morbid effects arising from mercury, lead, glanders, or syphilis; that there is, in fact, a specific *materies morbi* in the blood, and that

tubercle results from the modifications produced by that poison on nutrition.

In regard to this theory, it may be remarked, that many of the analogies are striking and pertinent, and afford valuable suggestions on various points connected with the subject; but, at the same time, the generalization is too hasty and indiscriminate; for, it must be conceded, that the analogies refer to advanced periods of the various diseases, rather than their inception, or even a moderate amount of development. Thus, all diseases of an exhausting or prostrating character have, at certain points, similar phenomena; for example, patients dying of inflammation of the brain and of typhus fever would present remarkable points of resemblance, and yet they are totally different in their character, one being simply a local inflammation, the other produced by a specific poison. In order, therefore, to render the analogy complete, it must be sustained throughout, and not be manifest alone in a single condition or stage. But after all, Dr. Madden resolves tuberculosis into diseased nutrition, for his imaginary poison is presumed to affect the nutritive functions, and thus causes the development of tubercle.

SECTION VII.

CHANGES IN THE CONDITION OF ALBUMEN AND FIBRIN.

According to the views of some pathologists, the special lesion of tuberculosis will be found in morbid states and secretions of albumen or fibrin. Chemical analysis has shown, in many cases, a slight excess of albumen, and this may be regarded as one of the conditions appertaining to tuberculosis. It is difficult to conceive, however, that a slight excess of this constituent of the blood should lead to the excretion of bodies like tubercles, and which undergo such remarkable changes after deposition. And it is well known that other diseases, including rheumatism, diabetes, and Bright's disease, have even a

larger proportion of albumen than phthisis; so that unless this element undergoes some special change, mere *excess* is wholly insufficient to account for the tuberculous condition.

Some recent observations have gone a step farther, and an attempt has been made to point out certain specific changes in the albumen, which, it is supposed, may throw light on tuberculosis. The observation has been made by Parkes, of London, Melseus, of France, and Panum, of Germany, that albumen may occasionally be precipitated from the blood by the action of an acid and a neutral salt—for example, acetic acid and chloride of sodium—but if long exposed to the action of an alkali or acid, it ceases to be precipitated. Dr. Parkes scarcely attempts to generalize from this observation, further than to hint the great importance of chloride of sodium in the animal economy, and its possible agency in the solidification and resolution of albumen. Jones and Sieveking predict, that these reactions of acids and alkalies on the serum of the blood will throw light on the constitution of tubercle. The subject is evidently of great interest, but the facts are too few and dubious in their relations to admit of even partial generalization.

The modifications of the fibrin of the blood, in some of its various forms, has been dwelt on by many pathologists. It is classed by Dr. Williams as *aplastic* lymph; while Rokitansky denominates the whole process of tuberculosis a *fibrinous crasis*. The latter pathologist declares that the arterial elaboration of fibrin constitutes the essential element of the tuberculous crasis. According to this theory, the entire mass of fibrin speedily becomes affected, and is excreted in the form of tubercle. The opinion of Rokitansky is based largely on the rapid coagulation of tubercle-blastema, its tendency to softening, and its formation being favored by arterialization of the blood, and hindered by a state of venosity.

SECTION VIII.

RETROGRADE MORPHOLOGY.

Dr. William Addison ascribes tuberculosis to a *retrograde metamorphosis*, in which the lower grade of cell-growth takes the place of the higher; and, as a consequence, tissues are not only imperfectly developed, but there is, likewise, a *retrograde* action manifested. Thus, cells of a low grade of action take the place of the higher or coherent cells, and the tissues consequently degenerate. According to the views of Dr. Addison, there is no essential difference between the cell-products of hepatization, pus, and tubercle. He believes, also, that the secondary blood-vessels observed by Van der Kolk and Guillot, which are formed after obliteration of the capillary system of the pulmonary artery, the adventitious vessels being supplied with aortic blood, constitute a part of the retrograde morphology which enters into the tuberculous condition.

We may readily enough admit the chief facts claimed for this theory of retrograde action in the nutritive function; but, at the same time, the essential cause of this great change remains, as before, unexplained.

SECTION IX.

DERANGEMENT OF THE ORGANIC NERVOUS POWER.

The first tangible point of tuberculosis, according to Dr. Copland,* consists in the cause imparting a morbid condition to the nerves of organic life, and, as a consequence of this, the blood becomes impaired. According to this opinion, the morbid deposits may be traced directly to the blood, yet the primary cause is in the nervous system, and acts through it on the

* Dict. Prac. Med., part xv, p 750.

blood. We can not doubt the presence of impaired innervation, but, at the same time, its exact relationship to tuberculosis remains to be determined.

SECTION X.

INFLAMMATION.

Many writers have sought to explain the deposition of tubercles on the hypothesis that inflammation was always present, and, therefore, was essential to the change. All of the phenomena of the disease, however, so pointedly contradict this hypothesis, that it need occupy but a limited space in our review of the subject. Neither the subjective nor objective symptoms, the chemical composition of tubercle and the blood, nor the results of post-mortem examinations, afford the slightest countenance to this opinion.

CONCLUSION.

The preceding *ten* theories embrace the principal doctrines which are maintained at the present time in explanation of the nature of phthisis. To these might be added many minor conjectures and less plausible hypotheses, especially among the more ancient authors; such as a *specific contagion*, advocated by Aristotle; *acrimony of the fluids*, by Cullen; *phosphoric acid*, by Baumes; *atony of the lymphatics*, by Hufeland; *obstruction of the mesenteric glands*, by Sutton; *hydatids*, by Baron; *entozoon*, by Carmichael. It can not be denied that some of these principal theories are plausible, and contain more or less truth, in the form of isolated facts; but when we attempt an explanation, on either of these bases, of the true nature of phthisis, we are at once met by numerous, if not insuperable difficulties. Doubtless these difficulties arise, at least in part, from the essential obscurity of the subject; but, at the same time, it is

equally probable that pathologists have too often substituted effects for causes, and have based general conclusions on isolated facts.

It will be remarked that the theories which occupy most attention at the present period may be classed under four general heads: 1. Those which refer phthisis to errors of primary digestion; 2. Some modification of that great pabulum of nutrition, *albumen;* 3. Idiopathic disease of the blood; 4. Derangement of innervation. The first and second theories are very intimately connected; and those who refer to altered or depraved albumen or fibrin, usually connect with it a preceding derangement of primary digestion, which, in fact, must be regarded as the initial link in the morbid changes.

The most common and captivating theory of tuberculosis is that which refers it to derangement of primary digestion. This opinion has been advocated by many German and English authorities, and, at the present time, has more supporters than any other doctrine. Dr. Wilson Philip* long ago described what he denominated *dyspeptic phthisis;* and Dr. T. J. Todd has elaborately discussed, in the *Cyclopædia of Practical Medicine*, the subject of what he denominates *strumous dyspepsia.* And, still more recently, Dr. J. Hughes Bennett has attempted to show that phthisis originates in derangement of primary digestion, especially characterized by the occurrence of *acidity.* Finally, Dr. Hutchinson has brought forward statistical evidence to prove that the disease is not only intimately connected with *dyspepsia*, but that it is particularly evinced by a distaste and difficult digestion of *fatty* aliment.

It will thus be perceived that the theory of indigestion has a very wide range, embracing, as it does, the strumous dyspepsia of Dr. Todd, the fatty indigestion of Mr. Hutchinson, and the acidity of Dr. Bennett. How far these theories are sustained by facts or logical induction, I shall proceed to inquire.

To render derangement of digestion, in a general sense, a competent cause of phthisis, it must be established that dyspepsia is a constant precursory symptom of the pulmonary

* Medico-Chirurgical Transactions, 1816.

disease; nor can it be regarded as an extreme assumption to say, that if deranged digestion is the essential cause of tuberculosis, such indigestion must invariably result in the tubercular affection. Indeed, if these positions are not admitted, we deny to dyspepsia the position of an essential inducing cause, and assign it the place of a secondary or accidental derangement. If, for example, indigestion and a distaste for fatty food, or the presence of acidity, are essential causes of tuberculosis, such symptoms must not only precede phthisis, but they must always be present, and lead directly to the pulmonary disease.

We are unfortunately in possession of but little statistical evidence bearing directly on this subject, and that little is sufficiently contradictory. Mr. Hutchinson* has furnished the results of fifty-six cases. They were out-door patients, attending the City Hospital for Chest Diseases. Of this number twenty-eight were males, and twenty-eight females; most were natives, and all residents of London. They were composed, chiefly, of clerks, porters, warehouse-men, shopkeepers, weavers, tailors, shoemakers, milliners, shop-women, school-teachers, etc. All except eighteen, in whom a history could be obtained, gave some evidence of hereditary taint, while in nine no reliable information was reached.

Of these fifty-six cases, dyspepsia was

Absent in	4
Mild in	21
Moderate in	22
Severe in	9

The prevailing symptoms of dyspepsia were biliousness, heartburn, flatulence, acid eructation; while the *form* manifested was difficult digestion, distaste for fats, sugar, and alcoholic liquors. Dislike for fats was present in seventy-one per cent. of confirmed cases; had existed throughout life in forty-eight per cent.; while only five per cent. were fond of fats; and only thirty-three per cent. could endure this class of food in moderate quantities. Acid eructations were present in sixty-two per cent.

* Med. Times and Gaz., April and May, 1855.

In these cases the dyspepsia

Preceded phthisis in	33
Followed phthisis in	9
Was coincident with phthisis in	10

These statements, it must be admitted, present a most formidable appearance, and it is not surprising that Mr. Hutchinson should draw decided conclusions from them, which he expresses in the following corollary: "To one or the other of these two classes, however, I suspect that all influence tending to produce phthisis, might easily be referred, namely, to errors in diet, or to the incompetency of the chylopoietic viscera." Thus Mr. Hutchinson, by attaching so much importance to dyspepsia in phthisis, is reduced to the necessity of regarding the *tubercular dyscrasia* as the result of faulty digestion or improper aliment; and even in cases clearly hereditary, he is still of opinion the digestive function is at fault.

The observations which I have been able to make on this subject are in marked contrast to those presented by Mr. Hutchinson. In one hundred cases occurring in my private practice, I have ascertained the following conditions:

Previous digestion good	85
Preceding dyspepsia	15

In ascertaining these facts, the histories of cases were carefully inquired into, and where any evidence of preceding indigestion could be obtained by the most careful examination, the case was classed with dyspepsia. I am not willing to admit, as has been alleged by some, that a want of careful and thorough examination has occurred where no evidences of dyspepsia are obtained; for, in all my cases, the patients have been questioned and cross-questioned with the greatest precision, and the results noted at the time.

In another series of cases I attempted to determine the question of ability to take and digest fat meats. Of forty-six cases thus noted, the following are the results:

Fond of meats	18
Not fond of meats	2
Fond of fat meats	23
Not fond of fat meats	15

Thus it will appear that exactly one-half were actually fond of fat meats, which they not only eat, but digested perfectly, and, with two exceptions, all were fond of lean meats. In these cases, also, the inquiries were made in the most careful manner, and the results fully recorded at the moment.

In addition to the above observations, those of Gellerstedt, in Sweden, are highly important. In three hundred and ten cases of phthisis, in forty-two only, or 7.09 per cent., had dyspeptic symptoms been manifested.

It is remarked by Mr. Ancell, that dyspepsia is sometimes totally absent in tuberculous subjects, and, that they may not only arrive at the stage of tubercular deposits, but may pass even through the first and second, and to the fatal stage, without a dyspeptic symptom.

The preceding facts, although to a certain extent contradictory, leave no reasonable ground for the opinion that phthisis is essentially the result of an antecedent dyspepsia. The cases related by Mr. Hutchinson, although they show the frequent occurrence of indigestion, under given circumstances, are far from proving a general law; while my own observations have been sufficiently numerous to establish the opposite rule. I do not design, in the slightest degree, to invalidate the facts presented by Mr. Hutchinson; but it is sufficiently evident that his generalization is altogether too hasty. His facts were drawn from a certain class of cases, the out-door patients of a hospital; and, from what we know of this class of persons in London, it is evident they are not in a condition to secure an abundance of nutritive food, a good atmosphere, and sufficient clothing. It is in that class of persons that food is particularly deficient; and it may fairly be questioned whether they ever had an opportunity of *cultivating a taste for fat meats.* The laboring classes of London can not indulge, *ad libitum*, in fine roast beef, fat mutton, or a fine quality of poultry; and hence, the tests proposed by Mr. Hutchinson must be regarded as peculiarly fallacious. Nor is it surprising that in such persons more or less dyspepsia should frequently occur, whether connected with tuberculosis or existing as an independent affection. On the other hand, my own cases were such as occurred in pri-

vate practice, many of them resided in the country, and were mostly in easy circumstances; and among these, antecedent dyspepsia was rare, and the aversion to fats not more common than in any other class of persons. And it may be further stated, that my observations have been much more extensive than represented in the figures above named; and that the same general results have been observed in a large number of cases, extending over a period of many years. I can not avoid the conclusion, therefore, that what may be true of a certain class of patients in London, is wholly untrue of another class in this country; and, consequently, the facts adduced by Wilson Philip, Sir James Clark, Dr. Todd, and Mr. Hutchinson, afford only important facts in relation to a certain class of cases, but do not establish a general law.

It must not be inferred, however, that I underrate the importance of the digestive function, either as a complication or cause of phthisis; for it is, doubtless, true, that chylopoietic derangement may become either the essential or inducing cause of the disease, and thus play an important part in the future progress of the morbid action. But my objection is to the theory which ascribes tuberculosis, in general terms, to derangement of primary digestion—a theory which is neither philosophical nor sustained by facts. Indeed, when we witness, as is often the case, the most inveterate and protracted cases of dyspepsia, running, it may be, through the greater part of a lifetime, failing to induce phthisis, it must be acknowledged that this cause, *per se*, is often inadequate to induce the disease. And further, when we find tubercular deposits a *congenital* disease, it must be admitted that the digestive organs are not the only source of this morbid condition. In such examples, primary digestion could have had no agency in the production of the disease, and the same is equally true of most cases occurring in early infancy.

We feel authorized, therefore, to reject the gastric theory as wholly incapable of explaining the origin of many, or even any large proportion of cases of phthisis; but, as a mere *symptom*, or in a therapeutical point of view, the derangements of digestion become vastly more important.

The theory of *defective elaboration of chyle* has been forcibly

dwelt on by several pathologists, and, either as a primary or secondary derangement, has been regarded as leading directly to tuberculosis. The theories of Schultz and Bennett, although they admit derangement of primary digestion, nevertheless look mainly to the condition of the lymph-corpuscles. According to Schultz, the tuberculous condition consists in an imperfect development of chyle-corpuscles; and these corpuscles being formed of a normal proportion of oil and albumen, any derangement of their elements results in abnormal chyle. Hence, in animals fed exclusively on oil or starch, the proper chyle-corpuscles are not formed, (in consequence of the absence of albumen,) the blood becomes proportionally deranged, and tuberculosis follows.

According to the views of Dr. Bennett, tuberculosis consists essentially in a disturbance of the normal relations between fat and albumen, which results in the imperfect formation of the chyle-corpuscles. This theory is nearly analogous to that of Schultz, but Dr. Bennett refers particularly to the observations of Ascherson, who alleges that an oily emulsion, formed in the digestive process, is necessary for the elaboration of the nutritive cells, and that albumen and oil, triturated together, unite in such a manner that the oil constitutes the nucleus, with a thin envelope of albumen. Dr. Bennett proceeds to state, very correctly, that healthy nutrition requires a due proportion of mineral, albuminous, and oleaginous elements; and he is of opinion that the experiments of Ascherson show *how* the oil and albumen act in relation to each other and to ultimate nutrition. These views, in the main, may be admitted to be true; for no enlightened physiologist will at all doubt, that the due admixture of carbonaceous and proteinaceous food is essential to the support of the animal system; one class being appropriated to the development of animal heat, and the other to the formation and support of the tissues. But furthermore, independent of the support of animal heat, oil doubtless aids in the elaboration of albumen; or, they act and react on each other in such a manner as ultimately to develop the physiological chyle-corpuscle. But Dr. Bennett goes further, and expresses the opinion that, in phthisis, there is an excess of

acidity in the alimentary canal, which renders the albuminous element of the food easily soluble, neutralizes the alkaline constituents of the saliva and pancreatic secretions, which renders them incapable of transforming the carbonaceous matter of vegetable food into oil, or of rendering the fatty matter easily soluble; in consequence of which an undue amount of albumen enters the blood, while the fat of the body is absorbed and consumed in the support of animal heat, and hence emaciation takes place. The next step is congestion of the lungs, which induces an albuminous exudation, constituting *tubercle*.

Such are the views of Dr. Bennett; and while they possess much plausibility, and, doubtless, represent, in part, the true state of the system, they are, nevertheless, inadequate to explain the essential points connected with the formation and deposit of tubercle. In the first place, the simple experiment performed by Ascherson, in which a thin layer of albumen is found to surround an oil globule when these two substances are triturated together, is fallacious in several respects; thus, such a compound of albumen and oil can not be taken as the type of the nutritive cell, if, indeed, they admit of any of the transformations which cells undergo. In the next place, cells of this character, according to the observations of Mulder,* may be produced by rubbing together oil and a solution of gum-arabic, which certainly could not be regarded as bearing any relationship to the physiological cell. Still, it must be admitted that the "molecular base" of chyle is largely fatty, or consists of oil, albumen, and salts, and that, finally, as the chyle reaches the mesenteric glands, the characteristic corpuscles and fibrin appear, while the albumen and oil diminish. It is, therefore, a process of elaboration; the nutritive materials of the incipient chyle are consumed or developed into chyle-corpuscles, fibrin, coloring matter, and red blood-corpuscles. And the elements essential to this complex nutritive act are albumen, fat, and certain salts; these constitute the pabulum out of which the great fabric is formed, and any deviation from this normal type must necessarily result in some form of morbid action.

* Carpenter's Phys.

But while we readily admit these physiological principles, we are led to inquire what are the facts which go to demonstrate, or even render probable, the assertion that tubercle depends on an absence of the fatty element? Doubtless a deviation of fat, or of albumen, or of the salines from the normal figure must, in some manner, interfere with the elaboration of chyle; but, again we ask, is there evidence to prove that the tuberculous condition consists in the diminution of oil and increase of albumen? In response to this question, there are no facts which throw much light on the subject. The assertion of Dr. Bennett, that acidity exists in the alimentary canal, and acts in the manner described, needs confirmation; and, indeed, the remarks already made on the state of primary digestion seem to show that the point of departure can not always be traced to that function. It may be remarked further, that so far as chemical analyses throw light on the composition of the blood, it is evident that there is a very unimportant deficiency of fatty matter in that fluid; and, still more remotely, that tubercle itself contains no inconsiderable proportion of fatty elements. We are fully authorized, therefore, to assume that, thus far, we have no evidence that the tuberculous condition arises from a deficiency of fat in the chyle, the blood, or in the tubercular deposits; or, still more emphatically, that it is the essential pathological condition which underlies that form of disease.

Passing beyond the chyle, we find Mr. Ancell ascribing the disease to a morbid state of the blood, which he believes to be the starting point in tuberculosis. But, unfortunately for this view of the subject, the most accurate and minute chemical analyses have been unable to demonstrate the presence of tuberculous matter, in any of its forms, nor has it been established that any of the elementary constituents of the blood become changed in a manner different from what occurs in other affections. According to the observations of Andral,* the fibrin preserves its normal quantity so long as the deposits remain solid, and the surrounding tissues are free from inflammation;

* Blood in Disease.

but, as softening takes place, accompanied with inflammation, the blood becomes proportionally charged with fibrin. The red corpuscles, on the contrary, are always diminished in number, which becomes more and more marked as the disease advances. It is, in fact, a state of anæmia of the most inveterate character, but does not, in any obvious manner, differ from that which occurs in other debilitated conditions. Of the albumen we can only say that it is slightly in excess; but, in this respect, offering nothing which is absolutely characteristic.

Under these embarrassing circumstances, the pathologist is forced to the conclusion that, although the blood is diseased in a marked and obvious manner, it does not offer any explanation of the true character of tuberculosis; for, as justly observed by Andral, if an impoverished state of the blood was sufficient of itself to produce tubercle, we should expect to find consumption far more common among chlorotic females. But there is no evidence that persons laboring under chlorotic anæmia are more subject to consumption than others; indeed, we often observe persons in an anæmic state for years without tuberculous disease becoming developed. It is well known that intermittent fever induces, in a most speedy manner, a state of anæmia; but so far from this causing the development of tubercles, many observers regard malarious disease as in some sense antagonistic to tuberculosis. It is abundantly evident, therefore, that the changes which occur in the common elements of the blood are insufficient to produce tubercles, and that if this blood be the actual seat of the disease, it is some inscrutable change which is inappreciable to the chemist or physiologist. It is not probable, indeed, that the most expert chemist could, by mere analysis, discriminate the blood of tuberculous subjects from that which belongs to other examples of anæmia.

The theory which ascribes tuberculosis to depression of the nervous function, especially of the nerves of organic life, is, like the others, insufficient to account for the phenomena; and, although such depression may be found in many cases, it is not demonstrable as the ordinary cause of the morbid deposits. There can be no doubt that the nervous system exercises an

important and direct influence over the circulation and function of nutrition; but that any known form of derangement is capable of establishing tuberculosis is not established by reliable observations, clinical or pathological, and, therefore, must be regarded as purely hypothetical. The nervous system of *animal* life seems, indeed, rather remarkably sustained; the mind seldom becomes desponding, but, on the contrary, the most remarkable but delusive hopefulness frequently continues to the latest period. How far this fact furnishes inferential evidence of the condition of the organic nerves may be a question, but it would seem to indicate that the nervous system, as a whole, is not essentially involved. In addition to this, and what is still more important, we have none of those evidences which would indicate impaired innervation of the sympathetic, such as deranged secretions, abdominal congestion, and similar evidences of depression of this portion of the nervous system. We do not pretend to doubt, however, that the state of the organic nervous function exercises an important influence over many of the vital acts, especially that of secretion; but the purely vegetative function of nutrition is, to a certain extent, independent of innervation, as is shown by its development, in the primordial cell, anterior to the formation of nerves. While we admit, therefore, the importance of the nervous function in the tuberculous condition, there is no evidence to prove that the disease originates from any defect in the function of the sympathetic system.

It is abundantly evident, from the preceding observations, that the theories on which most reliance has been placed to explain the nature of the tuberculous constitution, are radically defective, and fall far short of that elucidation which the importance of the subject demands. It can not, for a moment, be admitted that a state of dyspepsia explains the diathesis; nor can the imperfect development of the chyle and lymph, disease of the blood, or derangement of the nervous function, be regarded as the diathetic state. It must not be inferred, however, that I deny the presence of these *conditions* in connection with tuberculosis, nor that they are of unfrequent occurrence; on the contrary, all observation teaches that diges-

tion, innervation, the blood, and secretions, manifest more or less tendency to derangement in this state of the system. But it is, at the same time, evident that these derangements are not sufficiently constant, uniform, and characteristic, to entitle them to the position of essential pathological conditions or inducing causes, and that, therefore, they are to be regarded merely as occasional *exciting* causes, or, still more commonly, as effects or symptoms of the primary lesion.

The evident fault of those who attempt to speculate on the nature of tuberculosis, and to define a special lesion as the basis of all the changes, consists in an *exclusiveness* which limits the explanation to one individual function, omitting other conditions equally if not more important. This is the great fault of most theorists. They fasten on a single point, and blindly elaborate it to the exclusion of other changes, which are even more closely allied to the ultimate or local lesion. Thus, one fixes on the digestive function, another on the blood, others on the chyle, lymph, respiratory function, innervation, and so on; while, in truth, all the functions named become more or less involved, but perhaps none of them the primary cause of the diathesis.

In order to form any just conception of the nature of tuberculosis, it is proper to take, as the type, those examples in which the disease arises from hereditary predisposition, and ultimately becomes developed by its own inherent force, without any direct exciting cause. That cases of this elementary character are constantly occurring, no one at all practically familiar with the disease can doubt; and that such examples exhibit the true phenomena and the essential pathology of the affection, is equally apparent. Such cases do not require the intervention of bad diet, impure air, deficient clothing, mental anxiety, dyspepsia, or inflammation, for the development of open disease, but are influenced by certain constitutional peculiarities; certain functions, organs, and structures become impaired, and a series of morbid actions, revealed by characteristic external phenomena, take place, and gradually progress as the disease passes through its several stages.

It is an indubitable fact that tuberculosis often commences in

the most insidious manner. Its onset is not characterized by any of those marked symptoms which would enable us to refer it to deranged functions, such as have been made the basis of certain theories explanatory of its nature. On the contrary, it evidently originates in some of the ultimate actions of the system, either associated with the metamorphosis of the tissues, being a *debris* of the dissolving structures, or it is formed within the veins and lymphatics, as the result of new combinations in the materials recently absorbed.

The constant change which is taking place in the organic structures, affords a wide range for new combinations and new substances. In every organ of the body where blood-vessels and absorbents exist, these changes are constant and invariable; and there results from this disintegration various effete substances, as well as nutritive fluids, the one to be eliminated, and the other again appropriated to the tissues. The decarbonized blood, prepared for the nutrition of the tissues, is conveyed by the arteries to the different organs, and in its distribution through the capillary vessels completes the function of nutrition. But, conjointly with this process, disintegration is going on; and the result of this change of composition is the formation of new compounds, some of which are effete substances, destined to be conveyed out of the system, but mingled with a certain amount of nutritive fluid. The *debris*, containing effete substances, is taken up by the *veins*, and conveyed into the general circulation; the nutritive remains are absorbed by the lymphatics, and conveyed again to the chyliferous fluids.

The new compounds of effete substances are designed for excretion, the common and important combinations representing the nitrogenous and hydro-carbonaceous classes; among these we find urea, lithic acid, the hydro-carbon in the biliary secretion, and the carbonic acid discharged by the lungs, to say nothing of many other products. These compounds occur in the healthy condition of the system; and their proper formation and due elimination are necessary for the maintenance of health; and when a deficiency occurs in these processes, especially in that of elimination of effete substances, disease, general or local, necessarily results. The morbid actions resulting from

the retention of these substances are manifested in various forms; some of the effete elements act as poisons to the nervous system; others produce their injurious effects on the constituents of the blood; while some cause local excitement, congestion, or inflammation, together with morbid exudations.

It is a law of the animal economy that all extraneous substances which enter the circulation, seek elimination through particular tissues and organs; thus the impurities resulting from the metamorphosis of the tissues are thrown off, in the form of excretions, by the appropriate emunctories; while certain adventitious poisons, such as malaria, the special poison of fevers, including typhus and typhoid varieties, the exanthemata, and many other affections, seek elimination through particular tissues, doubtless depending on the peculiarities of each agent. And it is equally well established, that a poison seeking an outlet through an organ or tissue produces a local impression during its passage, which often induces more or less morbid action. This is manifest in the cutaneous and mucous inflammations connected with the exanthemata, the inflammation and ulceration of Peyer's glands in typhoid fever, the congestion and extravasation of the cutaneous capillaries in typhus, to say nothing of numerous less characteristic examples. These are familiar examples of poisons, *in transitu*, producing local disease; and there is reason to believe that the law is universal in its application. Doubtless a virus, in small quantities, may pass off through the skin, mucous membrane, or excretory glands, without inducing obvious, or, at most, but very slight, disease; but when the quantity is considerable, or the poison concentrated, congestion, inflammation, or deranged nutrition, in some of their varied forms, always ensues.

In the *acute* form of disease resulting from the effects of poisons, the local pathological changes are usually restricted to the products of *inflammation*, such as redness, softening, and inflammatory exudations; but in some forms of these affections there are, in addition to the ordinary results of phlogosis, certain *specific* deposits, or changes, which must be regarded as the special elaboration from the poison existing in the blood. This is witnessed in the *typhous deposits* of typhoid fever, the pustules

of small-pox, and the buboes and carbuncles of plague. When the morbid process is *chronic*, the changes are more evidently due to deranged nutrition than to inflammation; so we find, in place of redness, softening and ulceration, either local deposits in the form of degraded nutritive materials, hypertrophy, or induration. This is witnessed in the tubercles and nodes arising from secondary syphilis, and in the deposits of scrofula and phthisis.

But leaving this view of the subject, and changing the term from *poison* to *diseased nutrition*, we find numerous examples in which morbid products result from vitiated, arrested, or otherwise changed secretions, or elements, which induce general derangement of the constitution, and, in some instances, local deposits. This is witnessed in *diabetes*, in which the transformations of a nutritive element are arrested in its progress through the circulation, and the morbid product is conveyed off by the urinary secretion. In gout, certain changes take place in the blood, probably due to incomplete elaboration of nutritive elements, acute or chronic constitutional disease is established, and local deposits, more or less extensive, result from the general disease. So, too, in scrofula and phthisis, certain general evidences of morbid action take place, accompanied by local disease, in the form of inflamed lymphatic glands, or the more localized tubercular deposits.

In all of these examples, differing widely as they do in phenomena, progress, nature, and treatment, we find one essential condition common to all, which is a *specific* action. By this I mean to indicate that there is, in a certain class of diseases, peculiar inherent constitutional changes, the result of a special or *specific* agent or poison, and which agent or poison is uniform in its character, and invariable in its general results, and which preserves its individuality under the most variable conditions. Thus, we never find syphilis produced by paludal poison; measles by that of variola; nor is gout the result of hereditary phthisical taint; but each individual affection possesses its own *specific* morbid elements, produced by uniform causes, and giving rise to fixed and invariable results.

Among these affections, scrofula and phthisis stand pre-emi-

nent as *specific* diseases; they are, in my opinion, the result of peculiar and special causes, which give rise to uniform and invariable products, and are governed by fixed and well-defined laws. According to this view, tuberculosis is something more than *deranged nutrition*—a definition which has obtained such wide if not universal acceptation, but which is as unmeaning in reference to an actual explanation of the nature of the disease as are the terms "irritation" in pathology, and "alterative" in therapeutics. It is very true, indeed, that deranged nutrition exists in tuberculosis, and so it does in chlorosis, dyspepsia, diabetes, and a thousand forms of chronic disease; but as none of these have a natural tendency to produce local tubercular deposits, it is at once evident that the latter condition requires some special and peculiar lesion for its production, which it is safe to denominate a *specific affection.*

If we turn for an elucidation of the subject to the *local* deposit, we shall find this opinion strongly supported by the characteristics of tubercle.

The chemistry of tubercle indicates that it belongs to the so-called *protein* compounds; or more correctly speaking, it is of the albuminous series, being, however, a departure from the common characters of albumen. The opinions of pathologists have been widely different in regard to the actual nature of this morbid product. Chemists have detected in it albumen, casein, pyin, fatty matters, salts of soda and lime, and some say fibrin; while Güterbock claims to have discovered a peculiar substance, and Glover speaks of a peculiar extract. Whether these *peculiar* substances are to be regarded in the light of a special tubercular element, (*tuberculin?*) it would be fruitless in the present state of our knowledge to inquire, for the facts are too insecure and ill-defined to admit of any positive conclusions being based on them. At the same time, it may be stated as a hypothetical opinion, that some such peculiar basis of tubercle may yet be discovered. Whether tubercle is more nearly allied to casein than to albumen is an undecided question; it is certain, however, that it does not possess the properties of either, in any well-defined or characteristic form.

The microscopic elements of tubercle, as previously explained,

reveal imperfect cells and granules, indicating a feeble organic condition, which readily undergoes a retrograde action, instead of advancing to a higher state of organization.

These facts clearly indicate that tubercle is a peculiar or specific product, wholly unlike fibrin, albumen, casein, or other known compounds; that it is the product of the morbid action known as tuberculosis; never originates from any other process, nor is it related to any other heterologous deposit. It is, therefore, a product *sui generis*, specific in its origin, and uniform in its changes, when deposited in the pulmonary or other tissues.

Let us now inquire what are the sources whence this peculiar product could be derived. Four hypotheses may be adverted to in this connection. As previously stated, the disease has been referred to imperfect chylification, to disease of the blood, and to primary defect in the respiratory function. I have already stated the general reasons for discarding the theories which refer the disease to the chyle or the blood; and it may now be remarked that the formation of a new and peculiar compound, such as tubercle, in either the chyle or the blood, is, to say the least, extremely improbable. The chyliferous vessels, it is well known, possess a vital *selecting* power by which they reject all extraneous substances, or whatever is unfit for nutrition; and hence, whatever morbid product may be found in connection with the fluid, must be the result of elaboration, and not of mere absorption from deranged digestion. And as to the elaboration of tuberculous matter within the lacteals or thoracic duct, the evidence is simply negative. There exists no shadow of proof that any such process takes place; on the contrary, the transformations which occur within the chyliferous vessels, including the changes which take place about the mesenteric glands and in the course of the thoracic duct, are purely and exclusively of an elaborating kind. It may be true, indeed, that the degree of transformation will vary under different circumstances, and the changes may be less complete in one case than another; but we have no evidence, demonstrative or analogical, that new and peculiar products, wholly incapable of forming any portion of the tissues, or

taking part in any of the nutritive acts, are ever formed in the chyliferous tract; nor is it compatible with our views of vitality that such adventitious products should ever occur in that situation. If, indeed, tubercle were formed in the lacteals, or about the mesenteric glands, (the point of most probable abnormal action,) the evidences of disease would become at once apparent in this connection, involving especially the glands themselves.

For these reasons it seems improbable, if not impossible, that tubercle can be formed in connection with the elaboration of chyle; nor will it render the difficulty less if we assume that tubercle is merely albuminous, and this albumen, perhaps of a somewhat reduced type, is the product of faulty chylification. To such a position it may be distinctly answered, that tubercle is altogether different in its composition from albumen, and hence can not be a mere deposition of that substance. When it shall have been proven that, in tuberculous subjects, the albumen of the chyliferous vessels contains fatty matters, pyin, casein, and the other products of tubercle, then it may be admitted that the morbid process takes its origin in the lacteal system; but in the absence of such evidence, and in the face of the reasons already adduced, we are forced to the conclusion that this theory is erroneous.

With reference to the blood-origin of the disease, these reasons apply with equal, if not greater force. The blood is not an elaborating body. The changes which take place in its composition, either in the round of the general circulation or in the passage of arterial into venous blood, are the result either of additions to it in the capillary system, or abstractions from it by means of the various excretory organs. In the lungs the blood receives oxygen and exhales carbonic acid; in the liver it parts with much of its hydro-carbon; while the kidneys purify it by eliminating the nitrogenous elements of urine. In the capillary system it receives largely effete substances, together with the remaining nutritive elements which result from the metamorphosis of the tissues; but of its own action no new substance is produced, and comparatively but little change takes place in its own appropriate constituents. True, we observe certain differences between the arterial and venous blood,

the former being the most highly vitalized, and that which is adapted to nutrition; but these changes are due to the elimination of effete substances, and the vivifying influences of oxygen, and are not the result of its own inherent action.

But we have no proof that chemical changes take place in the blood so as to produce new substances, the only variations consisting in the increase, diminution, or altered properties of the normal constituents; and this wise provision of nature constitutes a safeguard against innumerable morbid actions, which, otherwise, would be constantly occurring; for it can not be doubted that, if any tendency existed to new combinations, the varying conditions of the composition of the fluid, and the different forces of the circulation, would induce daily changes incompatible with health or even life. While it is admitted, therefore, that the blood possesses an inherent vitality and independent cell-action, those properties are limited to the preservation of its own immediate elements, rather than the formation of new products; and it may fairly be doubted whether any form of blood-disease can arise *de novo*, but, on the contrary, must require some extraneous cause, either in the form of additions to the blood, the withholding of proper nutritive material, or the effects of deranged innervation. Thus, suppose the blood in rheumatism to be surcharged with uric or lactic acids, the morbid substance is not elaborated *in* the blood, but arises from the introduction of too much nutriment, which can not be transformed into urea, or from the failure to eliminate that substance by the proper emunctories. In diabetes the foreign substances are not produced in the blood, but are derived from without, and there is merely a failure in the process of transformation. In typhoid fever, small-pox, and so on, the disease of the blood does not arise from any inherent action, but the poison is received from without. In view, therefore, of these and similar facts, it seems a legitimate conclusion, that the formative power of the blood, so far as relates to the production of new substances, is extremely small, if it has any existence at all; and that while we fully acknowledge the importance of this fluid in pathology, and the necessity of addressing remedies to its abnormal condition, we must regard its

changes as secondary, depending on the action of extraneous agents and conditions.

The preceding principles have a direct bearing on the origin of tubercle. If the tubercular element is not formed in the chyle nor blood, there is but one remaining source to which we can look, namely, *the metamorphosis of the tissues*. We learn, from the most accurate physiological observations, that, during these changes, many new elements or substances are formed, and combinations are entered into which do not take place in any other part of the system. These changes are largely the result of chemical action, but doubtless, also, depend, to some extent, on new developments or directions of the vital forces, or on both combined. The products of these changes, in the main, are of a degraded character, having been produced by a retrograde action, and the elements and bodies so formed are destined for elimination, being unfit for recombination with the tissues; and if these substances accumulate too rapidly, or are not duly eliminated, disease, more or less intense, is the necessary consequence. Among these effete substances we find two prominent classes, one representing the carbonaceous, and the other the nitrogenous bodies. Nitrogen, in the form of urea and lithic acid, is produced in this manner, and eliminated by the kidneys; while the elements of carbon are thrown off mainly by the liver and lungs.

It may be supposed that certain opinions of physiologists in regard to urea and uric acid, militate against these views, and especially against the opinion that these bodies are not formed within the blood. Thus, while it is acknowledged that both urea and uric acid result from the decomposition of the tissues, it is observed that they are not detected in the "juice of flesh," or at least, that urea is not found in that substance, but uric acid, together with the allied substance hypoxanthine, has been detected, in considerable quantities, in the spleen. But granting that urea has not been found in the juice of flesh, its congeners, creatine and inosinic acid, are met with in that substance; and as there is reason to believe that these products of metamorphosis are converted into urea, it becomes probable that the change is effected, during the act of entering the blood-vessels,

by a process similar to the elaboration of secretions. Hence the change is not effected in the blood, but while in the act of *entering* that fluid. There are two additional facts which seem to weigh against the opinions here adopted in regard to the blood. One is the experiment of Wöhler and Frerichs, in which urate of potash was injected into the blood-vessels of rabbits; no uric acid appeared in the urine, but urea was largely augmented. It is inferred that the urea was formed in the blood, resulting, however, from the oxydizing process of respiration. Admitting this to be the proper explanation, it is hardly conclusive in the premises, for the change is due to the effects of oxygen in the lungs, and not to any cell-action of the blood, or reaction between its chemical or organic elements. Moreover, by such an act, a large quantity of chemical substances are suddenly thrown into the blood, which would be very different from what occurs in the spontaneous actions of the system. In the next place, the experiments of Lehmann showed that, while he was excreting 11.24 grains of uric acid in twenty-four hours, this was increased 22.64 when his diet consisted exclusively of animal food. It does not seem to me conclusive, however, that this remarkable increase of uric acid was derived *directly* from the food; on the contrary, it appears much more in consonance with the general laws of the economy, that the large increase of nitrogen was conveyed to the tissues, and made its appearance as uric acid following their metamorphosis.

But, whatever may be our conclusions in regard to these ultimate physiological questions, there can be no doubt that the effete, poisonous, and heterogeneous substances and elements are, as a rule, derived from the metamorphosis of the tissues, rather than the result of combinations in the blood. Or, if we admit that certain substances, as urea, first appear in the blood, it would still be evident that the *elements* were derived from the changing tissues, and, therefore, the question, in a pathological sense, would not be materially changed.

Taking all these facts into consideration, I am led to conclude that tubercle is almost of necessity the product of the metamorphosis of the tissues. It is here, and here alone, that we

find those important changes taking place which result in new combinations, chemical and organic, and which, passing into the blood, lead to local disease. This may be termed a *diathesis* when it is the result of a peculiar constitutional conformation, which, by its own natural tendency, eventuates in a specific form of disease. In the affections known as scrofulous and tuberculous, our pathological science is not sufficiently advanced to enable us to determine the nature or form of the original element or substance, which eventuates in tubercular deposits in the lungs. It may be that the metamorphosis of the tissues gives rise to an elementary form of tuberculous matter, of so subtile character as to elude the researches of the chemist and the microscopist, and which, passing through this current of the circulation, becomes lodged in the lungs, or other tissues, and there induces local disease. Another theory would indicate the formation of a low organic compound, essential tubercle, resulting from the decomposition of tissues; and that this substance circulates with the blood, and is deposited in the pulmonary tissue as tubercle. We are not able to determine, however, which of these hypotheses is the more plausible, but certain facts and principles indicate that the former is the correct explanation.

As opposed to the idea of an organic substance, of an albuminous nature, formed by the metamorphosis of the tissues, (or in the blood or chyle,) circulating through the system, and finally becoming deposited in the lungs as tubercle, we may mention the almost conclusive fact, that no such substance can be detected in the blood. If, indeed, a substance of the character of tubercle existed in considerable quantities in the blood, it would undoubtedly be detected by careful chemical analysis; but, on the contrary, we are unable to find anything resembling tubercle, except common albumen; and admitting that substance to be slightly in excess in the tuberculous constitution, it would involve an absurdity to call it tuberculous matter. If the albumen being slightly in excess in the blood constitutes that substance tuberculous matter, the whole system should at once become *saturated* with tubercular disease and deposits. Nor will it remove the difficulty by supposing that a secretion

of albuminous matter takes place from the pulmonary capillaries, as a consequence of this superabundance of that element in the blood; for, in that event, the deposit would partake of the simple characteristics of albumen, being merely an exudation of that substance; but we have no evidence that pure albumen will thus exude. A tendency to serous exhalation, the serum containing albumen, occurs in those states of the system in which the albuminous element is deficient, and where local congestions take place; but when this substance is in natural proportions, or even slightly in excess, it is extremely improbable that it will spontaneously exude through the capillaries of the lungs, in the form of small rounded masses constituting tubercle, or that even congestive action could induce such a result. And in the microscopic constitution of tubercle, we have indubitable evidence that this is not the mode in which that morbid deposit is formed. Tubercle contains granules and cells, the latter of a degraded character, but, at the same time, associated with fatty matter and other elements, indicating a low organic compound, susceptible of partial growth and limited duration. But these changes could not take place in connection with albumen; that substance, in a state of local deposit, would not admit of the formation of even degraded cells, much less would it maintain a growth for months and years before disintegration commenced; and the *fibrinous* element, which would be necessary for even abnormal growth and limited life, is not present in the deposit. And, in addition to this, it may be further stated, that an albuminous exudation into the pulmonary structures could scarcely assume the well-defined and rounded form of miliary tubercles; on the contrary, every analogy would lead us to suspect that, if it were simply an albuminous dyscrasy, the lungs would become largely infiltrated with the deposit, instead of that substance forming well-defined granules. It appears extremely improbable, also, that an albuminous deposit, in small and scattered granules, free from inflammation, as nearly all pathologists concede this to be, could ultimately excite so much inflammatory action as occurs in connection with tubercle. Simple albumen, on undergoing the process of liquefaction, should admit of ready absorption, without inducing

either inflammation or ulceration. Indeed, examples are numerous enough in the system in which even fibrinous deposits, having taken place under inflammatory action, soften and undergo complete absorption without ulcerative action. And no better example of this could be afforded than what occurs in pneumonia; here fibrinous deposits induce consolidation, but, in many examples, resolution takes place, and the fibrin, by a process of liquefaction, is completely removed.

It will doubtless be assumed by those who adhere to the theory of a degraded blood-plasma, that the tubercular diathesis has induced a depressed state of vitality, and hence the exudation readily passes on to destructive action. This, however, is a very partial answer to the objections mentioned; and, moreover, there are facts connected with certain forms of the disease, which clearly disprove that position. Thus, I have known examples in which the constitution was unimpaired, and no known hereditary taint existed, and yet an attack of pneumonia would finally be followed by the deposit of tubercles. Here the local action was really exalted, and the deposits of a fibrinous character; but mingled with this is found a certain amount of tubercle which speedily softens. This would preclude entirely the idea of *deficient* action constituting its basis.

It would appear, therefore, from these and similar considerations, that the theory which ascribes tubercular deposits to an albuminous dyscrasy of the blood, and ultimate exudation of that substance into the lungs in the form of tubercle, is radically defective, if not positively absurd.

Let us turn now to another view of the subject. On the supposition that the *elements* of tubercle are formed in the metamorphosis of the tissues, and that these elements, seeking elimination through particular tissues, become deposited or arrested, with all the attending phenomena of tubercle, the difficulties previously alluded to are removed, and the whole subject assumes a clearer and more philosophical aspect.

The evidence, that the elements of tubercle originate in the metamorphosis of the tissue, is based, in part, on the preceding considerations, by which we learn that no developments take place in the blood of the character of tubercle; and, in the

second place, the fact, that numerous and important compounds result from the disintegration of structures, renders it more than probable that it is here we must expect to find the origin of this morbid substance. It is true we can not, in the present state of science, demonstrate the existence of tubercle, or tuberculous elements, either in the decomposing tissues or in the blood; but we can not assume that the absence of such demonstration is conclusive evidence that such morbid elements have no existence, for it is equally impossible to detect, by chemical reagents, the presence of poisons which are known to be operating in the system. Thus the virus of small-pox is known to be in the blood, but the chemist is unable to demonstrate its presence. And, in relation to tubercle, it can not be demonstrated in the blood, even admitting the theory to be correct which ascribes it to that fluid. In fact, a large proportion of poisons which enter the circulation cannot be detected at any point, nor under any circumstances; hence it would be contrary to analogy if the elements of tubercle could be demonstrated to be present in the changing structures, or in the venous blood which receives the products of decomposition. It is true, some of the most important effete substances, such as urea and uric acid, can be detected in the blood; but even urea, which is a gross compound, is difficult of detection, and, according to Lehmann, it requires an accumulation in the blood of the entire quantity of urea formed in the system, for one hour, in order that it may be readily detected. But, upon the supposition that the morbid material of tubercle may be in a purely *elementary* form, it becomes at once obvious that its detection could not be anticipated.

Strong corroborative evidence of the correctness of these views may be deduced from the irritation of the lymphatic system, which is often present in the tuberculous diathesis. The concurrent opinions of a large proportion of pathologists establish the identity or close similarity of scrofula and phthisis; in fact, the two forms of disease are so often associated, while the general and local morbid actions are so nearly the same, that there evidently exists a close relationship, if not identity. And yet there are some points of distinction which are exceed-

ingly interesting, and evidently throw much light on the present view of the subject. Thus we often meet with cases termed *scrofula*, in which the external lympathetic system becomes involved, while phthisis pulmonalis is not developed. Indeed, there appears some reason to conclude, that when the lymphatic system becomes considerably involved, and external scrofula is developed, tubercular deposits are not liable to take place in the lungs. It becomes important, therefore, to inquire under what circumstances the affections co-exist, or why one may seemingly afford immunity from the other.

If the morbid elements originate in the decomposing tissues, it is quite evident the *venous blood* would receive the largest proportion, for it is well known that the lymphatics, like the lacteals, possess some degree of *selecting* power, which enables them to reject effete substances. But there are certain conditions when the lymphatics become impaired in vitality, and, losing some of their discriminating power, admit certain irritants, which induce more or less disease. This is observed in syphilitic poisoning, and various other conditions, in which the lymphatic glands become irritated or inflamed, as the direct effect of the foreign substance which has gained admission with the lymph. But this condition can occur only as the result of some *decided irritant* circulating with the lymph, or the immediate effects of primary inflammatory action. Taking, therefore, cases of scrofula into consideration, it seems evident that some subtile irritant gains admission to the lymphatics, and induces inflammation of the glands and tissues with which it comes in contact. It is scarcely probable that a slight variation in the elaboration of lymph (such as might be presumed to exist in tuberculosis) could induce so much local irritation as is often witnessed in cases of scrofula. Indeed, in regard to this whole subject, it appears evident that mere changes in the quantity of lymph or albumen could not, upon any known law of epigenesis, cause the degree of local irritation which is usually associated with scrofula and phthisis, and which is so inconsiderately ascribed to the presence of these substances; for, with all the variations which are claimed to exist in tuberculosis, these physiological elements remain but slightly changed,

and appear capable of performing their functions to a certain limited extent.

The only plausible solution, therefore, which can be offered of the nature of the irritant which enters the lymphatics in scrofulosis is, that the substance, whatever it may be, is an elementary body, and not in the form of an organic compound; hence it eludes detection, but produces characteristic effects on the parts with which it comes in contact.

In examples of *tuberculosis*, the morbid element enters the venous radicals, passes into the general circulation, and reaches the lungs and other tissues; in *scrofulosis*, the irritant enters the lymphatics, affects the glands, and gives rise to all the signs of that disease. To what extent these two conditions may act reciprocally, or how far the predominance of one may suspend or modify the other, are important but undecided questions; but there are some facts which indicate that a decided impression produced on one system affords some relief to the other; and thus scrofula often exists without tuberculosis, and *vice versâ*. It is not improbable, indeed, that if the morbid element takes the course of the external lymphatics, the internal structures may escape, and thus these vessels, acting as a diverticulum to the lungs, actually afford a protection to those organs.

The law which governs the development of these forms of disease, so as to give the preponderance to one or the other, remains unknown; we can not determine why, in one person, the morbid element should enter the lymphatics and develop external scrofula, while, in another, it should pass into the general circulation, and finally involve the lungs. These variations may arise from the influences of climate, the effects of diet, air, and hereditary predispositions, or may depend on different morbid elements. But our inability to offer a reasonable solution of the difficulty furnishes no valid argument against the views here adopted; for, on any other theory, (that of the blood, for example,) the difficulty is even greater. Thus, if the disease be developed, as Mr. Ancell believes, *in the blood*, there would be greater difficulty in comprehending the mode in which the lymphatic system could become exclusively involved.

But the truth is, these are ultimate facts, about which it is idle to speculate.

Assuming now, on the data given, that a morbid substance is generated in the metamorphosis of tissues, it is fair to infer that it will, like all other foreign matter, seek elimination through some organ or tissue. Indeed, it is a law of the animal economy, that all foreign bodies or poisons which enter the system seek an outlet through which they can be eliminated. This is accomplished through the medium of different tissues; for each element has its own special affinities in this respect. We find illustrations of this law in the elimination of the ordinary effete substances of the system, in the effects of morbid poisons, and in every species of virus or foreign substance which enters the system. Thus the virus of small-pox, measles, and scarlatina seek elimination through the skin and mucous membranes; the poison of typhoid fever affects mainly the glands of Peyer; the paludal poison is eliminated by the liver; that of yellow-fever acts mainly on the liver and intestinal mucous membrane; while the dysenteric virus possesses an affinity for the mucous membrane of the large intestines. In the elimination of effete substances generated by the decomposition of organs, we find the same law of affinity in operation. The nitrogenous compounds, in the form of urea and uric acid, seek elimination through the kidneys; the compounds of carbon, through the liver and lungs, while others pass off by the skin. These substances, in the physiological state, produce no disease while passing through their appropriate emunctories; but if their elimination fails, or becomes imperfect, they accumulate in the blood and induce diseases of various organs. And here in this morbid state we find the same order of specific action; thus, urea affects especially the brain and nervous system, while the retained carbon acts on the nerves, the lungs, and the liver. And we might add to this general view the specific action of medicinal agents, which illustrates this law in a forcible manner, but the subject does not require further elucidation.

But there is another law, regulating the effects of poisons and foreign bodies, which demands careful examination. It will be observed that in the passage of foreign bodies through emunc-

tories and tissues, evidences of local disease always become manifest. The morbid material does not pass quietly and harmlessly out of the system; but while in contact with the structure through which it seeks elimination, more or less excitement or disease takes place. This is witnessed in the typhous deposits of fever, the pustules of small-pox, the cutaneous efflorescence of measles and scarlatina, and the various forms of local inflammation which result from specific causes. All poisons injure more or less the tissues upon which they happen to locate, or even in their transient passage through them.

We assume, therefore, that the morbid element constituting tubercle seeks elimination from the system, and, evidently, mainly through the medium of the lungs, but in a more limited sense, through other organs and tissues.

It is probable that the morbid element may exist in the system for an indefinite period without inducing local deposits, being, in fact, eliminated as rapidly as produced, especially while existing in small quantities. This condition, in which the elementary tubercle is formed in small quantities, and eliminated as formed, constitutes what we recognize as the diathesis or precursory stage of phthisis; but when it becomes greatly augmented, or, by defective eliminating action, is deposited in the lungs or other tissues, it assumes the form of local disease.

Probably the earliest effect produced is what we have already described as constituting the precursory stage of phthisis, in which we find some degree of emaciation, slight cough, a morbid condition of the fauces, and more or less tendency to hæmoptysis. If the lesion can be arrested at this point, all the symptoms, general and local, subside; but if it progress, finally local disease takes place in the form of tubercles. The morbid element constituting the basis of tubercle, obeys the same general laws here that are observed in other forms of specific disease; namely, a local impression is produced, the nutrition of the part becomes modified, and abnormal action in the form of local deposits is the result. In small-pox the virus produces local inflammation in the form of a pustule, which goes on to suppuration; in tuberculization the process belongs

to the same form of morbid action, but differs in its results, depending on the character of its primary cause.

Observations have not fully determined the earliest characteristics of tubercle; but, as a matter of necessity, the tubercle-plasma must be deposited in a fluid condition. This, indeed, has been affirmed by observations with the microscope; but the earliest fully demonstrable condition is that of minute microscopic molecules, granules, and irregular cells. This condition, as observed by Dr. William Addison,* it requires the aid of the microscope to detect; and hence, the non-existence of tubercle is not to be assumed because it is invisible to the naked eye. But the whole process of tubercular growth affords indubitable evidence of a morbid exudation different in many respects from that of inflammation, being apparently intermediate between that condition and simple derangement of nutrition; but, at the same time, the whole process is so entirely *sui generis* that its specific character can admit of no reasonable doubt. There is, in fact, something more than a simple exudation of blood-plasma, in the form of modified albumen or fibrin, which would be called cacoplastic. It is impossible to conceive that either albumen or fibrin could be deposited without something approaching to inflammatory or congestive action; and it is also evident that neither of these deposits, when resulting from overaction, ordinarily pass through the stages which pertain to tubercles. Thus, depositions of albumen do not manifest the tendency to cell-development, however partial it may be, which is observed in tubercle; and, on the other hand, fibrinous deposits do not exhibit a like tendency to early disintegration or solution. If fibrin be originally defective, it does not pass into organization; and when even a low grade of organic action ensues, it is much more permanent than we witness in tubercle, and altogether different in character.

We are forced, therefore, to look for a specific action in the development of tubercle. That specific action, doubtless, consists in the effects of the elements of tubercle seeking elimination through the pulmonary tissue, and which may not inaptly

* Med. Times, vol. xvi, p. 298.

be compared to the pustulation caused by small-pox virus passing through the skin and mucous tissue. Under these circumstances the morbid element becomes deposited in the pulmonary tissue, and a perverted nutrition ensues; the specific action induces the formation of molecules, granules, and ultimately the tubercle-cell. Growth takes place under the specific influences of the original morbid element, which modifies the nutritive action, producing a substance neither the result of ordinary inflammation, nor simple degraded lymph, but a specific product, *sui generis*. The laws of epigenesis which govern the development of the new product, induce the formation of imperfect cells, which have a limited growth and duration of existence. Being of a peculiar or specific character they can not become assimilated to the surrounding tissues; and possessing imperfect cell-development, together with the special character of the product, the growth ceases, a retrograde action, manifested by softening, takes place, and elimination follows. This process of softening probably bears the same relation to tubercle that ordinary suppuration does to the inflammatory deposits; it is a retrogressive act, which reduces the solid body to a fluid state, and causes its elimination.

But the entire morbid process in connection with the disintegration of tubercle, is directly modified by the nature of the inducing cause. If the tubercle-element becomes exhausted or suspended, the process of softening and elimination exerts but little influence on the surrounding tissues; but if this morbid material continues to be deposited in considerable quantities, the surrounding structures take on a form of destructive action, of a low inflammatory type, the disintegrating process continues, and thus large cavities are formed.

Of the precise nature of tuberculosis and tubercle it is well to confess our ignorance. I have ascribed its origin to the development of a specific substance; but this substance does not admit of demonstration, and, therefore, is known only by its analogies and effects. Nor is the want of knowledge in this particular at all singular, for we must confess to similar ignorance in regard to the paludal poison, that of the exanthema, of typhus, and, in fact, all forms of elementary poisons or irri-

tants. And although we have the advantages, in this disease, of the presence of local deposits to aid in the elucidation, there is no light obtained from that source, for, in fact, as great obscurity exists in relation to tubercle, as the diathesis which produces it. We may, indeed, call the deposits "aplastic" lymph; still we are as far from an explanation of the nature of the substance as before. Tubercle is neither lymph, albumen, casein, nor any recognized organic product, but it is, in fact, TUBERCLE, *sui generis*, wholly unlike the other protein series. It resembles more nearly Mulder's hypothetical *protein* than any other substance, for it is destitute of sulphur and phosphorus.

In regard to the precise mode of its deposition, we can not speak positively. Negatively, it is not the product of ordinary inflammation, for extensive deposits may take place without co-existing vascularity of the part; it appears more nearly allied, therefore, to a secretory action, or simple exudation without material increase of vascularity. But it is evident that there must be some determining cause which gives rise to the local deposit, and it is affirmed by Vogel and others, that there exists a state of hyperæmia of the capillaries of the part; still, it would remain to be explained why this vascularity should take place, and why it should so frequently become developed in the pulmonary tissue. If it be ascribed to altered blood-plasma, the difficulty would not be removed, for there is no known alteration of that substance which does not occur in disease uncomplicated with tubercles; and, again, the theory would leave unexplained the fact that tubercles manifest a strong tendency to locate especially in the pulmorary tissues. There is no evident reason why altered blood-plasma should more frequently affect the lungs than the liver, kidneys, or brain; nor, indeed, is it probable that a slight change in the vitality of the fibrin of the circulating fluid, together with a diminution of red, and increase of white corpuscles, (the *obvious* change of the blood in tuberculosis,) could induce an exudation in the lungs without anterior local disease.

But when we trace the local changes more minutely, abundant reason will be found for the conclusion that tubercle, as such, is not a simple exudation of blood-plasma, but an epigen-

esis occurring extra-vascular. Thus, in the first place, tubercle is *not* blood-plasma—it is neither lymph nor albumen, but a modified product, the result of a local action, altogether specific in character, and derived from an anterior morbid element, which must be regarded as the determining cause. It has previously been stated that, governed by the general laws of morbid products, the tubercle-element seeks elimination, and that the lungs receive a large share of this substance which, for a time, is thrown off without inducing local disease. Finally, however, this element increases in action, until it perverts the nutrition of the part; and, as a result of this action, the *amorphous stroma* (the first exudation) is deposited in the tissues of the lungs, and in this the molecules and granules find a matrix. This amorphous stroma is not true blood-plasma, but a modification of the nutritive fluids, and, therefore, it gives rise to a peculiar organic product. In this stroma the tubercle-cells become developed, and, as already shown, they are imperfect corpuscles, produced under the influences of a low form of nutritive action. These cells are wholly unlike those which belong to degraded lymph-deposits, ("aplastic," "cacoplastic.") Those of lymph-origin fail to organize and pass speedily into suppuration—the corpuscular elements having predominated in the inflammatory effusion, and pus-cells being the ultimate product. But in tubercle, the cells are constantly and invariably imperfect, resulting from the nature of the peculiar *stroma* in which they are developed.

It seems evident, therefore, that the determining cause of tubercular deposits is the primary morbid element, which, in seeking elimination through the lungs, produces a local action in the capillaries of the mucous and areolar tissues of the part; this causes an exudation of the amorphous stroma, in which become developed molecules, granules, and, ultimately, tubercle-corpuscles. Hence it is a modified nutrition, but of a *specific character*, being the result of a specific morbid element. It is a condition of the deposits that they are insusceptible of true organization, and incapable of maintaining a stationary existence; hence they soften, and, like pus, usually seek elimination instead of absorption. The breach of continuity which is thus formed tends to extend rather than to heal; fresh deposits of

the morbid element take place, a low grade of inflammatory action supervenes, and the disorganization extends until the pulmonary substance becomes more or less extensively involved.

As some evidence of the correctness of the preceding views, we may advert to what occurs in variola, cancer, and typhoid fever. In variola and typhoid fever a poison is admitted to exist, which passes through the system, impinges on certain tissues, and produces local deposits. The poison of variola produces especially a local exudation of the corpuscular plasma in the skin; while typhous deposits take place in the alimentary canal. The former produces the exudation-corpuscles of inflammation; the latter causes the development of incomplete cells, not unlike those of tubercle. In cancer no acknowledged virus exists; but local changes occur, and the medullary form is prone to softening and elimination. In these examples a local irritant, sometimes inappreciable in its essential characters, produces extensive changes of nutrition, as profound and characteristic as those which occur in cancer. This is especially obvious in regard to variola; and although neither chemistry nor the microscope can detect the primary poison, yet its existence is as clear and undoubted as the local effect.

In relation to the tubercular diathesis, whether hereditary or accidental, some doubt may exist as to its mode of origin. The hereditary predisposition to tuberculosis is well established, but its exact relationship to the local deposits is uncertain. It is assumed, however, that certain functional defects of hereditary origin mark the tubercular diathesis; the blood is supposed to undergo certain changes which, in turn, modifies the nutrition of the whole system. But it will be observed that this condition may exist for an indefinite period without local deposits; hence it becomes a question, whether there is not some ulterior change necessary to the formation of tubercle. I believe that such is the case, and that ulterior change consists in the development, during the metamorphosis of the tissues, of the tubercle-element, which leads to the local deposits. The hereditary diathesis, therefore, merely favors or leads to the development of the elements which directly induce the local deposits; and,

until this ulterior change takes place, the mere diathetic state is wholly incapable of producing the organic change in the lungs or other organs. This, then, is the hereditary predisposition: a certain organization which may ultimately lead, under favorable circumstances, to the development of a tubercle-element, the latter causing the local deposit.

The duration and special phenomena of this diathetic state are exceedingly variable. The poison may be developed, and cause a certain impression on most of the functions, constituting what has been described as the *precursory stage* of phthisis, but as it is regularly eliminated, local disease does not occur until certain changes take place. But in other examples no precursory stage occurs; the individual remains apparently in perfect or even robust health, until pneumonia sets in, which is finally followed by phthisis. Here the predisposition is aroused by a local inflammation, and the developments necessary to produce tubercle follow the primary lesion.

Finally, the following conclusions seem fairly deducible from the preceding statements:

1. The tuberculous element originates in the metamorphosis of the tissues.

2. It seeks elimination through the lungs, and may continue to pass, in certain quantities, for an indefinite period, without inducing local deposits.

3. When the morbid element reaches a certain degree of concentration, or when, by long-continued action, it produces a morbid effect on the lungs, local deposits take place.

4. The first deposit is the elementary morbid substance known as the amorphous stroma; this is followed by the development of molecular granules and peculiar cells, which constitute *tubercle*.

5. After the existence of solid tubercle for a given period, it softens, and the debris seeks elimination through the bronchial tubes.

6. The morbid action extends to the adjacent tissues, causes inflammation, softening, and disintegration, too often resulting in fatal disorganization.

7. The perfect uniformity of tubercle throughout the body, in whatever tissue or organ deposited, exhibits strong evidence of the specific character of the disease, and that it could not originate from the ordinary derangements of nutrition.

8. The chemical and histological character of tubercle favor the opinion that the whole process is specific in origin and development.

PART SECOND.

ETIOLOGY OF PHTHISIS.

ETIOLOGY OF PHTHISIS.

In attempting to estimate the influences which operate in the production of phthisis pulmonalis, we necessarily direct our attention to those causes and conditions which are natural or hereditary, and those which may be considered accidental or acquired. The concurrent opinions of the entire profession fully establish the fact, that the tuberculous predisposition is capable of transmission from parent to offspring; nay, more than this, that in some examples the actual disease itself is thus communicated, tubercles having been formed in the fœtus in utero, and, therefore, strictly congenital. In a majority of cases, however, it appears to be only the *predisposition* which is transmitted, and the open disease becomes subsequently developed. The intensity of this predisposition, and the certainty of its development, are quite variable; in some examples the hereditary taint is so decided, that, even under the most favorable circumstances, or at least without the application of any obvious exciting cause, the disease becomes fully developed; while in other instances, the tendency to local disease is much less intense, and requires some of the usual exciting causes for its development. We are not permitted, however, in the present state of our knowledge, to assume that *all* cases are of hereditary origin; for examples are sufficiently numerous in which no *known* hereditary taint existed, while the development of the disease can be traced to some evident special cause. The causes of phthisis, therefore, are necessarily divisible into those which are natural or heredit-

ary, and those which are accidental. But this statement requires greater precision, in order to bring clearly to view those conditions and agents which seem most likely to develop the disease, and hence we must take into consideration the predisposing and exciting causes. As already intimated, we are not prepared to assign an hereditary taint as the universal cause of phthisis; and even when this predisposition does belong to the constitution, it is often requisite to apply an exciting cause to bring the disease into activity. Again, a predisposing cause, if sufficiently intense and prolonged, may be competent, without any pre-existing natural tendency, to develop the disease.

It is probable, also, that the tuberculous constitution may be congenital, while the ancestors were altogether free from that form of disease. That is, an imperfect organism may be transmitted from parent to offspring, which tends to the development of phthisis, while the parents were free from that disease, although exhibiting other defects.

CHAPTER I.

CONGENITAL PREDISPOSITION TO PHTHISIS.

SECTION I.

HEREDITARY PREDISPOSITION TRANSMITTED BY PHTHISICAL PARENTS.

It is not deemed necessary, in this place, to enter into a labored investigation of the subject of hereditary transmissions; and I will merely offer a few general statements of this doctrine which has received the sanction of the ablest investigators from the time of Hippocrates to the present moment. In the first place, the most casual observer can not fail to remark, that the physical conformation, temperament, intellectual and moral characters, are often transmitted from parents to children. It is not claimed, however, that this law is universal in its application, or invariable in its results; on the contrary, we often find examples in which but little, if any, resemblance to either parents or grandparents exists, however carefully the history may have been traced. Still the "family resemblances" are so numerous and frequent as to place the general law in a clear and undoubted light. And with this obvious physiological law clearly established, it ceases to be a matter of surprise that morbid states, or *tendencies* to morbid states, should also become susceptible of hereditary transmission; for the same general laws which govern the physiological acts, will be found equally effective in the evolution of morbid states. A large class of diseases are positively known to be susceptible of transmission in this manner, among which may be mentioned diseases involving the nervous system, gout, rheumatism, diabetes, asthma, diseases of the heart, syphilis, scrofula, and tuberculosis.

Much discussion has taken place as to the *mode* in which the transmission takes place; whether it is through the medium of the solids or the fluids. A little attention to the different forms of disease which are admitted to be capable of transmission will readily enough settle this question, at least it will establish a general law, if it does not afford a satisfactory explanation of each individual case. It will be remarked that, in the examples of transmission of syphilitic affections, on the one hand, and nervous disorders, on the other, the modes of propagation become extremely probable, if not positively certain. Syphilitic disease is evidently transmitted by means of the direct virus; while nervous affections depend, in all probability, on peculiar physical conformations, wholly independent of any form of poison. In relation to the means by which the tuberculous element is transmitted, some doubt may exist; and, indeed, different modes will be observed under varying conditions; thus, the mere diathesis must be presumed to depend on faulty conformation; while the actual local deposits might be supposed to afford evidence of the direct transmission of tubercle itself. But even in these striking examples an erroneous induction may place the subject in a false light. In fact, the connate tubercle is probably elaborated in the system of the infant, in consequence of faulty organization. Or, at most, merely the *elements* of tubercle (as elsewhere explained) could be thus imparted.

It must be admitted, however, that it is chiefly the predisposition alone which becomes hereditary; and this is rendered evident by the fact that persons will remain free from disease for many years, when, finally, their physical conformation gives rise to tubercular deposits. Such examples afford conclusive evidence that it is not an original *blood* disease, but arises from certain ultimate changes of nutrition.

Several important facts have been observed in relation to the laws governing hereditary transmission of the tuberculous predisposition; and among these none is more interesting than the suspension or interruption of the propagation for one or more generations. Every practitioner has met with numerous examples in which both parents were apparently free from taint, while their offspring suffered from tubercular or scrofu-

lous affections; but, on pushing the inquiry further, it would be found that uncles, aunts, or grandparents had suffered from similar diseases. A young man, laboring under the precursory signs of phthisis, presented himself to me for treatment; and the history of his case revealed the fact that he had lost four sisters and two brothers with consumption, and he, the remaining child, was now threatened. His father died at the age of forty-five, without any sign of pulmonary difficulty; his mother, aged fifty-four, is living, in the enjoyment of good health. On further inquiry, I learned that the grandfather on the mother's side was said to have died of "consumption of the bowels;" also that his mother had one sister die of consumption, and several of her brother's children perished in a similar manner. This is a very remarkable case. The maternal grandfather has some form of scrofulous or tubercular disease, but the daughter (mother of the patient) is well at fifty-four years of age, and yet her *seven* children become the subjects of consumption; *six* die, and the seventh manifests decided symptoms of the approach of the disease.

It remains to be established to what extent this *atavism* may proceed; that is, for how many generations may the morbid action remain dormant, and finally become excited into action? We have conclusive evidence that one, two, or three generations may pass by without consumption, when it will suddenly be revived, without any apparent cause; but, in a majority of cases, according to my own observations, it will hardly pass the second generation without becoming in some way manifest. It is a curious law, also, that a portion of a family of children will escape, while others become the victims of disease. In this and similar instances of apparent suspension of disease, the explanation will most generally be found in the effects of *crossing*, that is, one parent being free from taint. Under such circumstances, it will be found that, in those who escape, the physical conformation of the sound parent has been copied; and in this manner, doubtless, the specific diathesis may become entirely extinct, the sound parent imparting a good constitution to the children.

The *frequency* of the hereditary transmission of phthisis and scrofula is an important question. And here it may be re-

marked, that the question before us would be placed in a more definite light if the recorded facts were limited to phthisis alone; but such has been the tendency of writers to blend scrofulous and tuberculous affections, that it becomes impossible, in statistical inquiries, to make a separation of the two forms of disease, and hence we are obliged to consider them jointly.

In the cases analyzed by Louis, one-tenth were children of tuberculous parents; but this accurate observer considers his facts too meager to justify positive conclusions.

The following table furnishes the results ascertained at the Brompton Hospital for Consumption, in which the disease existed in the parents.

Sex.	Cases of Consumption.	Predisposed by disease in Parents.	Per Cent.
Males	669	122	18.2
Females	341	124	36.3
Total	1010	246	24.4

This table exhibits 24.4 per cent. of hereditary cases, which accords with the statements of Dr. Walshe; but when it is remembered that the history was traced only to the parents, it is fair to infer that the proportion would have been greatly increased had the investigation extended to the second and third generations.

I have analyzed one hundred cases, eighty males and twenty females, occurring in my own private practice, of which the following is an abstract:

The father was tuberculous in	5
The mother in	13
Both parents in	3
Grandparents in	5
Brothers and sisters in	15
Uncles and aunts in	5
Relatives in	7
Total	53
No known relative affected in	47—100

It will be observed that this table shows a very large per centage of hereditary cases, but it extends beyond the parents. If we limit hereditary transmission to those cases alone in which the parents are affected with the open disease, the proportion will be greatly reduced. Thus, instead of fifty-three in one hundred, we will have only twenty-one as the number per hundred. I believe, however, that where several members of a family become affected with phthisis, it may fairly be considered hereditary; and this is certainly true where the grandparents have been diseased, although the parents may have escaped. When different branches of the family have been affected, such as cousins, uncles, and aunts, without the parents, grandparents, or brothers and sisters, I have classed them under the head of relatives.

In three hundred and fourteen cases, given by Rilliet and Barthez, the following statement is found:

Positively hereditary	25
Probably hereditary	21
Total	46

Taking the aggregate of the positive and probable, the per cent. would be 14.6.

The following table exhibits the results observed by Lebert in one hundred and thirty-two individuals affected with scrofula and tubercle, whose family histories were obtained:

132 Cases.	No. hereditary Taint.	Scrofulous.	Tuberculous.	Scrof. & Tub.
Scrofula.....44.....	.....29.....	..... 8.....	..... 3.....	..... 4.....
Scrofulous and tuberculous .....30.....	.....12.....	..... 3.....	..... 8.....	..... 7.....
Tuberculous.....58.....	.....46.....	..... 0.....	.....12.....	..... 0.....
Total.....	.....87.....	.....11.....	.....23.....	.....11.....

From this table we obtain the following facts in regard to tubercles:

Fifty-eight cases of tubercles had twelve instances of hereditary transmission; or 22.5 per cent., while of the thirty cases of combined scrofulous and tuberculous diseases, eighteen had hereditary, or 60 per cent.

In relation to *scrofula*, Mr. Phillips furnishes the following facts, obtained from 2023 families, numbering 7587 children; of these children 1739, nearly 23 per cent., afforded evidences of some form of scrofulous disease. In 506 instances, both parents seemed free from taint, while of 2021 children belonging to them, 421, or near 21 per cent., were scrofulous. In 276 instances, both parents labored under scrofula, their children amount to 1092, and of these, 271, or nearly 25 per cent., exhibited marks of scrofula. In 589 instances the father bore marks of scrofula, the mother being free from taint; their children amounted to 2107, and of these 483, or nearly 23 per cent., exhibited marks of scrofula. In 652 instances, the mother afforded evidences of the disease, while the father was free; their children amounted to 2367, and of these 563, or nearly 24 per cent., bore marks of scrofula.* These statements will be more readily comprehended by the following arrangement:

No. of Families.	Condition of the Parents.	No. of Children.	No. of Scrofulous Children.	Percentage.
.....506.....	Both parents untainted..	.....2021.....	..... 421.....	....20.8...
.....276.....	Both parents tainted.....	.....1092.....	..... 271.....	....24.8...
.....589.....	Father alone tainted.....	.....2107.....	..... 483.....	....22.9...
.....625.....	Mother alone tainted.....	.....2367.....	..... 563.....	....23.7...

These results are interesting, but evidently defective. Mr. Phillips infers that they show a hereditary transmission in a little less than 4 per cent. If we take these statistics as a guide, it will appear that 20.8 per cent. of the children of untainted parents have scrofula; while in examples where both parents afforded evidences of scrofula the percentage was increased to only 24.8. This would make a difference of only 4 per cent.

* Scrofula, etc., p. 111.

in favor of hereditary transmission. But there is one obvious source of fallacy in this statement which may materially modify the result: it appears that the investigations in those who are styled free from taint, did not extend beyond the parents; whereas, it is extremely probable that, in many of these examples, the grand or great-grandparents may have suffered from the disease. The law of transmission fully recognizes the importance of extending investigations to the second or third generations; and without this precaution we are constantly led into the most serious errors. If this course had been pursued, it is extremely probable that the 2021 children, (whose parents are said to have been untainted,) and in whom nearly 21 per cent. became scrofulous, would be found to have had tainted grand or great-grandparents.

Furthermore, it is by no means certain that a portion of these supposed untainted parents may not have been, at that time, or afterward become, affected with tubercular disease; for it will be remarked that the author looked alone to the marks of external scrofula, without investigating the condition of the lungs. It is obvious, therefore, that the conclusions of Mr. Phillips are not exact, but must be regarded as a mere approximation to the truth.

Dr. Balman* furnishes the following statistics. In one hundred and forty-one scrofulous persons, phthisis preceded it thus:

FATHER'S SIDE.

Father died of phthisis in	9
Uncles and aunts in	61
Grandfathers in	11
Grandmothers in	17
Total	98

MOTHER'S SIDE.

Mother died of phthisis in	11
Uncles and aunts in	38
Grandfathers in	9
Grandmothers in	29
Total	78

* Scrofulous Disease, etc., London, 1852.

It appears, from this table, that consumption was quite common as an antecedent of scrofula, on both the father's and mother's side, but somewhat more frequent in the former, in the proportion of ninety-eight to seventy-eight. It clearly marks the hereditary character of scrofula.

According to Lugol, one-half of scrofulous cases have tuberculous parents.

The evidence adduced in the preceding tables indicates hereditary transmission in from one-fourth to one-third of the cases; but whether this is a fair estimate of the actual proportion is very questionable. There is a strong presumption, in fact, that this statement falls below the average proportion of hereditary cases; for, as already intimated, many of the investigations go no farther than one generation, while, had the researches been extended to the second or third, a much greater proportion might have been detected. So far as I can rely on my own cases, I am fully convinced that *one-half* have acknowledged an hereditary predisposition, as shown in some branch of the family; and this I am induced to think will be found about the proportion in this country generally.

It is a subject of curious and interesting inquiry to determine the relative frequency of transmission by father and mother, and also the relative frequency of transmission to sons and daughters. The statistics bearing on these inquiries are not sufficiently accurate and extensive to decide these questions with absolute precision; but they afford, nevertheless, some interesting facts which are not altogether unreliable.

In my own cases some remarkable facts will be observed. Thus, in one hundred cases, the disease is transmitted by the father four times, and by the mother thirteen, showing a very great preponderance in favor of transmission by the mother.

The number of cases, it is true, is not sufficient to establish a law, and might be materially modified by additional facts; but it will be seen by what follows, that the disease is transmitted most frequently *to* females, which affords some ground to conclude that it may be more readily imparted *by* females.

The Brompton Hospital Report contains the following tables:

TABLE SHOWING THE SEXES OF TWO HUNDRED AND FORTY-SIX PATIENTS, AND THE DISEASED PARENTS.

	Males.	Per Cent.	Females.	Per Cent.
Father	42	6.2	31	9.
Mother	24	3.7	39	11.4
Father and mother	12	1.8	10	2.9
Mother, and brother or sister	19	2.8	22	6.5
Father and mother, brother or sister	4	0.6	6	1.7
Total	122	18.2	124	36.3

This table shows a large percentage in favor of hereditary transmissions to females over males, in the proportion of thirty-six to eighteen, two to one. The following affords an abstract of the preceding table, omitting cases in which both parents were affected, and also brothers or sisters.

	No. of Cases.	Father Consum'ye.	Per Cent.	Mother Consum'ye.	Per Cent.
Sons	106	63	59.4	43	40.6
Daughters	108	47	43.5	61	56.5

Thus, the father transmits the disease to sons in 59.4, to daughters only 43.5, while the mother transmits to sons 40.6 per cent., and to daughters 56.5.

The tables of Dr. Balman exhibit greater frequency of transmission of scrofulous diseases by females than males:

Father died in.....9 instances; mother in..... 11.
Grandfather in.....20 " grandmother in.. 37.

This exhibits a greater frequency of transmission from mothers and grandmothers.

The preceding statements seem to indicate (with what certainty each one must judge) that females transmit the disease more frequently than males; and if we might draw conclusions from such limited and uncertain data, we would also conclude that fathers transmit it most frequently to sons, mothers to their daughters. The presumption is, that these are the facts of the case, although perhaps not positively proven.

SECTION II.

HEREDITARY PREDISPOSITION TRANSMITTED BY NON-PHTHISICAL PARENTS.

It is a question of great interest whether parents free from tuberculous predisposition, may produce children with a congenital tendency to that form of disease. The affirmative of this question is rendered probable by many observations. We occasionally meet with examples in which the disease did not exist in the parents, nor any of their ancestors; and yet children appear to be born scrofulous or tuberculous; or, at least, with a connate tendency to these affections. Many writers admit this view, among whom may be especially mentioned Mr. Ancell and Sir James Clark; and it is generally assumed, that various causes capable of impairing the vitality of one or both parents, may induce this condition. It is fair to assume that it is not a transmission of a specific disease, but merely a weakened vitality, in which the ultimate affection is readily engendered; or, like the true hereditary predisposition, may, by its own inherent action, advance to open disease.

Among the various conditions of the parents which may engender the tuberculous diathesis, we may enumerate the following:

1. Syphilitic disease. 2. Mental despondency, especially of the mother. 3. Inequality in the ages, temperaments, and habits of parents. 4. External influences, such as climate or

food, favoring the development of tuberculosis. 5. Sexual excesses. 6. Intemperance.

Many of the statements, in reference to individual diseases, are purely speculative, and, indeed, it is very difficult to specify the forms of derangement most liable to induce congenital phthisis or scrofula. In general terms, however, it may be said that all those forms of disease which are calculated to destroy the harmony or impair the vigor of fœtal growth, are, theoretically, competent to induce a scrofulous or tuberculous constitution. It has been stated by Sir James Clark,* that parents laboring under disordered states of the digestive organs, gout, cutaneous diseases, effects of mercury, debility from disease, age, etc., or, in more general terms, a deteriorated state of health, may give rise to the scrofulous constitution in children. This statement is doubtless correct in a general sense; if it were not so, we should be obliged to exclude all accidental causes from the list of those capable of inducing the tuberculous diathesis, and limit that disease strictly and absolutely to the hereditary taint. In our present state of knowledge we are not prepared to embrace this latter alternative, and therefore admit that certain forms of deteriorated constitution of parents (not essentially scrofulous) are capable of imparting to offspring a form of constitution which, under favorable circumstances, degenerates into tuberculous or scrofulous disease.

But the close reasoner will readily enough perceive that this is no evidence of the hereditary transmission of the actual *scrofulous* diathesis, but that it is merely a constitutional *imperfection*, which, being readily impressed with morbific agents, may degenerate into true scrofula. It is not, therefore, an actual predisposition to *scrofula* which is inherited, but merely a *weak* constitution, which, acted on by *other* causes, may finally develop that disease.

Among the various forms of disease of parents supposed to be capable of imparting a scrofulous tendency to children, syphilis occupies an important place. It is contended by some, that parents laboring under constitutional syphilis are capable of

* A Treatise on Pulmonary Consumption.

producing scrofulous children; and, indeed, some writers have expressed the opinion that scrofula is merely a modification of syphilis. It was the opinion of Astruc that syphilis, transmitted through several generations, finally merged into scrofula; and Alibert affirms that at St. Louis a large proportion of scrofulous cases arose from hereditary syphilis. The latter author had a syphilitic patient, eighty years of age, who contracted the disease at an early period, and from this person proceeded two generations, many of whom were scrofulous. Among modern writers Dr. Whitehead* may be mentioned as having espoused this doctrine, and he expresses the belief that the conversion of syphilis into scrofula is by no means improbable. In confirmation of this opinion he mentions a remarkable case, in which secondary syphilis made its appearance in a man who had supposed himself cured before marriage; his wife suffered with similar symptoms, and two of the daughters died before the age of twenty, affected with phthisis, complicated with swelling of the knee in both, such diseases having been previously unknown in the family.

But, notwithstanding these and similar examples, we are not justified in admitting the convertibility of these two forms of disease. It is contrary to the laws which govern specific poisons that they are capable of conversion one into the other, or, in fact, into any specific form of morbid action other than that which belongs especially to them. It is very true, indeed, that secondary or tertiary syphilis may give rise to various forms of disease; the lymphatic glands may become involved, the skin affected with eruptions, the mucous tissues with ulceration, the bones with caries; thus differing widely from the original disease, and seemingly new affections. But in all these modifications of diseased action it is still the specific effect of the original virus, operating through the medium of the general system, and not the production of a new morbid element. And in those examples in which phthisis or some form of scrofulous disease arises in the offspring of syphilitic parents, it does not prove the direct conversion of syphilitic into scrofulous disease; on the contrary,

* On Hereditary Diseases, etc.

it merely affords evidence that the impaired vitality of the parent is capable of imparting to the children a weak or imperfect constitution, in which scrofula or phthisis may ultimately become developed. I do not conceive that we possess any scientific evidence of the conversion of syphilis into scrofula.

I entertain no doubt, however, that secondary and tertiary syphilis may become the inducing cause of phthisis. A number of cases have come under my observation in which syphilis appeared to be the exciting cause, and was so considered by the patients themselves. The most marked cases were those in which no hereditary predisposition existed, and where the system became affected with the syphilitic poison in an extreme degree. I am strongly inclined to the opinion that a much larger number of cases of scrofula and phthisis are due to syphilis, as an inducing cause, than is generally believed; but, as this opinion is partly inferential, it would be improper to base any important conclusions on it.

CHAPTER II.

CAUSES WHICH MAY INDUCE PHTHISIS INDEPENDENT OF AN HEREDITARY PREDISPOSITION; OR, WHICH FAVOR THE DEVELOPMENT OF DISEASE WHERE THE CONNATE TENDENCY EXISTS.

General observation has established the fact, that phthisis may originate in persons apparently free from all hereditary taint. The causes which have been supposed capable of inducing phthisis, are too numerous to admit of accurate classification; but the most prominent are believed to be connected with climate, diet, occupations, and habits. To these, however, must be added certain pathological causes, which are deemed sufficient, under certain circumstances, to induce the development of tuberculosis.

When general causes operate independent of a tuberculous predisposition, it usually requires a long-continued application to establish disease; but when the diathesis already exists, these causes act much more speedily and certainly. Hence, persons predisposed to phthisis would be liable to suffer from causes which would scarcely disturb the health of those free from a tendency to tuberculosis. In considering these accidental causes, therefore, we can not fail to perceive that the two classes of persons will be differently affected. In the hereditary class, the influences operate merely as *exciting* causes; while in those not hereditarily predisposed to phthisis, they act both as predisposing and exciting.

In considering these general questions, it is impossible to draw a distinction between persons possessing a sound or dia-

thetic constitution, and we can only, therefore, investigate the effects of incidental causes on all classes, whatever may be their constitutional predispositions.

SECTION I.

THE INFLUENCES OF CLIMATE IN THE PRODUCTION OF TUBERCULOSIS.

The influences of climate in the production of phthisis has, from the foundation of medicine, been considered highly important; hence, I shall endeavor, in the succeeding observations, to present, as nearly as possible, the most reliable facts which have been collected. The subject is naturally divisible into two branches; the first relates to the geographical distribution of the disease, while the other embraces the effects induced on tuberculous subjects by a change of climate. The latter obviously belongs to therapeutics, and will be discussed in that connection; while the former will engage our attention as one of the causes of the disease.

The subject is evidently complex and full of difficulties. Thus it is not merely the degrees of latitude, or the range of the thermometer, which are to be studied; but, in reaching conclusions, we must likewise take into the account the altitude, the degree of moisture, endemic influences, races and habits of the people, diet, degree of civilization, and the state of medical science. These secondary influences are often more potent than mere degrees of latitude or temperature. Indeed, if it were otherwise, it would be an easy task to trace the distribution of phthisis over the habitable globe, and to deduce the laws which govern its prevalence.

THE GEOGRAPHY OF PHTHISIS.

By the expression "geography of phthisis," I mean to indicate the natural prevalence of the disease among the permanent inhabitants of a given district of country, independent of its

occurrence in transient persons, those who occupy prisons, or belong to armies. The opinion has long prevailed in the profession that climate exercises a strong influence over the development of phthisis; and a careful examination of the well-ascertained facts affords ample confirmation of this impression, although the true state of the question is, perhaps, not even yet fully developed. As to the main fact, in a general sense, there is reliable evidence to show, that while consumption is almost unknown in some localities, it is so common in others as to cause the chief mortality. These differences must depend on some potent law of climatic or endemic influence, peculiarities of race, or domestic habits, which it becomes us properly to understand.

It may be stated, *in limine*, that so far as mere temperature exercises an influence over the development of phthisis, there are two remarkable facts clearly established, namely, that the extremes of heat and cold are conditions unfavorable to its production. The arctic and the tropical regions, therefore, are the situations, *cæteris paribus*, most exempt from phthisis; while, on the contrary, the so-called temperate latitudes are the locations most liable to its development. It is probable, therefore, that a tolerably well-defined thermometrical line may be found where the disease is at its maximum, and progressively diminishes north and south; but, at the same time, it can not be presumed that the prevalence of phthisis can be marked out simply by the parallels of latitude or range of the thermometer, for numerous incidental conditions will be found to exert a controlling influence over its development. Among these secondary causes (which may often be regarded as primary) will be found moisture, altitude, habits of the people, and similar agencies. Among these, doubtless, by far the most potent are moisture and altitude. A cold and moist climate will prove unfavorable; while a cold and dry, or warm and dry atmosphere, will be conversely propitious. I shall proceed to examine this subject according to the influences of the different zones, exhibiting, as we proceed, the exceptional examples and the causes which produce them. It will become evident, as we progress, that any attempt to establish an absolute connection

between the isothermal lines and phthisis must prove utterly fallacious; for, notwithstanding the general law in relation to extremes of latitudes, yet so many disturbing influences will be met with, especially in the temperate latitudes, that the mere degree of heat can not be regarded as the governing principle in the development of phthisis.

PHTHISIS IN THE ARCTIC REGIONS.

By this term I do not mean strictly the *arctic circle*, but design to embrace in it those regions which, by their degree of cold, may fairly be denominated *arctic*. These may properly embrace all above the sixtieth parallel of north latitude, which will present sufficient uniformity of results for our present purposes. This division will include, in the Eastern hemisphere, the greater portion of Sweden and Norway, Russia, north of St. Petersburg, and Lapland; and, in the Western hemisphere, the northern half of British America, Russian America, Greenland, and Iceland.

Statistical information concerning these cold regions is necessarily scanty; but general observations and statistics, as far as they can be obtained, reveal the general fact that phthisis, in in these high northern latitudes, is an extremely rare affection. The testimony of Sir A. Crichton and Sir George Lefevre go to show that phthisis is much less common in Russia than in Great Britain. Sir A. Crichton, who made personal observations in Russia, says consumption is infinitely more common in Great Britain and Ireland than in Russia; but that scrofulous affections are vastly more frequent in the latter.* Among the nobility, however, he is of opinion that the disease is more common. Linnæus states that in Lapland consumption is an extremely rare affection. In the history of Greenland, by Crantz, it is affirmed that consumption is very rare. Dr. Baly has collected statistics from the prisons of Norway, from which it appears that the mortality is very low, which he ascribes to the infrequency of phthisis. Dr. Schleisner, who was charged

* Practical Observations on Pulmonary Consumption.

with a commission, by the Danish government, to Iceland, states that the disease is very rare in that island. Thus, of 13,924 deaths, from 1827 to 1837, not one occurred from phthisis.* And Dr. Thorstenson, who practiced in Iceland seventeen years, bears testimony to the infrequency of the disease either in the form of scrofula or phthisis.† Such a locality may be said to be absolutely free from the disease; not, indeed, that no case can be presumed ever to have occurred, but the infrequency is so great that the population may be considered free from consumption. According to M. Panum, the Fero Islands are equally exempt from consumption.

But there are some portions of the polar regions which do not seem to enjoy the same immunity. Finland and Archangel, for example, are said to furnish cases of the disease. The latter is remarkable for its dampness. So great, indeed, is the humidity of this climate that the agriculturists are obliged to dry their grain in ovens.

We have but little definite information of the prevalence of consumption among the Esquimaux who inhabit the arctic portions of the American continent; but so far as evidence has been produced by travelers, it indicates that phthisis is very uncommon among that extensive race. It is mentioned by Dr. Edwards, Surgeon of Captain Parry's ship, that two hundred and fifty Esquimaux remained a year near the ship, of whom eighteen died, but no case of consumption occurred. Among Captain Ross's company (which is estimated as equal to one thousand men for a year‡) only two deaths from consumption are recorded, which gives a proportion less than would have occurred in England.

These data are necessarily imperfect; but, as a whole, they indicate that the arctic regions, Eastern and Western, (and points bordering on them,) produce comparatively but little consumption. On this subject the following is nearly the language of Boudin.§ In the polar circle continual day succeeds to long night, and this sudden transition painfully affects health. Sleep is defective and unrefreshing. Children become rickety, and

* Boudin. † Ancell. ‡ Drake.

§ Traité de Géographie, etc., Médicales, etc.

females severely suffer; yet phthisis is very rare. All the physicians of Scandinavia affirm that phthisis becomes more rare as we advance north.

In Sweden, Colonel Tulloch has estimated the proportion of deaths from phthisis at 5.6 per thousand; and Dr. Gellerstedt gives the proportion of eight per thousand at the Military Hospital of Stockholm.

In examining the special qualities of these climates, in which phthisis appears to be so rare, we are forcibly impressed with their seeming incongeniality to consumptives, and the general harshness of their character. In Iceland the changes are rapid and extreme, with more frequent variations than occur on the continent; fogs are frequent, and the climate is necessarily damp. The food of the Icelanders consists chiefly of fish, bread, rancid butter, game, and, to some extent, the Iceland moss. Their habitations consist of huts, which are dark, damp, ill-ventilated, and very filthy. These are conditions which would not be supposed, *à priori*, to prevent the development of phthisis; on the contrary, the general laws of hygiene would lead us to expect that the cold, damp, and variable climate, together with damp, filthy, and ill-ventilated habitations, and a diet deficient in nutritive qualities, should rather render the disease of common occurrence.

Norway has, likewise, a variable climate. The food of the laborers consists of black rye bread and salted butter or cheese, for breakfast; boiled barley and fish, with beer, for dinner; and, once or twice a week, fresh meat.—(M'Culloch.) Corn spirit (which is only 14*d*. a gallon) is largely consumed. The same general remarks may be made in relation to Lapland: it is cold, damp, and variable, with ill-ventilated habitations and innutritious diet.

Here we may rest an important fact. Phthisis is not common in the arctic regions; but there we encounter a low and variable temperature, moist atmosphere, scanty diet, and ill-ventilated habitations. Why, then, is there exemption from phthisis?

PHTHISIS IN EUROPE.

Turning to Europe, (excluding the extreme northern portions,) we shall find phthisis very common between the fiftieth and sixtieth degrees of latitude, which embraces Great Britain, Prussia, Russia south of St. Petersburg, Belgium, Holland, etc.

In Great Britain phthisis evidently prevails to a great extent, but certainly not in so pre-eminent a degree as to deserve the name of the *English disease*. The civil returns in England vary somewhat for different years, as well as in different districts, as will be seen by the following statements:

	Proportion to Deaths.	Proportion to Population.
Phthisis in London.....1847	1 in 8.5	1 in 305.5
" " " 1854	1 in 7.8	1 in 337.8
" " England (5 years).....1838 to 1842	———	1 in 258
" " " 1847	1 in 7.9	1 in 321.1
" " " 1849	———	1 in 352

It has become the custom, of late years, to class, under the head of *tuberculosis*, several forms of disease, such as scrofula, tabes mesenterica, phthisis, hydrocephalus—supposing them all to have a similar origin, or, at least, to belong to the same class of affections. Taking these diseases together, the following would be the result:

	Proportion to Deaths.	Proportion to Population.
Tuberculosis in London.....1847	1 in 6.1	1 in 215.4
" " " 1854	1 in 5.6	1 in 241.6
" " England.....1847	1 in 6.2	1 in 251.9

The following table, by Mr. Phillips, exhibits the results in different situations:

Seaside towns	1 in 301
Inland towns	1 in 265
Manufacturing towns	1 in 219
Non-factory towns	1 in 256
Linen and cotton towns	1 in 209
Woolen towns	1 in 252
Eastern counties	1 in 258

In Prussia the disease may be considered about of equal frequency as in England.

Proceeding south ten degrees, we shall find on the European continent (between the fortieth and fiftieth degrees) France, Austria, Turkey, Italy, Bavaria, Switzerland, Sardinia, and about one-half of Spain and Portugal, which may fairly be included, making some reservations for the sea-coasts of the southern portions.

France.—In Paris, the following table, by Boudin, embraces the returns for twelve years:

	Total.		Total.
1839	3492	1845	3736
1840	4338	1846	4696
1841	4294	1847	5094
1842	4363	1848	4551
1843	3897	1849	4102
1844	3913	1850	3727

Boudin assumes the population to have averaged, for the whole period, one million, which would give the proportion of 1 in 238 of all living, and 18.8 or 1 in 5.3 of the whole mortality. This, it will be remarked, is greater than that of London.

The hospital statistics of Paris show the proportion of deaths from phthisis to be 3.25 to the whole mortality. At Marseilles, the proportion is estimated at one in four.

The different *Departments* of France vary greatly in the production of phthisis and other diseases of the chest. According to the tables of Boudin, based on the *rejections* of applicants for admission to the army, the variations are quite remarkable. He divides the eighty-six Departments into five series, and the exemptions constitute the proportion refused in each one hundred thousand examinations:

1st	series,	15	Departments	less than		100	exemptions.
2d	"	18	"	from 100	to	200	"
3d	"	23	"	from 200	to	300	"
4th	"	18	"	from 300	to	500	"
5th	"	12	"	from 500	to	1116	"

Thus it will be seen that the exemptions take the wide range of from less than one hundred to eleven hundred and sixteen. The Departments ranging the highest, are the *Nord* and Pas-de-Calais. These Departments are situated in the extreme north of France, lying between the fiftieth and fifty-first degrees of north latitude, and the surfaces of both are mostly plains, with extensive marshes. The Departments presenting the lowest figures are Morbihan and Mayenne, (giving, respectively, fifty-one and sixty exemptions,) situated between the forty-seventh and forty-eighth degrees north latitude, the former on, and the latter near, the coast of the Bay of Biscay. In both these Departments the surface is elevated, being intersected with mountain ranges, although containing some low lands on the coast. Generally, those Departments having the highest figures are occupied with extensive lakes or marshes, or, at least, have flat surfaces, which is true of the following: Le Nord, (1116,) Pas-de-Calais, (1030,) Orne, (682,) Allier, (594,) Lot-et-Garonne, (608,) Bouches-du-Rhone, (510,) Aube, (579). This list might be greatly extended in illustration of this statement, but it is not deemed necessary. It is true that there are apparent exceptions to this rule; but, nevertheless, the illustrations are so numerous and pertinent, that it seems to indicate some connection between phthisis and the face of the district.

The remaining countries embraced in this division (Austria, Turkey, Italy, Bavaria, Switzerland, and portions of Spain and Portugal) afford no exemptions to the prevalence of phthisis. I do not deem it necessary to enter into the particulars in each of these examples, (for some of them will be examined more in detail in their relations to *change* of climate;) but it may be mentioned, in a general sense, that in Germany, Italy, and Spain, phthisis and scrofula are, perhaps, as common as in England and France. At Munich, Berlin, Naples, Venice, Nice, Geneva, Madrid, Lisbon, Gibraltar, the disease is evidently of very common occurrence. In the city and canton of Geneva, in 1838, phthisis was estimated to occur in the proportion of one in three hundred. Even the renown of Italy is evidently ill-founded, for consumption is known to be very common among its inhabitants.

Dr. Cotton remarks that he has been informed by a physician who long practiced in Italy, that the prevalence of consumption is generally acknowledged by the Italian physicians. Dr. Meryon declares that more *natives* die of consumption in Nice than in any town in England of the same population. Dr. Pollock states, from his own personal experience, that in no country is phthisis so rapidly fatal as in Nice, Genoa, Florence, and Naples.*

In Turkey, bronchitis, pneumonia, and pleurisy are common, and phthisis is by no means rare. Andral states that phthisis is very common in the Mediterranean Archipelago. According to Colonel Tulloch's reports, five and one-eighth per thousand die annually of diseases of the lungs; and of eight hundred and thirteen patients at the royal naval hospital, fifty-one died, of whom seventeen, or *one-third*, were from phthisis. But there are some exceptions to this rule. Thus, in the Tuscan Maremma, on the Mediterranean, *where malaria prevails to a great extent*, of 81,731 sick, only one hundred cases of phthisis, or one in eight hundred and seventeen, were observed.

It will be perceived by the preceding statements that the whole continent of Europe, south of the sixtieth degree of north latitude, produces consumption to a large extent, and the only exemptions consist of small spots, protected by peculiarities of location. These middle or temperate regions seem peculiarly prone to the development of phthisis; but we are unable to trace it to any special condition of climate, habits, food, drinks, or races. The differences of condition and habits are very great in the different countries; thus, the food, drinks, and modes of living in England, France, Germany, Spain, etc., present wide dissimilarities; and yet the prevalence of consumption, with unimportant exceptions, is about the same in all. Although it is impossible to be exact, yet it will be found near the truth to state that, in Europe generally, consumption destroys one in every two hundred and fifty to three hundred persons living, and causes, perhaps, one-sixth of the entire mortality.

* Dr. Cotton on Consumption.

PHTHISIS IN ASIA.

There is reason to believe that phthisis is less prevalent in corresponding latitudes in Asia than in Europe; it is true, the data are few and imperfect, but so far as our knowledge extends, we think this statement will be found correct. Whether this exemption (if it really exist) is to be ascribed to the influences of climate, habits of the people, or other causes, remains to be determined by future observations. All that we can now determine is, that certain portions seem remarkably exempt from phthisis. Thus, the Steppe of Kirghis, situated in the northern portion of Independent Tartary, between the forty-fourth and fifty-fifth parallels of north latitude, is said to be measurably free from consumption. It is affirmed by Maydell, government physician, that he never met with a case of consumption in that country. Notwithstanding this exemption, the climate is remarkable for its sudden changes, and extremes of heat and cold.

So far as facts can be obtained, we are led to believe that Persia, Syria, and China, are measurably free from phthisis. Southy refers to the statements of Dr. Fryer, who traveled extensively in Persia, and who gave an account of the prevalent diseases, without mentioning consumption, from which it is inferred that no cases were witnessed; and also to the statement of Chardin, that consumption does not occur among the inhabitants of this region.* In Syria, phthisis appears to be equally rare. Of twelve hundred and ninety-seven patients received at the Dispensary, Beyrout, only four are noted as phthisis; and even this, probably, indicates a figure greatly too high.

Different statements have been made in relation to China; but the most reliable statistics which I have obtained, were furnished by Dr. J. G. Kerr, missionary physician at Canton.† The statements of Dr. Kerr are based on the reports of Dr. Peter Parker, his predecessor, but adds that his own convic-

* Treatise on Pulmonary Consumption, 1814. † MS. letter.

tions correspond with the figures given by Dr. Parker. Dr. Kerr kept no record of cases, on account of the large number of patients, averaging over one hundred per day, on five days of the week.

Total number of cases for two years ending December 31, 1837.....		4575
Scrofula	13	
Phthisis Pulmonalis	1	
Total number of cases for 1839		800
Scrofula	13	
Phthisis	none	
Total number of cases for three years, ending July, 1845		6209
Scrofula	79	
Phthisis	1	
Chronic Bronchitis	17	
Total number of cases from July 1, 1845, to December 31, 1847.....		8247
Scrofula	105	
Phthisis	4	
Chronic Bronchitis	57	
Total number of cases in 1848–49		8205
Scrofula	294	
Phthisis	1	
Chronic Bronchitis	248	
Total number of cases in 1850–51		8815
Scrofula	368	
Phthisis	19	
Chronic Bronchitis	358	
Total number of cases		37,051
Total of Phthisis	26	
Total of Scrofula	872	
Total of Chronic Bronchitis	680	

Proportion of each:

Phthisis	1 in 1425
Scrofula	1 in 42.7
Chronic Bronchitis	1 in 54.4

It is difficult to determine precisely what degree of confidence should be reposed in these statistics; but if they can be relied on, consumption is a very rare disease in China. We can not avoid remarking, however, that scrofula and bronchitis prevail

to an unusual extent; and it would be a fair inference, that where these affections become so frequently developed, *phthisis* could hardly be of rare occurrence. It is a question, therefore, whether the distinction has always been made between chronic bronchitis and phthisis; that is, whether many of the cases classed with the former did not, in fact, belong to the latter variety. Still, if consumption was a common disease in Canton, or the south of China, the reports assuredly would have embraced a larger number of cases; for, when somewhat advanced, errors of diagnosis will not be likely to occur.

PHTHISIS IN INDIA.

In examining the prevalence of phthisis in India, we meet with many difficulties, among which may be mentioned the great extent of country, differences of climate, and the fact that statistics are drawn mainly from the army. India lies between 1° 20′ and 31° 15′ north, and longitude 71° 45′ and 140° east. It is evident, therefore, that great diversity, both in regard to heat and moisture, must necessarily exist. Very different statements have been made in relation to the prevalence of phthisis, doubtless growing out of the varying circumstances from which the facts were drawn. In Bengal, occupying a middle position, it is asserted by Rochard that phthisis is very common. And on the authority of Twining, the disease is said to be more certainly and rapidly fatal than in England. Dr. Webb asserts (*Pathologica Indica*) that the prisoners of Midnapore, (Bengalese,) situated in Upper India, latitude 22° 30′, are very liable to phthisis, pneumonia, and pleura-pneumonia. Thus, in fourteen thousand three hundred and thirteen prisoners who appeared to be well on entering the jail, fourteen cases of consumption seemed to be generated by the prison discipline. This, however, proves nothing beyond the fact that the prison influence was prejudicial, and certainly establishes no law in reference to climate.

A more reliable statement is derived from Colonel Sykes's reports, which embrace the following facts. In the Bengal and Northwestern Dispensaries there were admitted, in five years,

267,456 patients. Of these, eleven hundred and fifty-eight, or one in two hundred and thirty, were admitted for external scrofula; and one hundred and eighty-seven, or one in fourteen hundred and thirty, for consumption. It is also stated that in six of the seventeen Dispensaries no case of consumption occurred, and in some others a single case only was found.

These facts show that certain portions of India may be regarded as nearly free from tuberculosis.

We are furnished with evidence, also, that the Madras Presidency (extending from the eighth to the twentieth parallel) is remarkably free from consumption. According to Dr. Balfour's report, consumption occurred among the native troops in the following proportion: Sea-coast stations, four per thousand; on the plains, four per thousand; on the table-lands, three per thousand. Mr. Ancell observes that the disease is extremely rare in the British army all over India, not much over one case per thousand men being reported.

The following is the tabulated statement for Madras, per thousand:

Europeans	Sea-coast	1.3
	Plains	.2
	Table-lands	.7
Natives	Sea-coast	.4
	Plains	.4
	Table-lands	.3

Contrasted with the above, we find phthisis very common in the island of Ceylon; that is to say, the mortality among the English troops was 3.5 per thousand men, which is nearly equal to the mortality in Canada, the latter being 3.8 per thousand. But it has been justly remarked (Ancell, *loc. cit.*) that the *native* regiments were comparatively exempt from the disease. This fact would indicate that the disease can not be regarded as common in the climate of Ceylon.

Another portion of India deserves to be noticed. The *Tenasserim Provinces*, extending along the coast from the eleventh to the nineteenth degree, is a moist and variable climate, which might, *à priori*, be expected to produce phthisis; but it is reported by Colonel Tulloch as remarkably free from that disease;

and, indeed, he regarded it as one of those points in which consumption could be scarcely said to prevail.

PHTHISIS IN AFRICA.

There are only portions of Africa of which we can speak with any degree of certainty. There is reason to believe, however, that phthisis is very rare in Algiers, Egypt, Nubia, Abyssinia, Senegal, Sierra Leone, and other portions of the country. M. Broussais states that in Algiers, of forty thousand sick in the French army, only sixty-two, or one in six hundred and fifty, were phthisical, and only one in one hundred and two deaths. At Sierra Leone phthisis is rare among natives and English.

Rochard* terms Algeria the *promised land* of consumptives. M. Bonnafont says phthisis is infinitely less common than in Europe, the deaths from consumption among the military being only one in 19.55 of the whole mortality. At Médéah, of seven hundred and seventy-seven fever patients admitted to the hospital, there was not one of phthisis. At Blidah, of seven hundred and ninety-eight deaths, only ten, or one in 79.80, were from phthisis. At Bone, M. Moreau observed, in six thousand two hundred and forty-five admissions in three years, only twelve consumptives, or one in five hundred and twenty. It is asserted, however, that the civil statistics are less favorable; thus, among the natives the proportion to the whole mortality is one in twenty, and among Europeans one in 15.5.

Senegal, says Rochard, is one of the hottest countries of the globe, and, at the same time, the most variable. There are two seasons, one hot and dry, the other humid and less burning. East winds prevail during the first, which bring heat, dryness, and sand. To this succeeds a west wind, which is cool and humid, from the sea it traverses. Marshes fill the air with miasma, which produces the most frightful fever ever witnessed. Intermittents, hepatitis, dysentery, nervous colic, decimate the European population. At Saint Louis, one in seven of the soldiers died; at Sierra Leone, one-half perished; while, at Gambia, the mortality was still greater. And yet phthisis is rare. At Senegal, of nine hundred and fifty-two patients, not one of

* De l'Infl. de la Nav. et des Pays Ch. sur la marche de la Phthisie Pul.

phthisis was met with. At the naval station the mortality was greater; in 1846 and 1847, of three thousand one hundred and forty-four men, one hundred and forty-eight died, of whom six were from phthisis, or one in 24.66; and one hundred and twenty-six returned home, of whom fourteen were on account of phthisis, or one in nine. This would give, of the actual deaths from consumption for two years, one in five hundred and twenty-four, and one in 24.66 of the whole mortality. At Sierra Leone the English compute one in four hundred and eighty-five soldiers.

Egypt has long enjoyed the reputation of being favorable for consumptives. Pliny ascribed the cure of his freed man Zosimus to a voyage to Egypt, and Celsus recommended the atmosphere of Alexandria. The climate is warm, dry, and equable, and it seems to confer a high degree of immunity from phthisis.

These general facts, although wanting in precision in many instances, nevertheless show that consumption is not common in Africa, more especially the northern portions; and that this applies, as a general rule, to both natives and foreigners.

PHTHISIS IN THE SOUTHERN HEMISPHERE.

Comparatively little is known of the prevalence of phthisis south of the equator. Some facts, however, have been collected, especially by Rochard, which may serve as a basis for a general opinion.

The opinion is expressed by Mr. Ancell that, the Cape of Good Hope, a portion of South Africa, the southern half of Australia, Van Diemen's Land, New Zealand, and the southern portion in South America, are much less subject to phthisis than corresponding regions north of the equator.

In relation to the Cape of Good Hope, it may be remarked that the climate is hot and variable, but sufficiently dry, and hence Mr. Ancell considers it favorable to consumptives. Rochard, however, is of opinion that the variable character of the climate renders it unfavorable in this class of disease. And this remark is fully sustained by the computation of Colonel Tulloch, who estimates the cases of phthisis as one in one hundred and eighty-nine soldiers.

In reference to New Zealand, the statements are contradictory. It is admitted that the climate is mild; and at *Auckland* it has been asserted that the admissions to the hospitals for diseases of the chest is one-third less than in Great Britain. Rochard, on the contrary, affirms that diseases of the chest are very common, and that among the natives whole families are destroyed by pulmonary affections.

The statements in regard to Australia are, also, contradictory. Of five hundred and sixty cases treated at the Sydney Dispensary, in 1836, nine are designated as consumption. At Hobart Town, of 30,102 cases of disease, one hundred and four were phthisis. At Van Diemen's Land, tuberculosis is said to be infrequent. It does not appear that phthisis is at all common in Australia, and so far as is known it is infrequent among the natives.

South America appears to be productive of phthisis. Rochard declares that Chili, notwithstanding its great beauty, is unfavorable to consumptives; while on the borders of the La Plata, phthisis is very common and rapid in its course. The disease often terminates in a year, and at times within four or five months. On board vessels, one in 6.66 deaths occurred from phthisis. Peru is equally unfavorable. Some distinction, however, in relation to localities, is necessary. Thus, according to Dr. A. Smith, phthisis is quite common at Lima, and along the coast generally; but in elevated regions, approaching the Andes, the disease is equally rare. In British Guiana, phthisis is stated to be exceedingly infrequent. Dr. Hancock states that he did not meet with a single example of genuine phthisis on the coast of Guiana. Tahita and the Marquesas doubtless produce a large amount of phthisis. Diseases of the chest are exceedingly common, and phthisis affects both natives and Europeans. Rochard states the number of consumptives among the marines as one in sixty-five. In Tahita, the Marquesas, and all Oceanica, the disease is declared to march with frightful rapidity, often destroying patients within four or five months.

It is difficult to determine precisely what value to place on these statements. They are derived, mainly, from the statistics of the French and English navies, which assuredly do not prop-

erly represent the condition of the native population. Still, it seems tolerably certain that phthisis, in the Southern hemisphere, is more common than in corresponding regions north of the equator.

PHTHISIS IN THE UNITED STATES.

In attempting an examination into the prevalence of Phthisis in the United States, we encounter very great difficulty in reaching accurate and reliable conclusions. These difficulties depend mainly on the following causes: First, the vast extent of the country, and the great varieties of the physical condition of the surface, and the widely different degrees of heat and moisture. Secondly, the want of perfectly reliable statistics in regard to conditions of climate, as well as the prevalence of disease. These circumstances surround the subject with great difficulties; but, by a careful analysis of the facts presented, with the limited personal observations I have been able to make, it is hoped and believed we may approximate the truth. The sources whence my information has been derived are mainly the following: The *United States Census for* 1850; *United States Army Reports from* 1839 *to* 1854; *Drake's Diseases of the Interior Valley; Blodget's Climatology;* and various articles in the Medical Journals. In addition to these sources of information, I have corresponded with physicians located in every part of the country, and corrected the whole, as far as practicable, by my own observations.

Before enumerating the prevalence of phthisis in the different sections, it may prove useful to furnish a brief sketch of the physical aspect and climatological relations of the whole country.

The climate of the United States, embracing, as it does, such a vast extent of territory, necessarily exhibits wide differences in temperature; and the degree of elevation, vicinity of great lakes, as well as sea-coast, necessarily modify different portions in a remarkable degree. The territory ranges from twenty-four to forty-three degrees north latitude, and from seventy to one hundred and twenty-four degrees west longitude. This vast

extent of country, stretching from the Atlantic to the Pacific oceans, and including two separate mountain ranges, with an immense intervening valley, or, perhaps, more properly, *plain*, presents so many modifying conditions, that every possible variety of climate exists, ranging from almost Siberian rigor to the heat of the tropics, and from an annual precipitation of forty-eight inches to arid regions almost without rain.

The portion of the United States lying east of the Alleghany Mountains presents a slope from the high lands to the Atlantic, of great uniformity of surface and climate. This eastern slope has but little altitude, and is not intersected, at many points, by elevations of sufficient extent to modify the conditions of the climate; and hence the mere degrees of latitude, (with limited elevations, slightly increasing the amount of rain, and diminishing the temperature,) are its essential climatological elements. The Alleghanies have not sufficient elevation to exercise that marked influence over climate which arises from great mountain ranges overshadowing adjacent valleys.

Passing to the west of the Alleghany Mountains, we approach the great interior valley, drained by the Ohio, Mississippi, and Missouri rivers, with their tributaries, commonly called the Mississippi Valley, sloping south to the Gulf of Mexico. This vast region is bounded on the north by a great system of lakes, extending, in fact, to Hudson's Bay, on the northeast by the Alleghany Mountains, and on the west by the Rocky Mountains. This region is a vast plain; the rivers have no immediate high lands or mountains, (except at their head waters,) and, in fact, the lower Mississippi runs almost its entire course on an elevation, the surface falling on either side. The northern lake region is also a plain, possessing, in its general aspect, but little elevation.

West of the Mississippi, the ascent is gradual to the great chain of the Rocky Mountains, the intervening plain being high and arid, widely different from the eastern portion of the valley. The surface is interspersed with sandy and saline portions, the whole possessing an elevation which gives it a marked character; thus, at the one hundredth meridian the elevation is two thousand feet, while at the one hundred and fifth the eleva-

tion is five thousand feet. This mountain plateau has an elevation of six thousand feet, with an average breadth of two hundred and fifty miles, and is nearly a thousand miles long.*

The mountains which rise from this plateau present the form of abrupt peaks rather than a continuous chain; some of these have a great altitude, reaching fourteen thousand feet, and are clothed with perpetual snow. This mountain range, which runs a little west of north, is sufficiently great, both in elevation and extent, to exercise an obvious climatological influence.

It is estimated that the ranges of mountains embraced in this system occupies, at the fortieth parallel, about one-third of the breadth of the United States.† The ranges embrace the portion known as the Rocky Mountains; but between this and the coast are many abrupt elevations and extensive valleys, with a high coast-range of mountains cutting off the moisture of the sea air. This system, therefore, embraces interior valleys, between the main chain of the Rocky Mountains and the coast ranges, which are remarkable for their dryness and great summer heat.

The preceding brief statement shows the configuration of that portion of North America embraced in the United States to possess remarkable variations, which must necessarily produce great modifications of thermometrical, barometrical, and hygrometrical conditions. A general view of the configuration of the United States exhibits two great mountain systems, east and west, with a vast intervening valley or plain, (in fact a *trough*,) and coast-margins constituting sea exposures. The Alleghany Mountains, on the east, consist of parallel ridges, frequently interrupted, rising on a plain or *watershed*, having an average elevation of three thousand feet; but the mountains based upon this elevation rise to various hights, ranging from two thousand to six thousand seven hundred feet above the ocean. The Atlantic slope is comparatively uniform, having no important elevations or depressions; and gradually descending to the ocean, is necessarily subject to the influences of sea air. The Rocky Mountains occupy one-third of the whole breadth of ter-

* Blodget. † Professor Henry's Smithsonian Report.

ritory, and, together with the plateau on which they rest, rise to a great altitude. This mountain range evidently exercises important climatological influences on the interior valley.

These two mountain ranges diverge from each other as they pass north; the descent from the eastern range to the interior valley is abrupt, while the western is more gradual and of much greater extent. The space between the base of the Rocky Mountains and the Mississippi river is estimated at one-third the breadth of the entire territory; its elevation, at forty degrees north latitude, and one hundred and five degrees west longitude, is five thousand feet, descending at the Mississippi river to one thousand feet.*

This great valley extends south to the Gulf of Mexico, without interruption, except an unimportant elevation called the Ozark Mountains, which exercise a merely local influence. Although its outlines can not be regularly defined, it may be said to extend from the twenty-fourth to the forty-sixth degrees of north latitude, and from the eightieth to the one hundred and fifth degree west longitude. At the north is a vast system of lakes, without mountain-elevation; while at the south it terminates at the Gulf of Mexico.

The extremes of temperature for the territory of the United States will be observed by the accompanying table to be very great; thus Portland, Maine, has a mean annual temperature of 45°.2, while Key West, Florida, rises to 76°.5. And between these extremes the variations of latitude, modified by elevation, necessarily present wide differences. The isothermal curves for the year descend considerably lower in the interior valley than on either coast, while they are higher on the Pacific than the Atlantic ocean. The interior valley is thus actually colder than either coast; and it has been determined that, within the range of the Rocky Mountains, the isothermal lines rapidly ascend to the north.

The winds of the interior valley have been determined with some degree of accuracy at various points, but I shall endeavor to present only a summary of the general results. At the ex-

* Professor Henry's Report.

treme southern portion of the valley, embracing the Gulf region, the southeast wind prevails; thus, expressed in per centage, the mean is found to be: southeast, thirty; southwest, twenty-five; northwest, twenty; northeast, twenty-five. Extending further north, the southwest wind becomes predominant, and, as far north as Toronto, the following mean per centage is obtained: Southeast, twenty-one; southwest, thirty-one; northwest, twenty-eight; northeast, twenty.

The following table, compiled by Dr. Drake,* gives the per centage of winds in semicircles.

SOUTHERN GROUP. NORTH LATITUDE 24°–32°.

Eastern	S. E. 30+N. E. 25=55	per cent.
Western	S. W. 25+N. W. 20=45	" "
Southern	S. E. 30+S. W. 25=55	" "
Northern	N. W. 20+N. E. 25=45	" "

MIDDLE GROUP. NORTH LATITUDE 34°–46°.

Eastern	S. E. 21+N. E. 20=41	per cent.
Western	S. W. 31+N. W. 28=59	" "
Southern	S. E. 21+S. W. 31=52	" "
Northern	N. W. 28+N. E. 20=48	" "

NORTHERN GROUP. NORTH LATITUDE 60°–70°.

Eastern	S. E. 13+N. E. 20=33	per cent.
Western	S. W. 17+N. W. 49=66	" "
Southern	S. E. 13+S. W. 17=30	" "
Northern	N W. 49+N. E. 20=69	" "

MEAN OF THE WHOLE.

Eastern, 43; Western, 57; Southern, 46; Northern, 54 per cent.

It will be observed, in relation to the preceding table, that the observations extend to the arctic circle, and therefore, the northern group does not represent what occurs in the Mississippi Valley, which does not properly extend beyond the *middle* group in the table. The prevalence of winds in the southern and middle groups is as follows:

* Diseases of the Interior Valley.

SOUTHERN GROUP. NORTH LATITUDE, 24°–32°.

Southeast	30 per cent.
Southwest	25 " "
Northeast	25 " "
Northwest	20 " "

MIDDLE GROUP. NORTH LATITUDE, 34°–46°.

Southwest	31 per cent.
Northwest	28 " "
Southeast	21 " "
Northeast	20 " "

It will thus be perceived that in the Mississippi Valley the southeast wind predominates in the southern group, and the southwest in the remainder of the Valley. Calculated according to semi-circles, however, it will be found that in the southern portion up to the thirty-second degree, the eastern wind prevails over the western, in the proportion of fifty-five to forty-five, and the southern over the northern as fifty-five to forty-five. In the second group, extending to the forty-sixth degree, the western prevails over the eastern wind in the proportion of forty-nine to forty-one, and the southern over the northern as fifty-two to forty-eight.*

Several modifications, however, will be observed. In Texas and New Mexico the prevalent wind in the winter is due north, and in the summer due south, with more or less south wind in the summer. In most of the Southern states, including South Carolina, Georgia, Alabama, and Mississippi, the winds are nearly equally divided between the different points in winter; while during the summer, the south and southeast prevail.

In the Eastern states (New England) the prevalent winds in the winter are from the northwest, and during the summer from the southwest. The winter, however, has a considerable amount from the northeast.

On the Pacific coast, the prevalent wind is from the south-

* Drake. Diseases of the Interior Valley.

west, and in the winter, pretty equally from the different parts of the compass, the northwest slightly predominating. In Oregon and Washington territories, the remarkable fact is observed that during the winter, wind is from the southeast, while in the summer a large portion is from the northwest. Hence, the cold during the winter is greatly diminished.

The special character of the winds of this great valley is their variability. They seldom continue in one direction more than a few hours, or, at most, a few days, and often blow from three points of the compass in twenty-four hours. A southeast wind will change to the southwest, and again to northwest with great rapidity, giving to the atmosphere humidity, warmth, and even intense cold, within a few hours. Storms or hurricanes are of very infrequent occurrence, although there is often a fresh breeze, and, at times, high winds, especially during the winter and spring months. During the summer, there are occasional high winds and even severe storms; but the tendency is, during hot weather, to moderate breezes and even frequent calms.

The *humidity* of the United States is necessarily variable. The Gulf region is exceedingly humid, being, in fact, constantly nearly saturated. The dew point in this region is necessarily high, with a very limited complement. The southern wind extends up the interior valley, with a gradually diminishing moisture as it progresses. West of the Mississippi the moisture is much less. The west and northwest winds are comparatively dry, containing but little vapor; and as the southeast and northeast winds are less prevalent in this region, it is comparatively dry. East of the Mississippi, the southwest and southeast winds traverse the valley, and consequently the air is greatly more humid. The lake region, owing to its low temperature, possesses but little vapor. It is a dry and cool region, and taking the year throughout, does not reach the dew point. East of the Alleghany Mountains, the North Atlantic states have a comparatively cool atmosphere, with a considerable degree of humidity, arising from the vicinity of the ocean, without intervening elevations. The Pacific coast is mild and humid, while the inter-montane valleys are hot and arid.

With this brief outline of the climate and physical aspect of the United States, we will proceed to state the best ascertained facts in regard to the prevalence of phthisis in the different regions. Our statistical information is drawn from three sources: first, the United States census; second, the Army Reports; and, third, the reports of local authorities. In regard to the Army Reports, it is evident the statistics arising from this source, although valuable and important in many respects, can afford no criteria by which to judge of the prevalence of phthisis in the region of country where the troops happen to be stationed; consequently we shall direct our attention mainly to the civil returns and local reports.

The United States census for 1850, furnishes the main facts on which we depend. It is freely admitted that this census can not be regarded as more than approximative; but I see no reason to doubt that it does approach the truth, and that it furnishes the *comparative* prevalence of disease in the different states of the Union. We will begin with the most northern and proceed south. The United States are separated artificially into four geographical divisions, called the Eastern, Middle, Western, and Southern divisions. These divisions are entirely arbitrary; but inasmuch as there exists some similarity in the climatology of each division, (though each one gradually merges into the other,) they will be retained for the present purpose. In arranging the tables, diseases of the respiratory organs, including pneumonia, bronchitis, pleurisy, and laryngitis, are placed in a column opposite phthisis, so that the two classes can be readily compared.

EASTERN DIVISION.

	North Latitude, Between	West Longitude, Between	Population to Sq. Mile.
Maine	43° 5′ and 47° 20′	66° 50′ and 71°	19
Vermont	42° 44′ and 45°	71° 33′ and 73° 25′	31
New Hampshire	42° 41′ and 45° 11′	70° 40′ and 72° 28′	34
Massachusetts	41° 23′ and 42° 52′	69° 50′ and 73° 30′	127
Rhode Island	41° 22′ and 42° 3′	71° 6′ and 71° 38′	109
Connecticut	41° and 42° 2′	71° 20′ and 73° 15′	79

EASTERN DIVISION—(CONTINUED.)

MORTUARY STATISTICS OF DISEASES OF THE RESPIRATORY ORGANS.

	PROPORTION TO ENTIRE MORTALITY.		PROPORTION TO POPULATION.	
	Dis. Resp. Org.	Phthisis.	Dis. Resp. Org.	Phthisis.
Maine	1 in 27	1 in 4.4	1 in 2034	1 in 341
Vermont	1 in 25	1 in 4.15	1 in 2560	1 in 417
New Hampshire	1 in 26	1 in 4.5	1 in 2009	1 in 343
Massachusetts	1 in 20.8	1 in 5.6	1 in 1059	1 in 287
Rhode Island	1 in 24.9	1 in 4.7	1 in 1589	1 in 310
Connecticut	1 in 17.6	1 in 5.9	1 in 1110	1 in 385
Mean	1 in 23.5	1 in 4.8	1 in 1721	1 in 347

MIDDLE DIVISION.

	North Latitude, Between	West Longitude, Between	Population to Sq. Mile.
New York	40° 30′ and 45°	71° 56′ and 79° 56′	67
New Jersey	38° 58′ and 41° 21′	73° 58′ and 75° 29′	59
Pennsylvania	39° 42′ and 42° 15′	74° 44′ and 80° 34′	50
Delaware	38° 27′ and 39° 50′	74° 50′ and 75° 40′	44

MORTUARY STATISTICS.

	PROPORTION TO ENTIRE MORTALITY.		PROPORTION TO POPULATION.	
	Dis. Resp. Org.	Phthisis.	Dis. Resp. Org.	Phthisis.
New York	1 in 47.8	1 in 6.6	1 in 3201	1 in 440
New Jersey	1 in 19	1 in 7	1 in 1377	1 in 508
Pennsylvania	1 in 26	1 in 8	1 in 2090	1 in 641
Delaware	1 in 20.8	1 in 10	1 in 1227	1 in 603
Mean	1 in 28.4	1 in 7.9	1 in 1973	1 in 548

WESTERN DIVISION.

FREE STATES.

	North Latitude, Between	West Longitude, Between	Population to Sq. Mile.
Ohio	38° 30′ and 42°	80° 35′ and 84° 42′	50
Indiana	37° 47′ and 41° 50′	84° 48′ and 88°	20
Illinois	37° and 42° 30′	87° 26′ and 91° 31′	15
Michigan	41° 30′ and 47° 20′	82° 25′ and 90° 30′	7
Wisconsin	42° 30′ and 49°	87° and 95° 54′	6
Iowa	40° 30′ and 49°	90° and 102°	4

WESTERN DIVISION—(CONTINUED.)

MORTUARY STATISTICS.

	PROPORTION TO ENTIRE MORTALITY.		PROPORTION TO POPULATION.	
	Dis. Resp. Org.	Phthisis.	Dis. Resp. Org.	Phthisis.
Ohio	1 in 22	1 in 11.3	1 in 1491	1 in 764
Indiana	1 in 17.4	1 in 11.8	1 in 1345	1 in 913
Illinois	1 in 13	1 in 13.5	1 in 944	1 in 976
Michigan	1 in 10	1 in 6.5	1 in 956	1 in 602
Wisconsin	1 in 11.8	1 in 10	1 in 1243	1 in 1050
Iowa	1 in 10	1 in 12.8	1 in 940	1 in 1206
Mean	1 in 14	1 in 10.9	1 in 1153	1 in 911

SLAVE STATES.

	North Latitude, Between	West Longitude, Between	Population to Sq. Mile.
Kentucky	36° 30′ and 39° 10′	82° and 89° 30′	25
Tennessee	35° and 36° 40′	81° 40′ and 90° 15′	22
Missouri	36° and 40° 36′	89° and 95° 45′	10
Arkansas	33° and 36° 30′	89° 30′ and 94° 30′	4

MORTUARY STATISTICS.

	PROPORTION TO ENTIRE MORTALITY.		PROPORTION TO POPULATION.	
	Dis. Resp. Org.	Phthisis.	Dis. Resp. Org.	Phthisis.
Kentucky—Whites	1 in 22.3	1 in 13	1 in 1571	1 in 857
Colored	1 in 14.6	1 in 10.6	1 in 736	1 in 537
Mean	1 in 19.3	1 in 11.6	1 in 1278	1 in 770
Tennessee—Whites	1 in 26	1 in 13	1 in 2150	1 in 1209
Colored	1 in 18	1 in 14.3	1 in 1229	1 in 949
Mean	1 in 21.6	1 in 13.5	1 in 1632	1 in 1133
Missouri—Whites	1 in 19.5	1 in 19.9	1 in 1074	1 in 1067
Colored	1 in 12.5	1 in 16.3	1 in 817	1 in 1054
Mean	1 in 18.6	1 in 19.4	1 in 1032	1 in 1081
Arkansas—Whites	1 in 11.2	1 in 19.6	1 in 849	1 in 1474
Colored	1 in 14	1 in 39	1 in 772	1 in 2322
Mean	1 in 11.9	1 in 22	1 in 830	1 in 1585

SOUTHERN DIVISION.

	North Latitude, Between	West Longitude, Between	Population to Sq. Mile.
Maryland	38° and 39° 44′	75° 10′ and 79° 20′	42
Virginia	36° 33′ and 40° 43′	75° 25′ and 83° 40′	—
North Carolina	33° 50′ and 36° 30′	75° 45′ and 84°	18
South Carolina	32° 2′ and 35° 10′	78° 24′ and 83° 30′	26
Georgia	40° and 42° 30′	43° 20′ and 46° 50′	15
Florida	25° and 31°	80° and 87° 35′	1
Alabama	30° 10′ and 35°	85° and 88° 30′	15
Mississippi	30° 10′ and 35°	88° 10′ and 91° 35′	12
Louisiana	29° and 33°	88° 40′ and 94° 25′	11
Texas	26° and 38°	94° and 108°	—

MORTUARY STATISTICS.

	PROPORTION TO ENTIRE MORTALITY.		PROPORTION TO POPULATION.	
	Dis. Resp. Org.	Phthisis.	Dis. Resp. Org.	Phthisis.
Maryland—Whites	1 in 17.96	1 in 8.5	1 in 1103	1 in 527
Colored	1 in 16.3	1 in 9	1 in 959	1 in 534
Mean	1 in 17.8	1 in 8.7	1 in 1046	1 in 529
Virginia—Whites	1 in 14.2	1 in 9.4	1 in 1287	1 in 865
Colored	1 in 9	1 in 16	1 in 518	1 in 922
Mean	1 in 11	1 in 11.7	1 in 830	1 in 886
N. Carolina—Whites	1 in 10.2	1 in 16	1 in 1002	1 in 1494
Colored	1 in 10.7	1 in 23	1 in 750	1 in 1645
Mean	1 in 10.4	1 in 18	1 in 893	1 in 1546
S. Carolina—Whites	1 in 6.7	1 in 72	1 in 661	1 in 7040
Colored	1 in 6.5	1 in 45	1 in 493	1 in 3460
Mean	1 in 6.6	1 in 52	1 in 630	1 in 4369
Georgia—Whites	1 in 12.9	1 in 28	1 in 1469	1 in 3199
Colored	1 in 9	1 in 46	1 in 650	1 in 3313
Mean	1 in 10.4	1 in 35	1 in 956	1 in 3246
Florida—Whites	1 in 16	1 in 20	1 in 1573	1 in 1966
Colored	1 in 11.9	1 in 24	1 in 1059	1 in 2033
Mean	1 in 13.6	1 in 21.6	1 in 1286	1 in 2033
Alabama—Whites	1 in 12.3	1 in 18.2	1 in 1211	1 in 1800
Colored	1 in 11.7	1 in 38	1 in 854	1 in 2760
Mean	1 in 11.7	1 in 24.8	1 in 994	1 in 2131

SOUTHERN DIVISION—(CONTINUED.)

	PROPORTION TO ENTIRE MORTALITY.		PROPORTION TO POPULATION	
	Dis. Resp. Org.	Phthisis.	Dis. Resp. Org.	Phthisis.
Mississippi—Whites...	1 in 10.2	1 in 18.5	1 in 904	1 in 1633
Colored..	1 in 6.7	1 in 21.3	1 in 650	1 in 2058
Mean.....	1 in 9.5	1 in 19.7	1 in 877	1 in 1826
Louisiana—Whites....	1 in 27.7	1 in 13.6	1 in 1194	1 in 591
Colored...	1 in 23.9	1 in 28.9	1 in 892	1 in 1254
Mean.....	1 in 23.4	1 in 18.6	1 in 1017	1 in 807
Texas—Whites.....	1 in 11.8	1 in 22.8	1 in 837	1 in 1621
Colored.....	1 in 28	1 in 51.8	1 in 874	1 in 344
Mean.....	1 in 11.9	1 in 27.2	1 in 865	1 in 1898

GENERAL RECAPITULATION.

EASTERN DIVISION.

Bet. N. Lat. 41° and 47° 20′; W. Long. 66° 50′ and 73° 30′; Pop. 2,705,095.

Phthisis.

No. of Cases.	Proportion to Population.
8246	1 in 328

MIDDLE DIVISION.

Bet. N. Lat. 38° 27′ and 45°; W. Long. 71° 56′ and 80° 34′; Pop. 5,843,325.

11244	1 in 519

WESTERN DIVISION.

Bet. N. Lat. 33° and 49°; W. Long. 80° 35′ and 95° 45′; Pop. 7,525,150.

8527	1 in 882

SOUTHERN DIVISION.

Bet. N. Lat. 39° 44′ and 25°; W. Long. 75° 25′ and 108°; Pop. 6,644,372.

5161	1 in 1287

General Diseases of the Respiratory Organs.

Eastern division.....	1913	1 in 1414
Middle division.....	2428	1 in 2428
Western division.....	6029	1 in 1248
Southern division.....	7675	1 in 865

WHITE POPULATION OF THE SOUTHERN STATES.

	PROPORTION TO ENTIRE MORTALITY.		PROPORTION TO POPULATION.	
	Dis. Resp. Org.	Phthisis.	Dis. Resp. Org.	Phthisis.
Maryland	1 in 17.9	1 in 8.5	1 in 1103	1 in 527
Virginia	1 in 14.2	1 in 9.4	1 in 1287	1 in 865
N. Carolina	1 in 10.2	1 in 16	1 in 1502	1 in 1492
S. Carolina	1 in 6.7	1 in 72	1 in 661	1 in 7040
Georgia	1 in 12.9	1 in 28	1 in 1469	1 in 3199
Florida	1 in 16	1 in 20	1 in 1573	1 in 1966
Alabama	1 in 12.3	1 in 18.2	1 in 1211	1 in 1800
Mississippi	1 in 10.2	1 in 18.5	1 in 904	1 in 1633
Louisiana	1 in 27.7	1 in 13.6	1 in 1194	1 in 591
Texas	1 in 11.8	1 in 22.8	1 in 837	1 in 1621
Mean	1 in 14.4	1 in 27.7	1 in 1124	1 in 2372

SLAVE POPULATION, (SAME DIVISION.)

Maryland	1 in 16.3	1 in 9	1 in 959	1 in 534
Virginia	1 in 9	1 in 16	1 in 518	1 in 922
N. Carolina	1 in 10.7	1 in 23	1 in 750	1 in 1645
S. Carolina	1 in 6.5	1 in 45	1 in 493	1 in 3460
Georgia	1 in 9	1 in 46	1 in 650	1 in 3313
Florida	1 in 12.9	1 in 24	1 in 1059	1 in 2033
Alabama	1 in 11.7	1 in 38	1 in 854	1 in 2760
Mississippi	1 in 6.7	1 in 21.3	1 in 650	1 in 2058
Louisiana	1 in 23.9	1 in 28.9	1 in 892	1 in 1254
Texas	1 in 28	1 in 51.8	1 in 874	1 in 344
Mean	1 in 13.4	1 in 30.3	1 in 769	1 in 1732

TOTAL MEAN OF SOUTHERN STATES.

Whites	1 in 14.4	1 in 27.7	1 in 1124	1 in 2372
Slaves	1 in 13.4	1 in 30.3	1 in 769	1 in 1732

WHITE POPULATION OF THE SLAVE STATES, (WESTERN DIVISION.)

Kentucky	1 in 22.3	1 in 13	1 in 1571	1 in 857
Tennessee	1 in 26	1 in 13	1 in 2150	1 in 1209
Missouri	1 in 19.5	1 in 19.9	1 in 1074	1 in 1067
Arkansas	1 in 11.2	1 in 19.6	1 in 849	1 in 1474
Mean	1 in 19.3	1 in 16.1	1 in 1413	1 in 1151

SLAVE POPULATION, (WESTERN DIVISION.)

	PROPORTION TO ENTIRE MORTALITY.		PROPORTION TO POPULATION.	
	Dis. Resp. Org.	Phthisis.	Dis. Resp. Org.	Phthisis.
Kentucky	1 in 14.6	1 in 10.6	1 in 736	1 in 537
Tennessee	1 in 18	1 in 14.3	1 in 1229	1 in 949
Missouri	1 in 12.5	1 in 16.3	1 in 817	1 in 1054
Arkansas	1 in 14	1 in 39	1 in 772	1 in 2322
Mean	1 in 14.3	1 in 20	1 in 888	1 in 1215

TOTAL MEAN OF WESTERN SLAVE STATES.

Whites	1 in 19.3	1 in 16	1 in 1413	1 in 1151
Slaves	1 in 14.3	1 in 20	1 in 888	1 in 1215

TABLE SHOWING THE MORTALITY FROM CONSUMPTION, IN SOME OF THE PRINCIPAL CITIES OF THE UNITED STATES.

	Year.	Whole No. Deaths.	Proportion to Population.	Supposed Population.
Charleston, S. C.	1856	155	1 in 387	60,000
Philadelphia, Pa.	1856	1501	1 in 399	600,000
New York	1856	2478	1 in 322	800,000
Baltimore, Md.	1857	779	1 in 218	170,000
New Haven, Conn.	1858	128	1 in 218	28,000

The following summary of the army statistics embraces most of the military posts of the United States, and the table shows the number of deaths from phthisis in proportion to the number of soldiers. In many instances the results are widely different from the civil statistics, but it is quite evident that military statistics can not represent the condition of a civil population.

SUMMARY OF THE ARMY STATISTICS FROM 1839 TO 1842, SHOWING THE NUMBER OF CASES AND DEATHS FROM PHTHISIS.

	No. cases.	Deaths.
Northern Coast Division	1 in 208	1 in 792
New York Harbor	1 in 167	1 in 268
North Interior Region	1 in 209	1 in 335
Region of Great Lakes	1 in 220	1 in 333
Northwest Interior Region	1 in 241	1 in 120
Middle Atlantic Region	1 in 394	1 in 449

	No. cases.	Deaths.
Middle Interior Region, E.	1 in 355	1 in 558
Middle Int. Region, W. First Division.	1 in 251	1 in 256
Middle Int. Region, W. Second Division.	1 in 189	1 in 409
South Atlantic Region.	1 in 400	———
South Interior Region, No. 1.	1 in 137	1 in 211
South Interior Region, No. 2.	1 in 500	———
Florida, Atlantic Coast.	1 in 417	———
Florida, Gulf Coast.	1 in 143	1 in 766
Texas, Southern Frontier.	1 in 241	1 in 404
Texas, Western Frontier.	1 in 253	1 in 527
New Mexico.	1 in 734	1 in 1957
California, South.	1 in 189	1 in 341
California, North.	1 in 177	1 in 319

These statistics fluctuate too greatly to entitle them to confidence as representing the condition of a *resident* population. No doubt the results are often modified by accidental circumstances, such as the location of the military post, character of the general accommodations, and many other influences. In no sense, therefore, do they represent fully the influences of climate in the production of phthisis.

The main fact developed in the preceding tables is, that phthisis, in the United States, progressively increases from north to south. It is not claimed that our figures are rigorously correct; indeed, the vast extent of country, and other impediments, render absolute accuracy almost an impossibility. Still it is probable our tables approach the true state of the question, at least sufficiently so for all practical purposes. As a strong corroborative evidence of the general correctness of the United States census of 1850, it may be mentioned that, so far as ascertained, these statistics have been sustained by those derived from State or corporation authorities. Thus, according to the United States census, the mortality from phthisis in the State of New York was one in four hundred and forty of the population, and the State census of 1855 makes the proportion one in four hundred and forty-four.

While, therefore, we admit that errors doubtless occurred in the United States census, they are not sufficiently numerous to invalidate the whole; and, again, if errors exist, they are as liable to occur in one portion of the country as the other. It could

hardly be possible that an error so extensive and continuous would run from the extreme North to the extreme South, and misrepresent throughout the true state of the question. Whatever errors, therefore, exist, are as liable to occur in one section as another, and hence will not vitiate the general results.

Nor can it be admitted that the equal prevalence of mortality of phthisis in Charleston, South Carolina, and New York city, furnishes any evidence against our general conclusions. In the first place, the cities generally exhibit a higher rate of mortality from consumption than the country, and the South is no exception to the rule. Indeed, it would be anticipated that persons confined to Southern cities, while affected with phthisis, would be placed under most unfavorable circumstances for recovery. The mortality, in such examples, would probably be much greater than in Northern cities; and hence a smaller number of cases might yield a larger mortality.

In addition to these facts, it must not be forgotten that a Southern city, situated like Charleston, will annually receive a large number of transient cases of consumption—persons who seek a Southern climate with the hope of finding relief. Such persons, when in an advanced state, soon sink, and thus swell the bills of mortality.

Taking all these facts into consideration, I am fully persuaded that consumption originates far less commonly in the Southern than in the more Northern regions, and that it gradually but perceptibly diminishes from Maine to Florida. And without claiming absolute accuracy, I believe the tables compiled from the United States census are very near the truth, and will be found sufficient guides for practical purposes. Thus, the mortality from phthisis, in the Eastern Division, may be set down at one in three hundred and twenty-eight; in the Middle Division, one in five hundred and nineteen; in the Western Division, one in eight hundred and eighty-two; and in the Southern Division, one in twelve hundred and eighty-seven. This shows the mortality from phthisis to be three times greater in the Northern than in the Southern Division.

These results are strikingly at variance with certain opinions which have grown into favor, of late years, in this country.

The army statistics, published by Dr. Forry, in 1840, seemed to prove that consumption was more common in the South than in the North; and the same view was adopted by Dr. Drake, in his work on the "Diseases of the Interior Valley of North America." The error, in both these instances, arose from basing conclusions on military instead of civil statistics.

Another fact has been brought to light by these statistics which, probably, had not been generally anticipated, namely, that the mortality from inflammatory diseases of the chest, mainly pneumonia, is much greater at the South than at the North. Thus, we find the mortality from diseases of the respiratory organs, in the Eastern Division, one in fourteen hundred and fourteen; in the Middle Division, one in two thousand four hundred and twenty-eight; in the Western Division, one in twelve hundred and forty-eight; and in the Southern Division, one in eight hundred and sixty-five.

It is not in accordance with our general views that pneumonia should be more fatal in Southern than Northern latitudes; but it appears, from the statistics before us, that such is the actual fact. It is probable we may find a solution of this apparent anomaly in the prevalence of the malarial poison at the South. We can not doubt that a constitution which has suffered during the summer and autumn from the malarial poison will be peculiarly liable to pneumonia the following winter and spring. And the disease, under these circumstances, is liable to become extensively congestive, which increases the mortality. In this manner, it appears probable, we can account for the mortality of pneumonia at the South.

PHTHISIS IN THE WEST INDIES.

Our information in regard to the prevalence of phthisis in the West Indies is extremely limited. I have sought, in vain, to obtain reliable statistics of the prevalence of the disease in Cuba, and the only attainable facts have been derived from practitioners of the island. Dr. Gans, who practiced in Cuba for a number of years, informs me that phthisis is quite common among the natives, and, in young females, is particularly

rapid in its course. According to Rochard, the deaths from phthisis among the marines stationed in the Antilles is one in eleven of the whole mortality, and one in three hundred and three of the whole number. The statements in regard to the prevalence of phthisis among the native population are so contradictory that it is impossible to draw conclusions from them. It may be stated, however, that while consumption has been found quite common among the French and English troops and sailors, there is no evidence that it is equally frequent among the natives. No doubt the climate of the West Indies is unpropitious to foreigners laboring under phthisis, especially when the disease has made much progress; but this would be no index to the prevalence of the disease among the resident population. It is probable, however, that these islands produce more consumption than the southern portion of the United States, but in what proportion is unknown.

SECTION II.

TEMPERATURE IN RELATION TO PHTHISIS.

There are two methods, evidently widely different in their etiological relations, of estimating the effects of temperature in the development of phthisis, or in predisposing to that condition. One relates to climatic heat, and the other to artificial temperature growing out of the habits and occupations of individuals. In regard to *climate*, we have already seen, while tracing the geography of tuberculosis, that the frigid and the torrid zones, with the latitudes bordering on them, are, in the main, more exempt from this disease than regions situated within the temperate zone. This curious fact seems to indicate that the extremes of heat and cold are less liable to induce phthisis than the variable and temperate regions of country. But even here some caution is necessary; for the question is at once rendered complex and doubtful by the differences in civilization, habits, diet, and other influences independent of climate.

So far as we are able to determine, from present data, the places most exempt from pulmonary disease are Iceland, Greenland, Lapland, Norway, and similarly situated Northern regions; and Senegal, India, western coast of Africa, in the tropical regions. Thus we find the Bengal and Madras Presidencies, together with Senegal, enjoying a remarkable exemption from phthisis; but in all these regions miasmatic diseases prevail to a great extent. It is impossible not to observe in these facts important laws, and although there are many exceptional examples arising to embarrass our conclusions, still, certain general principles may be safely deduced. In Central Europe, with an annual temperature of fifty degrees Fahrenheit, consumption is vastly more common than in India, with a mean of from seventy-six to eighty-four degrees. That the exemption in India is due, in part at least, to an elevated temperature, will scarcely admit of doubt, for the habits and customs of Europeans have been so largely introduced, that modes of living could scarcely cause the difference.

In extending this line of inquiry, we shall find certain remarkable exceptions to the rule announced. Thus, south of the equator, especially in the Western hemisphere, the disease is more common. This is particularly true of portions, if not all of Oceanica and South America, to which may be added the West Indies. In reference to Polynesia, it is established by various observers, that consumption is remarkably prevalent at Tahiti, large numbers of natives and Europeans becoming affected with the disease. But here, doubtless, is an active element independent of heat; thus, the atmosphere is humid as well as hot, and contains the poison of typhoid fever. It seems a general law that warm climates which are very humid are favorable to the production of phthisis; or, to state the fact in a different and perhaps clearer form, a large body of land in connection with a warm climate is essential to persons suffering from phthisis. It will be found, therefore, that groups of islands in tropical regions, such as Polynesia and the West Indies, prove unpropitious; while warm climates, with extensive surfaces of land, as in India and the Southern United States, present a smaller proportion of consumptives.

We can not presume to say that there is always a direct relationship between the degree of temperature and the prevalence of phthisis, for, in fact, there are so many disturbing causes brought to bear on most localities, communities, and individuals, that numerous exceptions must necessarily occur; but what has been stated may be received as the general law, and we, therefore, risk nothing in affirming that, *cæteris paribus*, the prevalence of consumption is least in very high and very low degrees of heat.

The influences of artificial heat are widely different from the effects connected with climate; and, inasmuch as the former condition is almost necessarily associated with impure air, or want of ventilation, and sudden transitions, it becomes difficult to separate these causes, or to assign to temperature its legitimate effects. We have sufficient evidence, however, that a high degree of artificial heat is unpropitious; but exactly how much of this unfavorable influence is due to the associated conditions is difficult to decide. But we would, as a safe practical rule, caution persons predisposed to phthisis to avoid excesses of artificial heat, for, if no other effect is produced, such changes are liable to induce inflammatory affections, which may become inducing causes of the disease.

It will, probably, be esteemed a thankless task to speculate on these effects of heat and cold, and, therefore, my remarks on this subject will be brief. We are presented with the singular phenomenon of opposite conditions of temperature exercising a similar influence in relation to the development of phthisis; in other words, extreme heat and extreme cold appear to protect the constitution against those subtile changes which result in the formation of tuberculous matter. It is impossible that these remarkable results can be accidental; on the contrary, there must be some general law operating under both conditions, and producing similar results.

If we seek to connect the influences of *oxygen* with the effects of heat and cold, we shall find exactly opposite conditions, so far as relates to the quantity consumed. A cold and dense atmosphere, as in the arctic regions, necessarily contains a larger proportion of oxygen than a hot and rarefied air, as it

is met with in the torrid zone; hence, persons situated in the former region consume a larger proportion of oxygen than the latter. In hot climates, on the contrary, the quantity of oxygen being diminished, the blood is not so thoroughly decarbonized, and this element being retained, a preponderance is given to biliary action.

It is difficult to determine what precise relationship exists between the diminished oxydation of the tissues, the retention of carbon, and the development of tubercles; but the fact itself (independent of certain other observations indicating the influence of venous blood in the retardation of tuberculosis) leads to the conclusion, that this condition of the system, in some measure, prevents the development of tubercles. We can not presume to offer a clear explanation of this condition, but we can, probably, advance a step in the right direction, by adverting to the diminished metamorphosis of the tissues under these circumstances. Whatever opinions we may adopt in regard to the effects of oxygen on the system, there can be no doubt that it favors the disintegration of the textures, and, consequently, the elimination of effete elements; and, although other conditions influence and often control these actions, yet it must be acknowledged that the retention of carbon in the system will exercise á strong influence in checking the molecular changes. Hence, the system, under such circumstances, is not rapidly changed, and the introduction of crude elements (except carbon) into the circulation must be comparatively slight. If, then, the explanation which has been advanced in relation to the origin of tubercular matter be true, namely, that it originates in some vice connected with the metamorphosis of the general tissues, we are furnished with a philosophical explanation of the absence of phthisis under the circumstances mentioned. In other words, carbon is retained, the tissues break up slowly, and tubercular matter is not formed. We might advance a step further, and state, that the presence of hydro-carbon exercises some specific influence over tubercular matter, either to prevent its formation, or to arrest its development; but it is sufficient to indicate the general relationship

between these conditions, without assuming to offer a full and minute explanation of the changes which occur.

Turning to the opposite condition, the arctic region, the facts already alluded to teach us that, like the tropics, consumption is comparatively a rare disease. How are we to explain this anomaly? If tropical regions afford an immunity from consumption in consequence of the diminished amount of oxygen, how are we to reconcile this with its *increased* consumption in cold latitudes, in which there is an equal freedom from the disease? The explanation is probably to be found in the *diminished temperature.* It is true the quantity of oxygen in a given bulk of air is greater than when the temperature is high; but this condensation is connected with an intense degree of cold, which must necessarily retard the organic movements. The stimulating effects of oxygen, by which the transformations of the body are rendered active, has been observed only in a moderately warm atmosphere; but if the same quantity of oxygen should be inhaled in a very low temperature, its stimulating, or at least *disintegrating,* influence would be greatly diminished. This I conceive to be the condition in cold latitudes; and it necessarily follows, that, like warm regions, though differing in cause, the metamorphosis of the tissues is less active, and, therefore, tuberculosis is more slowly developed. In addition to this, the inhabitants, during the cold season, confine themselves much to their huts, take but little exercise, eat a highly carbonaceous food, and thus completely protect their systems from the destructive tendencies of the oxydizing process. Thus, while in the cold air, their systems are rendered comparatively torpid; and when breathing the warm air of their huts, the proportion of oxygen is lessened, and the predominance of carbonaceous food, together with their want of exercise, present conditions unfavorable to active metamorphosis of the tissues.

It seems a fair inference, therefore, that the influences of heat and cold in protecting the system against the tubercular diathesis, operate by virtue of the diminished transformations of the tissues, depending, in one case, on the protective agency

of carbon, and in the other, on the depressing effects of cold. In either case the metamorphosis of the tissues becomes comparatively slow, and the tuberculous material scantily supplied.

The preceding views find some support in what occurs in the temperate zone. Here consumption is known to prevail more extensively than in the two extremes, and the various influences brought to bear on the vital actions are precisely such as we would expect, on the foregoing views, to develop the disease. In this zone we have not the protective influence of extreme heat or cold; but, on the contrary, the temperature is a medium one, accompanied by sudden transitions, passing rapidly to either extreme. In addition to this, it is the temperate zone in which we find the highest degree of civilization, the greatest activity of body and mind, together with all those influences calculated to promote rapid changes in the molecular action of the different tissues. The temperature is such that much active exercise takes place in the open air; or, in the absence of this, hard and protracted labor in confined situations, with often insufficient food and clothing. The diet, too, it must be observed, is often of a character calculated to imperfectly sustain the tissues and the expenditure of vitality; or, under opposite circumstances, it is mixed, and large in quantity, the structures become replete with nutritive materials, and, therefore, readily break up into crude elements in which tuberculous substances are readily developed.

According to these views, the extremes of heat and cold, *cæteris paribus*, afford a certain amount of protection against the development of tubercles, which is shown by the fact that the inhabitants of those climates are less liable to consumption than persons who live in the temperate zone; and hence we must conclude that mere *temperature* exercises only a conditional influence over the development of phthisis.

SECTION III.

HUMIDITY IN RELATION TO PHTHISIS.

The exact influence of a moist atmosphere in the production of tuberculosis has not been determined with scientific accuracy, although the general impression inclines to the opinion that it exercises a prejudicial effect. Nor is there any definite opinion in relation to the connection of temperature with moisture; thus, some assert that a warm and humid atmosphere is unfavorable, while others associate a low temperature with the evil effects of moisture.

The doubts and difficulties of this subject arise (at least in part) from confounding the questions of the geography of phthisis, *and a change of climate;* and furthermore, from a failure to place a proper estimate on the relative effects of localities possessing similar degrees of temperature, but varying in humidity and other modifying conditions. Thus the same temperature and the same hygrometrical conditions may exercise a widely different effect on the lungs, and therefore prevent a proper estimate being placed on moisture. An examination of the quantity of rain in different regions, although not affording positive evidence of the existing degree of humidity, will, nevertheless, form the only reliable basis on which we can found an opinion. I give below the mean annual quantity of rain at several points, derived mostly from Johnson's *Physical Atlas.*

Localities.	Latitude. ° ′	Inches.
Coast of Norway	60 57 N.	82 to 88
Western coast of Scandinavia	82 00	82
South Scandinavia and Western Russia		21.23
Middle and Northern Germany		20.35
South France		23.54
West France		24.61
British Islands, plains		24.51
" " mountain ranges		40.59
Madeira		29.82
Columbo, Ceylon	6 57 (plains)	99.21

Localities.	Latitude. ° ′	Inches.
Sierra Leone	8 30 N.	189.69
Madras	13 5 "	48
Bombay	18 56 "	80.04
Port Louis, Mauritius	20 10 S.	35.25
Macao, China	22 10 N.	68.30
Calcutta, Bengal	22 35 "	58.66
Canton, China	23 08 "	69.28
Delhi, India	28 37 "	23.51
Probable mean, ranging from 5° 25′ N. to including plains and mountains	28 37 "	74.00
Havana, Cuba	23 09 "	90.66
Vera Cruz, Mexico	19 12 "	66.09
Rio Janeiro	22 54 S.	58.68
St. Domingo	19 43 N.	127.88
Granada, Little Antilles	12 15 "	103.41
Antigua, " "	17 03 "	39.49
Guadaloupe	——	292.03
San Louis de Maranhoa	2 29 S.	276.12
Probable mean, extending from 2° 29′ S. to	23 09 N.	113.00
Mean quantity of rain in U. S., betw'n 24½° and 45°		39.00
Mean quantity of rain in Europe, bet. 36° and 60°		34.00
Mean in Australia.....from 33° to 43° S.		26.00
Mean within tropics		95.00
In the temperate zone, Northern hemisphere		37.00
" " " Southern "		26.00

The following table shows the amount of rain, in connection with temperature and altitude, of many localities in the United States:

Localities.	Spring. ° ′	Sum. ° ′	Aut. ° ′	Winter. ° ′	Year. ° ′	Lat. ° ′	Long. ° ′	Altitude. Feet.	Rain. Inches.
Albany, N. Y	46 7	70 0	50 0	26 0	48 2	42 31	73 44	130	40.67
Astoria, Oregon	51 8	59 9	55 2	47 5	53 6	42 44	124 29	50	86.35
Athens, Ill	54 4	76 2	57 2	28 0	53 9	39 52	89 56	650	41.80
Augusta, Ga	64 4	80 2	63 4	48 1	64 0	33 28	81 53	550	40.78
Boston, Mass	45 9	69 0	50 8	28 3	48 6	42 20	71 03	50	44.48
Burlington, Vt	42 7	67 9	47 8	21 6	45 0	44 29	73 11	367	——
Baltimore, Md	50 6	73 6	55 3	32 8	53 1	39 18	76 36	80	40.98
Beaufort, N. C	59 5	78 5	65 2	45 7	62 2	34 41	76 40	20	——
Cincinnati, O	53 7	74 0	53 9	33 7	53 8	39 06	84 29	543	46.89

Localities.	Spring. ° ′	Sum. ° ′	Aut. ° ′	Winter. ° ′	Year. ° ′	Lat. ° ′	Long. ° ′	Altitude. Feet.	Rain. Inches.
Charleston, S. C.	65 9	79 8	66 5	51 4	65 9	32 45	79 57	20	48.29
Concord, N. H.	42 6	65 4	47 3	22 7	44 5	43 13	71 29	250	41.09
Detroit, Mich.	45 9	67 6	48 7	26 8	47 2	42 20	82 58	580	30.07
Dubuque, Iowa	50 4	72 1	52 5	22 5	49 4	42 29	90 50	680	——
Fort Smith, Ark.	61 3	77 6	60 1	41 1	60 0	35 53	94 29	560	42.10
Fort Leavenworth, Kan.	53 8	74 1	53 7	29 6	52 8	39 21	94 44	896	39.29
Fort Riley, Min.	39 3	64 9	42 9	10 0	39 3	46 19	94 19	1130	25.52
Fort Conrad, N. M.	59 8	77 5	58 8	39 5	58 9	33 34	107 06	4576	6.76
Key West, Florida	75 8	82 5	78 2	69 5	76 5	24 32	81 48	10	47.65
Lancaster, Pa.	50 9	71 2	52 1	31 6	51 4	40 02	76 21	300	38.81
Louisville, Ky.	55 4	73 1	54 7	36 3	54 9	38 00	85 25	600	48.10
Mobile, Ala.	70 1	82 7	71 0	57 3	70 3	30 42	87 59	25	64.42
Milwaukee, Wis.	42 3	67 3	50 1	26 0	46 4	43 04	87 57	600	27.20
Mexico	63 4	65 2	60 1	53 0	60 4	19 26	103 46	7469	——
New York City	48 7	72 1	54 4	31 3	51 6	40 42	74 00	——	42.23
Natchez, Miss.	68 0	81 0	67 1	52 2	67 1	31 34	91 28	264	42.70
New Orleans, La.	70 0	82 3	70 7	56 5	69 9	29 57	90 00	10	52.31
Nashville, Tenn.	59 9	77 3	57 1	39 5	58 5	36 10	86 49	533	54.99
Portland, Me.	42 8	65 2	48 1	24 7	45 2	43 39	70 20	20	45.25
San Antonio, Texas.	67 7	82 1	71 3	53 9	69 3	29 25	98 25	635	33.77
St. Louis, Mo.	54 1	76 2	55 4	32 3	54 5	38 49	90 05	450	41.95
Washington City.	55 7	76 3	56 4	36 0	56 1	38 53	77 02	5090	41.20

It appears difficult, if not impossible, in our present state of knowledge, to determine the exact etiological influence of moisture in the production of phthisis. While many observers have been of opinion that humidity favors the development of tubercular disease, Louis, Lombard, and others consider that a mild, equable, and *moist* atmosphere prevents its development. Nor have observers been agreed in relation to influence of associated heat; thus, some have considered humidity, in connection with a high temperature, as the most prejudicial, while others regard a cold and moist climate as most prone to the production of phthisis.

We can not fail to perceive, however, in tracing the geographical distribution of phthisis, that its prevalence is uninfluenced by the degree of humidity. Thus, in the table given above, the mean annual quantity of rain in Europe is *thirty-four* inches, while within the tropics it reaches *ninety-five* inches. At Madras the quantity is forty-eight inches, while in the mid-

dle and north of Germany it is only 20.35. And, again, the East Indies, as a rule, is excessively moist, while Egypt is remarkably dry, both being favorable in regard to the development of phthisis. In our own country, we observe the quantity of rain at Boston to be forty-four inches, and at Mobile sixty-four; and yet the former doubtless produces more phthisis than the latter. In a more general way, we observe the laws on this subject developed on a broad scale throughout warm and cold regions. In the northern part of the United States there is much less vapor in the atmosphere than is met with in the South; indeed, the southern portion of the Valley of the Mississippi, receiving a moist air from the Gulf, is highly charged with humidity; and yet consumption, as our tables show, is vastly more prevalent North than South.

From these facts, I am led to the conclusion that moisture is a comparatively unimportant agent in the production of phthisis, and that when the disease prevails in humid localities there are additional influences which favor its development. Doubtless many persons have been misled on this subject by failing to draw a distinction between the influences of moisture in the production of phthisis, and the aggravation of disease, when once formed, by a warm and humid atmosphere. It will be observed that these are totally different questions; and the reader is referred to the chapter on Therapeutics for a further elucidation of this important question.

Excessive Dryness.—We have no evidence to prove that an excessively *dry* atmosphere favors the development of tuberculosis; although it might safely be conjectured that *any* excess, proving prejudicial to the animal economy, would increase the tendency to phthisis. Those countries, however, in which excessive drouth occurs, are well known to be comparatively exempt from consumption. Such is New Mexico; and we might find a more extreme illustration in the deserts of Arabia. Artificial dryness, such as is produced in store-rooms, proves irritating to the lungs, and, therefore, probably favors tubercular deposits. It may be said that either excess, in regard to moisture, will interfere not only with pulmonary exhalation, but also with the movement of blood in the capillaries; and in proportion as the

physiological condition becomes subverted, so will the tendencies to deposits increase. And when artificially induced, as in ill-ventilated rooms, the effects will doubtless prove injurious; but as an element of climate, dryness, like moisture, is comparatively without effect.

SECTION IV.

ALTITUDE IN RELATION TO PHTHISIS.

An impression has prevailed that elevated situations were less productive of consumption than the valleys or plains, and, consequently, that diminished atmospheric pressure exercised a favorable influence. In support of this opinion, Muhry* (of Göttingen) has cited the exemption of various elevated locations, and concludes that a rarefied air is favorable. He justly remarks that Europe contains but few locations sufficiently elevated to exercise much influence, and hence the subject has failed to attract attention. But even in Europe, it is known that phthisis is comparatively rare in the Hartz Mountains, the mountains of Thuringia, at an altitude of eighteen hundred to two thousand feet; and the same observations may be made of the more elevated situations of Switzerland. But it is within the tropical zone that the most marked effects are observed. In Mexico, at an altitude of seven thousand feet, phthisis is rare; and while, in many of these elevated situations, typhus, bronchitis, and pneumonia prevail, phthisis is not mentioned. According to the reports of Smith and Tschudi, phthisis is very common in Peru, on the lower sea-coast, but it is extremely rare on reaching an elevation of eight to twelve thousand feet, and patients were often cured by sending them to these high regions.

In the United States, although our observations have not assumed a sufficiently definite shape, yet I believe it a safe

* Henle and Pfeufer's Zeitschrift, in Charleston Journal, May, 1858.

general conclusion that the lower situations are more prone to develop phthisis than the high or mountainous regions. Thus, it will certainly be admitted, that consumption is more common along the north Atlantic sea-board than on the Alleghany Mountains, although definite statistics are wanting on the subject.

A plausible objection to this opinion is based on the fact, that persons suddenly ascending to a great hight experience difficulty in breathing the rarefied air; the respiration becomes quick, laborious, and oppressed; the pulse is quick and feeble, with a tendency to hemorrhage. This, however, is not a valid objection, for the condition referred to is temporary, and, doubtless, would soon subside, or, at least, would not occur in any oppressive degree in those long accustomed to breathe a rarefied air. But again, it is not an extreme elevation which should be sought; on the contrary, a moderate altitude, such as the patient could breathe with ease, should be selected, and the elevation gradually approached. It is stated that in the town of Cerro de Pasco, with an elevation of 13,670 feet, and a medium temperature of 35° to 40° F., the thorax and lungs of the inhabitants become expanded, and the breathing is, of course, free and easy. Hæmoptysis is rare, although the cold produces pleurisy.

It seems a fair inference, from these facts, (few as they are,) that elevated situations, or a rarefied atmosphere, exercises a favorable influence in regard to the development of tubercles, and that we may avail ourselves of this general law in the *prevention*, if not treatment of the disease.

SECTION V.

ATMOSPHERIC IMPURITIES AS CAUSES OF PHTHISIS.

An impure or vitiated atmosphere, from whatever cause the change may arise, must, necessarily, exercise a prejudicial influence on those predisposed to consumption. There may be some

doubt, however, whether vitiation of the atmosphere, as it is ordinarily understood, exercises quite that influence in the production of tuberculosis which is generally supposed. Thus, the increase of carbonic acid, one of the results of imperfect ventilation, probably does not favor the development of tubercles; nor is there sufficient evidence to prove that the mere absence of oxygen can exercise any prejudicial effect on the scrofulous diathesis, much less in generating that condition. Indeed, an impression prevails that a venous state of the blood, such as exists in cardiac affections, is a strong protection against the development of tubercles.

In opposition, however, to this view, we have the opinions of Baudelocque and others, that an atmosphere not sufficiently renewed (consequently containing too little oxygen) is the exclusive cause of scrofulous diseases. But these suppositions prove too much; for while there might be some plausibility in the opinion, that persons residing in small and ill-ventilated hovels would become affected from that cause, the theory totally fails when applied to the wealthy, who live in palaces possessing all the improvements of modern architecture. The truth is, the ill effects which have been noticed among the poor arise more from privations of food and clothing, together with cold and dampness, than any absolute vitiation of the atmosphere.

The facts brought to notice by Mr. Phillips very clearly show, that there is no immediate relationship between a dense population with ill-ventilated houses, and the production of scrofula. Thus, the disease was found frequently more prevalent in the sparse than the densely-populated portion of towns, whereas the reverse should obtain if a vitiated air was so potent in its influences.

Mr. Ancell, in commenting on these questions, seeks a compromise between the parties, by assuming that it is the want of proper renewal of the *residual* air of the lungs, and hence, in *that* sense, a vitiated air *may* prove truly detrimental; thus, sedentary habits, mental occupations, and similar agencies, retard the pulmonary action, and hence, *vitiate* that portion of air which is called *residual*. This, however, is simply begging the

question; for the explanation proposed involves other and primary causes, placing the vitiated air in a position so remote as to deprive it of any presumed primary influence.

In considering this subject, however, it becomes important to distinguish betweeen causes which operate to depress the vital powers generally, and thus *indirectly* favor the production of tubercles, and those causes which operate directly and specifically. It may readily enough be granted that an atmosphere loaded with impurities must necessarily prove unfavorable to animal life, and may induce various forms of disease; but it is necessary to show that the tendency is to the production of *tubercle* in preference to other morbid conditions. If this can not be done, such agencies lose their specific tendencies, and must be classed with general causes, quite as likely to induce typhus as tubercle.

SECTION VI.

TEMPERAMENTS IN RELATION TO PHTHISIS.

The influence of temperament in the development of phthisis involves merely a question of predisposition, which will be found in connection with those laboring under hereditary taint, or such persons as are exposed to the exciting causes. It is evident, however, that mere physical conformation must always occupy a subordinate position, for no temperament can do more than render certain persons more obnoxious to the influences of such exciting causes as have a tendency to favor the development of tubercles. Viewed in this light, certain physical structures possess some interest as exhibiting a tendency to tuberculosis, or rather an inability to *resist the influences* of certain causes which favor the development of tubercles. But even in this relation, it is a question whether it is, in fact, mere *temperament*, (using that term in its ordinary acceptation,) which gives rise to a tendency, under the operation of certain causes, to the development of phthisis; but, on the contrary, whether it is not

rather a weakness, or want of power of resistance, which favors the action of general agents in the production of this disease. Thus, a person may possess a weak constitution, (independent of an hereditary tuberculous diathesis,) which may have no *innate* tendency to the formation of tubercles, and which, under favorable circumstances, might pass through a long life without the development of this disease; but if this same person should occupy a cold and damp location, live on improper food, or breathe a bad atmosphere, then, with its weak powers of resistance, tubercles might become developed. And this weakness of constitution may be found in association with what is technically known as the nervous, bilious, or lymphatic *temperaments;* but the disease is not induced because of the preponderance of a particular temperament, but rather as the result of certain causes operating on a constitution of weak powers of resistance.

It may be remarked that the *lymphatic* temperament, is, *par excellence*, that which many believe most certainly predisposes to tuberculous affections. It may be plausibly, and, perhaps, truly affirmed, that in persons of this temperament, possessing comparatively feeble powers of resistance, the inducing causes operate more certainly and forcibly, and hence, that it is the form of organization most liable, under favorable circumstances, to the development of phthisis. There are just grounds for the opinion, however, that the tendency of the lymphatic constitution to develop tubercles is very slight, and that much the larger proportion of cases occur in those of a different organism. My own observations have led to the belief that the lymphatic constitution plays a very insignificant part in the development of phthisis; indeed, a large proportion of non-hereditary cases, which I have observed, were not lymphatic; but the bilious, nervous, and even sanguineous, with their varied interminglings, predominated. And in relation to hereditary cases, my impression is very decided, that most of the examples exhibit more of the nervous (and its combinations) than the lymphatic temperament. Fournet, indeed, expresses the opinion, that phthisis is less common in the highly-developed lymphatic temperament than where this organism exists in a less marked degree.

In relation to the influences of a *feeble* constitution, the following table gives the results of observations made by Rilliet and Barthez:

	314 Tuberculous Infants.	211 Non-Tuberculous.
Strong constitution.....	47	60
Feeble do.	133	4
Medium do.	94	46
Unknown.....	40	101

Thus, of those that became tuberculous, one in 2.3 had feeble constitutions prior to the disease, while of the non-tuberculous only one in fifty-two were in that condition.

It need only be added, therefore, that but little can be said in support of the opinion that the lymphatic temperament exercises any very important share as a connate predisposing cause in the induction of phthisis; but that feebleness of the vital forces generally, by diminishing the powers of resistance, renders such subjects, when placed under adverse conditions, more liable to tubercles than the robust.

SECTION VII.

AGE IN RELATION TO PHTHISIS.

The periods of life during which the larger proportion of cases occur, may be considered the age which operates as a predisposing cause of the disease. Further than this we can not consider age a *cause* of phthisis. It is evident that the early period of puberty, extending from twenty to thirty years, may be regarded as the time when tubercles are most commonly developed. A little wider range, (which would necessarily include more examples,) extending from eighteen to thirty-five, was given by that astute observer, Hippocrates. Andral and Lombard give the range of twenty-one to twenty-eight for men, and before twenty for females. Bayle, Louis, and Clark assume twenty to thirty years to be the age which embraces the largest number. According to the tables arranged at the Brompton

Hospital, the largest percentage occurred between twenty-five and thirty-five, thus:

TABLE OF AGES OF 2679 MALES AND 1679 FEMALES.

Ages.	Males.	Per Cent.	Females.	Per Cent.	Total.	Per Ct.
to 5	9	0.33	12	0.71	221	0.48
5 to 15	125	4.66	112	6.66	237	5.43
15 to 25	695	25.94	574	34.19	1269	29.11
25 to 35	953	35.50	578	34.42	1531	35.13
35 to 45	570	21.27	271	16.14	841	19.29
45 to 55	251	9.37	110	6.55	361	8.25
55 to 65	68	2.53	21	1.25	89	2.04
65 to 75	8	0 29	1	.05	9	0.20
Total Males...	2679	Total Females...	1679	Total.....	4358	

According to this arrangement, the largest proportion of cases occurred between the ages of twenty-five and thirty-five years, being thirty-five per cent. in males and thirty-four per cent. in females; and the next highest number was observed between fifteen and twenty-five, showing twenty-five per cent. for males, and thirty-four per cent. for females. It is a fair inference from this table that consumption occurs at an earlier age in females than in males; after the age of thirty-five the frequency of the disease decreases much more rapidly in the female than in the male, in the proportion of sixteen to twenty-one. It has been remarked, in explanation of this earlier occurrence of phthisis in females, that the hereditary predisposition is more common than in males, while the latter are more exposed, as life progresses, to the various exciting causes of the disease. In a practical point of view it is important to observe, in reference to females, that the period requiring the greatest care ranges from fifteen to thirty, and if they pass this latter age, the chances of the disease occurring become greatly diminished.

The following table, arranged at the same institution, by Dr. Cotton, shows perhaps more clearly the period at which consumption is developed in the sexes.

TABLE OF SEXES, (582 MALES, 418 FEMALES.)

Ages.	Males. Per Cent.	Females. Per Cent.
0 to 5	0.5	0.7
5 to 10	2.5	3.1
10 to 20	12.7	17.7
20 to 30	38.8	40.4
30 to 40	27.3	24.6
40 to 50	13.9	9.3
50 to 60	2.4	2.8
60 to 70	1.0	0.4

This table shows the largest proportion of both sexes from twenty to thirty; thirty-eight per cent. males and forty per cent. females; also, that the disease is more frequent in females than males up to thirty; while it diminishes more rapidly in the former after the latter period.

The following table is compiled from the United States Census of 1850. Males, 15,490; females, 18,026; total, 33,516.

Ages.	Males.	Per Cent.	Females.	Per Cent.	Total.	Per Ct.
Under 1	686	4.4	608	3.3	1294	3.8
1 to 5	927	5.9	907	5.0	1834	5.4
5 to 10	278	1.8	336	1.3	514	1.2
10 to 20	1144	7.3	2335	12.9	3479	10.3
20 to 50	8410	54.2	10198	56.5	18608	55.8
80 to 100	256	1.6	235	1.3	491	1.4

The above table, it will be remarked, is very defective in extending the range from twenty to fifty, instead of arranging the whole in decennial periods. The result, however, shows the largest proportion above twenty; and had it been continued in the usual form, would probably have given conclusions similar to those already quoted. In other respects it differs somewhat from the preceding statistics; thus, the proportion from one to five is comparatively large; five to ten and ten to twenty give a smaller number than in other tables. We can draw no conclusions from this table different from those previously given, or which modify the general law that the greatest number of cases occur between the ages of twenty and thirty years, or perhaps from twenty-five to thirty-five.

The following table, compiled from the Brompton Hospital Report, probably affords a very accurate view of the ages at which the disease occurs in London, exhibited on a reduced scale of population:

Ages.	No. Cases of Phthisis. Males and Females.	Reduced Scale of Population. Males and Females.	Ratio Per Cent. of Cases of Phthisis.
5 to 15	237	3709	6
15 to 25	1269	3922	32
25 to 35	1531	3651	42
35 to 45	841	2560	32
45 to 55	361	1660	21
55 to 65	89	945	9
65 to 75	9	487	2

According to this table the highest proportion occurs between the ages of twenty-five and thirty-five, being forty-two per cent.; while from fifteen to twenty-five and forty-five to fifty-five are exactly equal, being each thirty-two per cent.

SECTION VIII.

SEX IN RELATION TO PHTHISIS.

It has always been a disputed question as to the relative frequency of phthisis in the two sexes; but it seems now quite definitely settled that the preponderance is to females.

The United States census, for 1850, gives the following proportions:

Females.....18,026 } or thus, { 1 in 1286 living.
Males.....15,490 } { 1 in 1529 living.

The relative proportion of males and females is too nearly equal in the United States to disturb the apparent result of this estimate.

In London, from 1843 to 1856, the proportion was fifty-three per cent. males, and forty-seven per cent. females, showing a preponderance of the former.

In France the following results have been obtained. According to M. Benoiston, in forty-three thousand patients, admitted into the Paris hospitals for various diseases, the following proportion of deaths from phthisis occurred:

Females	1 in 21
Males	1 in 35

Again, in thirty-one of the forty-two counties of England, it was found that the proportion was greater among females. Sir James Clark has collected, from thirteen localities in Europe and America, the following results:

Females	17,330
Males	15,271

It is estimated, however, that for the whole of England (1847) the proportion is greater in females.

Males	1 in 337.6 of all living.
Females	1 in 310.1 of all living.

M. Chartroule observes that phthisis is a little more frequent in females than in males; thus, in Paris:

Females	5579
Males	3965

In Sweden the proportion is of females to males as ten to 8.9.

Dr. Cotton (*loc. cit.*) remarks that of the thousand cases which fell under his own observation at the Brompton Hospital, the proportion was found:

	No. Cases.	Per Cent.
Males	582	58.2
Females	418	41.8

From this he concludes that, at least in and around London, consumption is more frequent in males than females. This conclusion is probably erroneous. It is far more probable that males more commonly than females, seek relief at hospitals,

and that many of the latter remain at home. Hence, the only correct method of calculation is by ascertaining the per cent. of the whole deaths from phthisis, or what is still better, the proportion of deaths in each sex to the whole number living. Sir James Clark estimates the proportion as seven to five, while in Sweden it is placed ten to 8.9. These estimates are probably very nearly correct.

It would appear, from the preceding statistics, that consumption is more frequent in females than in males, and, therefore, the constitution of the former, whether acquired or natural, may be fairly presumed to afford a predisposition to the disease. It is probable, however, that the more sedentary habits of females and their in-door occupations, have a material influence in causing this preponderance against them.

It must be acknowledged, however, that in some localities the deaths among males preponderate, so that the above inferences are not universally true; and, as a whole, the influence of sex, *per se*, is probably very slight, if not absolutely insignificant.

SECTION IX.

OCCUPATION IN RELATION TO PHTHISIS.

The agency of various occupations in the production of phthisis is often well marked and decisive. The morbid influences, whether bearing the relation of exciting or predisposing causes, may be classed under the heads of vitiated atmosphere, excessive heat or moisture, deprivation of light, the inhalation of noxious vapors or irritating particles of matter, to which may be added constrained position, and want of exercise; also, undue exercise, and excessive exposure to cold, damp, or variable weather. Among the general causes, sedentary habits evidently stand pre-eminent; but the qualifying circumstances will materially modify the result.

Exercise.—Chartroule justly remarks that *labor* can not be regarded as a cause of phthisis; but, after disease has been manifested, all excessive fatigue impairs the vital powers, and thus hastens the development of morbid action. All excessive labor must be regarded as injurious; and if the subjects be at all predisposed to phthisis, it will undoubtedly hasten that condition. But much will depend on many incidental circumstances, such as the quality and quantity of food, nature of the occupation, the quality of the air which is habitually breathed, as well as the degree of heat or cold. In estimating the influences of labor, we must also take into consideration that which is intellectual, and that which is merely physical in its character. Those occupations which involve chiefly the mind, are almost invariably associated with sedentary habits, which must not be overlooked.

Intellectual labor.—There can be no doubt that excessive, or even considerable mental labor, has a marked tendency to impair the physical powers; it weakens the digestive function, and thereby deteriorates nutrition; diminishes sleep and repose, leads to sedentary habits, breathing impure air, and thus evidently favors the development of phthisis. It has been observed that those of cultivated minds and bright intellects often become the victims of this disease; but the inference that persons of active minds are especially predisposed to tuberculosis is less true than that such individuals are apt to engage in close mental applications, and thus impair the physical powers. In our own profession may be mentioned the examples of Bayle and Laennec, who so successfully investigated consumption, and yet, partly as the result of excessive mental application, fell victims to the disease they so laboriously sought to explain. It will be remarked, in this connection, that moderate mental application, with a due share of out-door exercise, can produce no injurious results; but it is the excessive labor, with its concomitants of late hours, disturbed sleep, impaired assimilation, and so on, which cause the injurious consequences.

There is no direct evidence to prove that persons who greatly exercise the voice and lungs are, in any unusual degree, liable to consumption; thus public speakers, clergymen, orators, law-

yers, professors, and singers seem not particularly predisposed to the development of tubercles.

The influences of artificial heat.—Among those who are exposed to excessive heat may be mentioned bakers, cooks, various artisans who work in iron, tailors, shoemakers, printers, etc. In some of these examples the heat is constant and excessive at all seasons, while in others it pertains to the winter only; and, in a portion, noxious substances are inhaled, which add to the mischief. But in all these instances the influence of heat is transient and irregular, so that the persons are exposed to great alternations of temperature, and extraordinary changes in the cutaneous transpirations. These conditions must necessarily prove injurious, especially to those predisposed to consumption. I have often seen tailors, shoemakers, and bakers, who have been exposed to these sudden alternations of heat and cold, become rapidly and extensively tuberculous, and nearly always with a fatal issue. It is affirmed by Chartroule that he has found glass-blowers especially obnoxious to the disease.

Occupations which expose persons to humidity.—General observation confirms the fact that occupations which expose laborers to continued moisture favor the development of phthisis. I do not propose, in this place, to discuss the general question of humidity in its relation to climate, but merely to indicate that those occupations, *within doors*, which immerse persons in a moist atmosphere, are more liable to develop tubercles than where the air is only *moderately* humid. Damp prisons, basements of dwellings, and similar situations, are unfavorable to health in a general sense, and especially contribute to the development of tubercle. An example has recently come under my notice, in which a person, apparently free from hereditary taint, had tubercles developed under the influences of an atmosphere of a paper-mill surcharged with vapor. In this case the disease seemed clearly traceable to this cause. But it is probable, that humidity combined with cold is more unfavorable than when united with an elevated temperature; it is the latter condition, however, that we usually meet with, that is, moisture combined with heat. Fourcault recognizes the unfavorable effects of humidity; but he carefully distinguishes between the influences

of dampness acting on persons engaged in sedentary occupations, and those who exercise freely in the open air.

I have ascertained that the teachers of the religious orders of the Catholic Church in this city very commonly fall victims to consumption. In their occupation of teachers they are placed in basement rooms, the dampness of which doubtless contributes largely to the fatal result. Indeed, there is no evident cause for this great mortality, except the nature of the apartments which they occupy, and the want of exercise in the open air. The result is, that probably three-fourths of all thus employed die of consumption, the disease often proving rapid in its course.

Occupations which favor the inhalation of dust or irritating substances.—Many artisans become subject to tubercles in consequence, apparently, of the inhalation of irritating substances. Among these may be enumerated workers in stone, needle-pointers, knife-grinders, workers in cotton, flax, and hemp, manufacturers of gun-flints, miners, coal-heavers, hatters, plasterers, feather merchants, etc. Dr. Peacock* has recently called attention to the occurrence of phthisis in the workers of French burr millstones. There appears to be little doubt that the particles of stone inhaled by these workmen are remarkably prone to induce phthisis, and especially so if any constitutional predisposition to the disease exists. Dr. Peacock observes that the men engaged in working these stones regard the occupation as highly injurious, and that the burr is much more dangerous than the Yorkshire or Derbyshire grit, the Scotch granite, or the German basalt, which are made into millstones. I have made inquiry of an intelligent foreman in an extensive millstone establishment of this city, and his statements are similar to those made to Dr. Peacock. He informs me that nearly all persons who work the French burr suffer with pulmonary disease; some very speedily, others more slowly. Some break down in two years, others in five or six, while a few of the more robust may continue at the business ten or twelve years. His remark was, that the business was very hard on the lungs.

* British and Foreign Med. Chirurgical Review, January, 1860.

It may be assumed, indeed, as a sufficiently accurate general law, that the inhalation of any irritating substance is susceptible, in certain cases, of developing phthisis; but this general rule requires considerable and important modifications. Thus, in order that such insufflations shall be capable of causing the development of tubercle, it is rendered probable there must usually be present either a hereditary predisposition or other inducing causes, which favor or coincide with the mechanical or chemical irritants. When the tuberculous constitution exists, the inhalation of irritating substances may very speedily cause the deposition of tubercles; or, in the absence of this predisposition, the long-continued action of humidity, exclusion of solar light, impoverished diet, mental depression, or similar causes, may so far modify the vital powers as to establish the condition of the body capable of elaborating tubercular matter. But, in the absence of both the hereditary diathesis and the acquired predisposition, the inhalation of irritating particles of matter will be far more liable to develop simple inflammation, such as bronchitis, laryngitis, lobular pneumonia, or granulations, than to give rise to tubercles. And it can scarcely admit of doubt that many instances in which these irritants were supposed to have induced consumption, the disease was, in fact, some form of chronic inflammation. With these qualifications, we may place the inhalation of irritating powders among the occasional causes of phthisis.

This general law accords with the observations of Parent-Duchâtelet, that healthy persons, even when habitually breathing an atmosphere loaded with dust, do not become tuberculous, unless other co-operating causes are brought to bear in the same case. Dr. Holland, of Sheffield, has clearly pointed out that various pathological conditions occur in the "grinders" of that city, among which phthisis is the least frequent; and for the development of consumption it requires the influence of other causes in addition to the mechanical irritants. The extensive investigations of Fourcault led to the conclusion that the action of dust on the air-passages, restricted positions, and tight lacing exercise a secondary and unimportant influence in the development of phthisis.

A highly important qualification in all the examples which have been introduced, relates to the conditions under which the inducing causes are brought to bear on the system, that is, whether they operate in connection with a good or vitiated atmosphere. Indeed, the greatest differences are found to exist between the same class of artisans, when operating in the open air or in confined and ill-ventilated workshops. This law is well illustrated in the Sheffield grinders already alluded to. Dr. Holland and Sir James Clark bear testimony that those artisans who operate in the country are much less liable to disease than those who are confined to workshops; the latter die between the ages of twenty-eight and thirty-two, while those who enjoy the advantages of country air, live to the age of forty. Facts of this character very forcibly illustrate the law already referred to, that, under favorable hygienic conditions, the inhalation of irritants produces far less injury than when the subject is acted upon by adverse causes. According to the Report of the Brompton Hospital, London, printers, compositors, clerks, shopmen, tailors, shoemakers, needlewomen, and milliners are peculiarly liable to consumption; and it is justly remarked by Mr. Ancell (*loc. cit.*) that in all these classes, sedentary habits, ill-ventilated rooms, during day and night, conspire to increase the disease in such persons.

M. Lombard (*Annales d'Hygiène*) has furnished the following statistical view of the different occupations and conditions in their relation to phthisis.*

I. Occupations furnishing a number of consumptives above the general mean, (144 per 1000:) Sculptors, printers, hatters, polishers, gensd'armes, brush-makers, soldiers, jewelers, tailors, carpenters and joiners, mattress-makers, lace-makers, wig-makers, domestics, linen-drapers, shoemakers, glove-makers, embroiderers, writers, copyists, turners, joiners, bakers, coopers, dress-makers.

II. Professions furnishing a number of consumptives less than the mean: Coachmen, quarry-men, carpenters, tavern-keepers,

* Chartroule, Traité de la Phthisie, etc.

butchers, porters, laborers, door-keepers, tanners, bleachers, boatmen, confectioners, tilers, founders, nurses, bakers, blacksmiths, farriers, locksmiths, bricklayers, weavers, wool-combers.

M. Lombard (*loc. cit.*) adds the following facts in regard to the different occupations:

1. The poor class are more than twice as frequently attacked with phthisis as the rich.

2. Sedentary habits induce a much larger number than active exercise, in the proportion of 141 to 89.

3. Great movement of the arms in sedentary persons diminishes phthisis, but increases it in those of active occupations.

4. Active exercise of the voice seems rather to diminish than augment the proportion, (75 to 1000.)

5. Cramped or confined positions seem to favor the development of phthisis, (122 to 1000.)

6. The disease is twice as frequent in those who labor in close rooms as those who are in the open air.

7. Air charged with aqueous vapor seems preservative, (55 per 1000.)

8. A hot and dry atmosphere favors the development of phthisis, (127 per 1000.)

9. An atmosphere charged with animal emanations is preservative, (60 per 1000.)

10. An air charged with emanations from living plants is preservative.

11. Air charged with emanations from fermenting acids or alcohol exercises a doubtful influence.

12. Emanations from varnish, turpentine, and drying oils exercise very unfavorable influences, (369 in 1000.)

13. Gases, which escape from carbon in combustion, appear to favor the development of phthisis.

14. Mineral vapors (lead, mercury, antimony, arsenic, copper) and mineral acids do not appear to be causes of phthisis.

15. Air charged with foreign bodies, as dust, generally exercise an unfavorable influence, but the effect varies with the nature and division of such substances, thus:

Large molecules	137 per 1000
Very small molecules	152 " "
Mineral molecules	177 " "
Vegetable molecules	105 " "
Animal molecules	144 " "

Chartroule tabulates the statistics furnished by M. Lombard, in the following manner, showing the proportion of phthisis produced by each cause:

Emanations from varnishes, turpentine, and desiccating oils	369 per 1000
Mineral molecules	177 " "
Various very fine molecules	152 " "
Sedentary habits	141 " "
Atmosphere of shops	138 " "
Hot and dry air	127 " "
Confined position	122 " "

PRESERVATIVE INFLUENCES.

Active life	89 per 1000
Exercise of the voice	75 " "
Life passed in the open air	73 " "
Animal emanations	60 " "
Aqueous vapors	53 " "

DOUBTFUL.

Emanations from acid and alcoholic fermentations.
Mineral vapors. Mineral acids.

The question arises, Are there any occupations which are really preservative in reference to phthisis?

It has been asserted by M. Rufz that manufacturers of tobacco are measurably exempt from phthisis; but M. Chartroule investigated the subject, and declares that the pretended immunity was an idle fancy. This accords with my own observations, and I fully agree with the same author, that the inordinate use of tobacco, in chewing and smoking, is a potent cause of the disease. It deranges the nervous system, impairs digestion, debilitates all the vital powers, and thus must prove most pernicious as an exciting cause of the disease.

The *general* elements which run through most, if not all the unfavorable occupations, may be thus stated: The inhalation of irritating vapors; constrained positions; want of exercise; impure air; deficient light; innutritious food; mental depression. There can be no question that, among these causes, mental depression exercises a most potent influence. Numerous examples, illustrating the influences of the mind in producing phthisis, must have come under the observation of every practitioner. Few examples, however, are so striking as that furnished by Laennec, as appears from the following extract, which can not, indeed, be too constantly placed before the profession:

"I had under my own eyes, during a period of ten years, a striking example of the effect of the depressing passions in producing phthisis; in the case of a religious association of women, of recent foundation, and which never obtained from the ecclesiastical authorities any other than a provisional toleration, on account of the extreme severity of its rules. The diet of these persons was certainly very austere, yet it was by no means beyond what nature could bear. But the ascetic spirit which regulated their minds, was such as to give rise to consequences no less serious than surprising. Not only was the attention of these women habitually fixed on the most terrible truths of religion, but it was the constant practice to try them by every kind of contrariety and opposition, in order to bring them, as soon as possible, to an entire renouncement of their own proper will. The consequences of this discipline were the same in all; after being one or two months in the establishment, the catamenia became suppressed; and in the course of one or two months thereafter, phthisis declared itself. As no vow was taken in this society, I endeavored to prevail upon the patients to leave the house as soon as the consumptive symptoms began to appear; and almost all those who followed my advice were cured, although some of them exhibited well-marked indications of the disease. During the ten years that I was physician of this association, I witnessed its entire renovation two or three different times, owing to the successive loss of all its members, with the exception of a small number, consisting chiefly of the

superior, the grate-keeper, and the sisters who had charge of the garden, kitchen, and infirmary."

A combination of influences doubtless operates in many of these examples. The effects of depressing passions, sedentary occupations, impoverished diet, and imperfect ventilation are the most active causes. A very forcible illustration of this general law has been observed by Parent-Duchâtelet in relation to the *filles du pavé* of Paris. These females, while engaged in their occupation, enjoy good health; but those who reform and engage in needle-work, perish of phthisis in great numbers. Here, evidently, remorse, combined with sedentary habits, contributes to the mortality; and the same remark will apply to many other conditions in which similar unfavorable results are observed. For example, prisons combine all the elements necessary to the development of disease, which we find to be produced in most places of confinement. Dr. Guy proved, by statistical evidence, that in-door occupation was favorable to the development of phthisis both in males and females, and that in males it varies inversely with the amount of physical exercise. He concludes, also, that posture, heat, and moisture exercise no marked influence in the production of the disease; but it is probable he has placed too low an estimate on these auxiliary causes.

There are, probably, no professions which afford actual protection against phthisis. Butchers, coal-miners, fish-mongers, and tanners have been supposed to be protected by their occupations; but, after all, it is a mere *degree*, and not absolute immunity which is afforded. M. Beau has recently announced the belief that workers in lead are comparatively free from phthisis. The influence of lead is compared to that of paludal poison, both inducing a state of anæmia, which is presumed to be protective. M. Beau's facts, however, are too few to be accepted as the expression of a law.

SECTION X.

INGESTA IN RELATION TO PHTHISIS.

It can not be doubted that improper articles of diet must necessarily modify the constitution of the fluids, and ultimately of secondary nutrition; and hence, the changes in the composition of the system may, under certain circumstances, be capable of inducing the formation of tubercles. This, at least, is a *rational* view of the subject, and we would esteem it exceedingly unwise to permit an infant to be nourished on the milk of a tuberculous nurse, or any other lactiferous fluid of an unhealthy composition. To what extent the tuberculous constitution or diathesis may be transmitted from the nurse to the child, through the medium of the milk, can not be determined by rigorous facts, and we are obliged to resort to analogy and induction. The opinion was entertained by many of the older writers and a considerable proportion of the more modern, including Lugol, that such transmission does take place; but these opinions are based on individual observations and isolated facts, and, therefore, do not assume the character of scientific conclusions. The question is not whether a tuberculous mother transmits the morbid influence through her milk, but the problem involves the possibility of the milk furnished by a tuberculous nurse imparting the disease to an infant born of healthy parents. If examples can be established in which the children of non-tuberculous parents become diseased while receiving milk from a tuberculous nurse, the question would be at once definitely and conclusively settled; but we have not the data to determine this inquiry in a satisfactory manner, and, as such examples very rarely occur, it will, in all time, remain a matter of doubt, at least so far as demonstrative evidence is concerned. The question is of too delicate a character, and is involved in too much obscurity, to admit of definite and reliable conclusions. There are no direct facts on record clearly proving that scrofula or phthisis can be transmitted, even by a tuberculous mother, through the medium of milk, and it is only a conjectural opinion, of which nearly all

partake, that the lactiferous secretion of such persons must, of necessity, be at least unhealthy, and probably tends to develop the specific disease. This opinion, although conjectural, would, nevertheless, be sufficient to deter any physician from recommending a scrofulous or phthisical nurse, or to encourage a mother thus situated in continuing to supply her child with her own milk.

Mr. Phillips expresses the opinion that scrofula can not be transmitted through the medium of the nurse's milk, but, at the same time, he would object to the employment of such a nurse. Mr. Ancell admits the probability of such transmission, but believes other conditions are essential to aid its development, such as impure air; in other words, the tuberculous milk becomes the predisposing cause, the bad air the exciting agent. This, however, places the influence of milk in the same category as all other predisposing agents, and, therefore, entitles it to great consideration on the part of the practitioner. There is, upon the whole, no scientific evidence to establish the fact that the milk of a tuberculous nurse is capable of exciting that disease in a child free from the diathetic condition.

Another question, of equal importance, relates to the effects produced on children by the use of unhealthy milk of the cow. There is a very general impression that unhealthy milk is capable of inducing scrofulous affections; and if we admit, with the profession generally, the identity of tubercles and scrofula, it would follow that consumption may be equally produced by this cause. But, I apprehend, we can not rest the induction of phthisis on this presumed identity; for there are, indeed, so many differences between consumption and scrofula that their absolute similarity can not be established; and hence it is quite probable that various forms of impure or innutritious diet may be sufficient to induce disease of the lymphatic system—in other words, *scrofula*—without the deposit of tubercles in the lungs.

There is a large mass of evidence (but which need not be introduced here) to prove that secondary syphilis may be communicated through the medium of milk; but this is a veritable poison, and, therefore, is not exactly a parallel example. But,

with all the aid of chemistry and the microscope, we are not able to determine any special changes in the milk of the syphilitic or the tuberculous, and, therefore, can not demonstrate any transmissible element.

It is evidently true that cows kept in large cities, such as Paris, London, and New York, confined to close and filthy stables, become diseased, and suffer from tuberculosis; and, as a matter of necessity, their milk is impure, and calculated to engender various forms of disease in infants to whom it is largely given.

There can be no doubt that *milk* is the appropriate food for infants, and that their tissues are more immediately and perfectly nourished by this fluid than other diet. The observations of Donné go to show that the milk globules, when injected into the blood, become at once assimilated to blood-corpuscles; and that the nutrition of those animals not fed on milk is less perfect than those nourished by that fluid. We can not doubt that the appropriate nourishment for an infant *is its own mother's milk*, (provided she be healthy,) and that any departure from this will prove more or less injurious. Even the milk of a wet-nurse can not be equal to that of a mother; the incongeniality of constitution and want of maternal sympathy are conditions no doubt capable of modifying the nutritive functions. Much less is the milk of the cow adapted to the human infant; for the composition of this fluid differs so widely from that of the human milk, that one can not replace the other. There can be little doubt, indeed, that much of the infantile mortality, so fearfully great in the large cities, is due to this cause. Ill-ventilated apartments and impure milk are the joint agents in producing debility in children, diseases of the alimentary canal, fevers, convulsions, and scrofula; and who shall say that the same potent agencies may not induce tuberculosis? Certainly, if any predisposition exists, impoverished and diseased milk would become a potent agent in calling into action the latent elements of disease, even without the transmission of any specific virus or morbid substance. Impure milk, therefore, is to be absolutely avoided in all cases, and especially if any predisposition to tuberculous disease is known to exist.

In taking a wider view of the subject, we are led to inquire to what extent, and under what circumstances, is tuberculosis, either in its origin or progress, influenced by any special form or class of diet? It must be confessed that this question presents many, if not insuperable, difficulties to its satisfactory solution, and it will be nearly impossible to deduce even general laws from the confusion of facts before us. One of the most remarkable facts in relation to diet is, that in the two great zones—the torrid and the frigid—in which tuberculosis is known to be the least common, the diet of the nations may be considered scant and innutritious. Thus, in the Northern regions, where vegetation is imperfectly developed, the diet of the inhabitants is a mixture of indifferent animal and vegetable food, while in the tropical zone vegetables predominate as the chief diet. In contrast with this, it is well known that the inhabitants of the *temperate* zone are supplied with a more abundant, nutritious, and varied diet, consisting of variable proportions of animal and vegetable food. It is remarked by Mr. Ancell, that in the West Indies, where a mixed diet is used, tuberculosis is very common, while in the East Indies, Syria, and Egypt, with less variety, (in the two latter, pulse, orange, pease, black bread, and rice being the principal food,) the disease, in any of its forms, is exceedingly rare. In the steppe of Kirghis, already alluded to, the principal, or, at least, one of the most common articles of diet is fermented mare's milk; and M. Maydell ascribes the remarkable exemption of the inhabitants of this region to their constant use of that peculiar article of food. Sir Alexander Crichton, who resided long in Russia, asserts that the peasants of that country live chiefly on black, sourish rye bread, and weak cabbage soup; the drinks being acidulous and fermented. And he remarks that, during long fasts, the peasant is reduced to black bread, bad hemp oil, and vegetables, to the total exclusion of every article derived from the animal kingdom, whether flesh or fish, even milk being strictly forbidden during fasts.* And yet, although this diet

* Observations, etc., on Consumption. 1823.

would seem unfavorable, the Russian peasants are greatly less liable to consumption than the English or French.

The food of the Icelanders consists of fish, bread, rancid butter, game, and Iceland moss. In Norway, the laboring class eat black rye bread, butter, cheese, boiled barley, fish, with, once or twice a week, fresh meat. In Lapland, and most Northern regions, the same class of diet prevails.

In our own country we have equally striking facts. The settlers on the St. John's River, near Fort Kent, latitude 47° 15′ north, are declared by Surgeon Witherspoon* to be almost exempt from phthisis, and yet they live on potatoes, milk, bread of unbolted flour, mixed with rye, barley, or buckwheat, often black, sour, and badly baked; this, with a little pork, forms the principal food of the poor, the rich faring a little better. Yet Surgeon Witherspoon declares he never saw or heard of a case of phthisis among the French or American settlers. The climate is cold, dry, and uniform.

It has been estimated that the inhabitants of Paris consume six times as much animal food as those of London, and yet consumption is more common in the former than the latter city. This important fact shows that mere animal food is not a preservative against the development of phthisis.

The importance of these statements can scarcely be overestimated. In a cold and rigorous climate, the natives are limited to a meager and innutritious diet, with long and severe fasts, and yet they are less subject to phthisis than the inhabitants of the central portions of Europe, or even of their own well-fed nobility. If any inference can be drawn from these facts, it is that a *simple* diet is more favorable than the complex food of the more temperate climates; but, perhaps, the cautious observer would rather conclude that diet has but little influence in the actual production of phthisis.

A careful review of the subject of diet, in a general sense, will leave the impression that regimen occupies a much lower position, as a cause of tuberculosis, than has usually been as-

* U. S. Army Medical Statistics.

signed it; and when we examine individual articles of food, with reference to the fundamental elements of nutrition, the subject will exhibit an equally negative aspect. It is abundantly evident that the due maintenance of health demands a proper supply of the nitrogenous, saccharine, and oleaginous elements, together with the inorganic substances; and that any extensive departure from these nutritive compounds, must, of necessity, more or less derange the physiological state of the system. But it still remains a question, whether these derangements are prone to induce the formation of tubercles; or whether, on the contrary, they are more liable to cause other forms of disease, independent of specific action. We constantly witness derangement of the digestive organs arising from improper diet, and the long-continued use of particular articles; or a deficiency of nutritive material involves the general system, and may result in debility, anæmia, scurvy, and similar forms of cachexia or general disease. But all this may occur without the production of tubercles; indeed, so far as we now know, the most rigid observations have failed to establish any direct connection between diet and tuberculosis; that is to say, as a *primary* causation.

In reaching these conclusions it is important to observe that reference is made exclusively to the *non-diathetic* state, in which there is an entire freedom from an hereditary predisposition. But where the diathesis already exists, the case is widely different; here, it can not be doubted that an impoverished or deficient diet, by impairing the vitality of the organism, will necessarily favor the development of tuberculosis; not, indeed, by the *direct* production of *tubercle*, but by diminishing the powers of resistance, and thus permitting the morbid element to gain the ascendency. In this way, a deficient diet becomes a *predisposing* cause of tuberculosis, but nothing more. Thus it is that butchers, and those who live freely, are found to be less liable to consumption than others; while persons restricted to a meager diet are, *cæteris paribus*, more liable to fall victims to the disease. I have made an observation in this city, (which will, doubtless, apply to other places,) in relation to the comparative frequency of phthisis among the lower classes of Ger-

mans and Irish. The Germans usually live much better than the Irish. The former eat freely of beef, sausages, garlic, and onions, and drink their favorite lager-beer; while the latter are commonly restricted to bread, potatoes, and coffee or tea, with a limited supply of meat and butter, and the free use of bad whisky. The Germans are ruddy and plethoric, while the Irish are comparatively pale and anæmic; and I think the observation is, beyond doubt, true that the former are much less liable to phthisis than the latter. Both classes live in the midst of filth and bad air.

It has been believed by practitioners, that the Jews are less liable to consumption and scrofula than other people, and that their exemption is to be ascribed to abstinence from the use of *pork*. I am inclined to the opinion that tuberculosis is not very common among this nation of people; in fact, it is less frequent in this city than among other classes; but how far this is to be ascribed to the cause mentioned, has certainly not been determined by any well-observed facts. Nevertheless, pork is an indigestible article of food, and possibly may have some tendency to induce *scrofulous* affections; but, at the same time, there is no sufficient reason to conclude that it is capable of engendering tubercles. The most that can be said, therefore, on that subject is, that pork is difficult of digestion, in most of its forms, and consequently not adapted to persons predisposed to tuberculous or scrofulous affections. We can not deny that it may possibly go beyond this in its etiological influence; but, without further facts, we are not authorized to ascribe to it more than this general effect.

In the United States but little can be said in reference to diet. The quality of food varies greatly in different sections of our country, but it is extremely difficult to assign to this cause any definite influence in the production of phthisis. In the Eastern states, the people are generally abstemious, drinking ardent spirits to a limited extent, and using comparatively but little animal food; but they have an abundance of milk, butter, cheese, and molasses, a diet, in fact, partaking more of the vegetable than animal character.

In the West, the diet consists largely of pork, beef, mutton,

and vegetables. A great variety is used; but the cooking is often imperfect, and, with the large quantity consumed, dyspepsia is quite common.

In the Southern states, more vegetables are used, and most classes drink more freely of ardent spirits. The negroes of Louisiana eat freely of sugar during certain seasons, and become fat on its use; while in South Carolina they subsist largely on rice and other vegetables. But little animal food is consumed, as a general rule, by the negroes of the South, and yet phthisis is not common among them.

The conclusion which seems warranted by the preceding facts is, that no known form of diet is, of itself, capable of developing tubercles; but that an impoverished diet, (especially combined, as it usually is,) with impure air and mental depression, diminishes the vitality of the system, and, therefore, where the predisposition exists, favors the development of tuberculosis. On the contrary, where the tuberculous diathesis does not exist, we have no conclusive evidence that any form of diet, however rigid it may be, is capable of causing the evolution of tubercles.

Another inference which seems a fair deduction from the statements made is, that a simple vegetable diet, with, at most, a limited amount of animal food, such as occurs in arctic and tropical regions, really affords the highest rate of exemption from the disease. And conversely, that the opposite classes of diet are associated with the greater prevalence of the disease.

Alcoholic Drinks.—The etiological relation of alcoholic drinks to phthisis presents a question of the highest importance, and one which has given rise to wide differences of opinion. The opinion that alcoholic drinks afford some degree of protection in phthisical constitutions, has grown into a popular belief, and the profession, to some extent at least, seem to sanction this view. On the contrary, however, some believe that even moderate drinking is injurious, and that the intemperate use of stimulants is unequivocally prejudicial.

There are evidently two questions which should be considered in this connection, namely, the *intemperate* and the *moderate* use of alcoholic drinks. These questions, however, are constantly

confounded, and therefore the results of investigations are not reliable.

In relation to the etiological influences of intemperance, very different opinions have been expressed by writers. The evidence, however, in relation to the prevalence of phthisis among habitually intemperate drinkers is not as decisive as might have been anticipated; indeed, an appeal to statistics has often revealed opposite, and, therefore, unreliable results. Thus, while some have attempted to show that the use of stimulating beverages induces phthisis, others have appeared equally confident that such drinks proved protective.

Dr. Guy, in a report of the statistics of King's College Hospital, states that the intemperate exhibit a larger percentage of phthisis than those not addicted to the use of ardent spirits. Thus, it is stated that pot-boys, licensed victualers, and brewers are more subject to phthisis than footmen, draymen, or tradesmen generally. Hence it is inferred that alcoholic and malt liquors act as predisposing causes of the disease. These statistics, however, are entirely too limited and equivocal in character to lead to any definite results. These persons drink chiefly malt liquors; and even the most ultra would hardly claim that ale and porter could be regarded as potent agents in the causation of phthisis, or that the class of persons alluded to drank much greater than others of a similar grade of society. It will be remarked, also, that the classes of persons between whom the comparison has been instituted, are very differently situated in regard to pure air and active exercise. For example, the drayman, footman, and general tradesman will enjoy the advantage of a better air and more exercise than the pot-boy, the victualer, or the brewer; and, doubtless, it is to these circumstances we are to ascribe the greater frequency of phthisis, in the latter classes, than the influence of malt liquors.

In opposition to the statistics of King's College Hospital, we may refer to post-mortem examinations of the intemperate made at New York, Boston, and Aberdeen. Dr. John C. Peters* reports the post-mortem examination "of nearly seventy persons

* New York Jour. Med., 1844.

who died from the excessive use of ardent spirits." In relation to phthisis, Dr. Peters observes, that in the whole number he did not meet with a tuberculous abscess, even of the smallest size, while chalky tubercles, and cicatrices, and puckering of the surface of the lungs, were often observed. Certain solid masses were found, which, on being cut into, were observed to consist of lumps or stripes of "callous fibrous tissue, around which were a few discrete, gray, crude, small, tubercular granulations." These appearances were limited to the upper third of the superior lobes. From these appearances Dr. Peters concludes that phthisis among the intemperate is a rare disease.

Similar observations were made by Dr. Ogston, of Aberdeen, Scotland. In the post-mortem examination of seventy-three intemperate persons, only a single example of tubercles was found, and in that case the deposits were latent.

Dr. James Jackson, of Boston, has given the results of thirty-five post-mortem examinations of the intemperate. Of this number, tubercles were found, in various stages, in five, from which he infers that phthisis is not common in this class of persons.*

This whole subject has recently been investigated, in a statistical point of view, by Dr. John Bell, of New York.† The author has endeavored to show, by the comparative prevalence of phthisis, and deaths from intemperance, in Great Britain and various parts of the United States, as shown by the mortuary statistics, the relation which exists between intemperance and deaths from consumption. The inquiries were also extended to the prevalence of phthisis in the same locality at different periods; the frequency of phthisis in the sexes; the age at which it occurs, and its duration, in the temperate and intemperate. It is wholly unnecessary, in this place, to follow the author through his laborious statistical researches, and I shall, therefore, merely refer to the conclusions which seemed legitimately to follow from the facts collected. In the first place, it may be remarked, that the most accurate statistics were often found

* New England Quarterly Jour. Med., 1843.

† Fisk Fund Prize Essay, Am. Jour. Med. Sci., Oct., 1859.

contradictory. Thus, in some districts it was shown that the ratio between the prevalence of phthisis and intemperance was often reversed, so that no general law could be deduced from the facts. A careful review of the whole subject, however, led Dr. Bell to the conclusion, that the use of alcoholic liquors do not prevent the development of phthisis, but, on the contrary, such drinks rather favor the deposition of tubercles. This conclusion, as based on the premises, is probably correct; and yet, in the more extended relations of the subject, it requires important qualifications.

It will be remarked that the statistics furnished by Dr. Bell have reference exclusively to the *intemperate* use of alcoholic drinks, even to the extent of death being induced; and hence, although the facts may represent fairly enough the relations of this extreme intemperance to phthisis, they are very far from indicating what would be the results of a moderate and judicious use of such drinks, That intemperance, with its attendant evils, may, in some examples, be the inducing cause of phthisis, is not only highly probable, but we may say positively certain; but, notwithstanding this admission, it is equally apparent that, taken on the largest scale, the effects of intemperance in this relation are much less marked than might be supposed. And I will go further and say that the statistics furnished by Dr. Bell prove conclusively that even the excessive use of ardent spirits is not, in the mass, productive of phthisis. Thus, it will be admitted that where intemperance prevails, numerous privations must be its attendants; and that these incidental conditions, including bad food, ill-ventilated habitations, exposure, and so on, will be found more than sufficient to account for the greater prevalence of phthisis in some districts, where ardent spirits are extensively consumed. And it may be further remarked, that if the intemperate use of alcoholic beverage contributes, *per se*, to the induction of phthisis, the incidental conditions already named should so far increase the development of consumption, as to render its predominance obvious and beyond doubt, in all those districts where ardent spirits are known to be extensively consumed. But this result has not been observed; and hence it is a fair conclusion, that

even intemperance does not, in a general sense, (whatever may be the result in individual cases,) increase the prevalence of phthisis.

But whatever may be our opinions in regard to intemperance, there is reason to believe that the moderate use of alcoholic drinks is rather protective than injurious in the consumptive constitution, and, therefore, can not be classed among the causes of phthisis. The moderate use of stimulating beverages, more particularly malt liquors, should be classed with *nutritious diet;* and, in constitutions predisposed to phthisis, such drinks, restricted within proper limits, can no more prove injurious than highly nutritious and stimulating food. But, in certain constitutions, the excessive use of stimulants will ultimately impair digestion, and when this occurs, tubercular disease may be a direct result. Even here, however, it usually requires the presence of the tubercular diathesis to establish pulmonary disease. It may be stated, finally, as a general law, that while persons addicted to the use of ardent spirits have an abundant supply of nutritious food, the appetite and digestion remaining good, there will be but little danger of the development of phthisis; and that the evil effects arising from the intemperate use of ardent spirits are not manifested in the production of tubercle, but that their morbid effects are witnessed in the development of functional and organic diseases of the stomach, liver, kidneys, and brain. When, however, intemperance is conjoined to scanty food, ill-ventilated habitations, exposure, and all the incidental evils of want and poverty, tuberculosis may readily be developed in those predisposed to that form of disease.

Impure Water.—It has often been asserted that various impurities in water become the cause of tubercles; but thus far the facts are exceedingly meager and unreliable. It is stated, on the authority of Percival, that the water of the river Kiruga, in Siberia, causes scrofulous diseases; but the statement is of little value, as the quality of the water is unknown, and possibly the inference itself erroneous. It is also stated that at Rheims, France, the cases of scrofula and bronchocele (which were very numerous) were greatly reduced, when a supply of pure water was procured for the town. But it will be remarked,

in this instance, that bronchocele was ascribed to the same cause, and as this affection is radically different from tuberculosis, the whole observation would seem to be vitiated.

Dr. Heberden paid great attention to the purity of water, and even went so far as to recommend distilled water. He expresses the opinion that water loaded with lime or mineral acids will prove extremely pernicious.

We may notice, in this connection, the supposed agency of *lime* in the production of tuberculosis. The most striking observation is that made by M. Wanner of France. According to this observer, in certain parts of the province of Sologne neither consumption, scrofula, nor calculous diseases prevail. The exemption from these diseases is supposed to depend on the absence of lime. The vegetable mold is very shallow, and contains no trace of lime. But it must be remarked that a single example of this character, enunciating so doubtful a proposition, can not be regarded as more than a curious fact, and not indicating any general law. In the United States facts, on the broadest scale, clearly invalidate this assumption. Thus, in the Eastern states, the formation is often primary, and the water is free from lime, yet phthisis is very common; while in most other portions, as the West and South, this mineral is very abundant, while consumption is less common than in the granite regions. It is not probable, therefore, that lime plays any important part in the etiology of tuberculosis.

The only conclusion which we can reach on the subject of water is, that various impurities may be capable of deranging the stomach, and, therefore, will prove injurious in those predisposed to phthisis; but there is no satisfactory evidence that the impurities of water act specifically, so as to cause the deposit of tubercles.

CHAPTER III.

PATHOLOGICAL INDUCING CAUSES OF PHTHISIS.

CERTAIN pathological conditions, either of a general or local character, are presumed to act as inducing causes of phthisis; that is to say, various morbid states of a non-tubercular character become capable of causing the deposit of tubercles, independent of, or coinciding with a direct predisposition, accidental or acquired. This doctrine of the pathological causation of phthisis, if found to be true, is one of vast importance, and would place in our possession the means of counteracting those adverse influences during their incipiency, and would, in fact, place under the control of the physician many cases which ultimately, through neglect, become confirmed and fatal. I will proceed to examine those conditions supposed to favor the development of tubercles.

SECTION I.

RELATIONSHIP OF PULMONARY INFLAMMATION, CONGESTION, AND HEMORRHAGE TO PHTHISIS.

The clinical experience of every practitioner will abundantly attest the fact, that inflammatory diseases of the respiratory organs are often the precursors of phthisis. Persons apparently in the enjoyment of good health are seized with a pneumonia, or bronchitis, or pleuro-pneumonia, which becomes protracted into a chronic condition, when, upon careful examination, it will be

found that tubercular deposits have supervened upon the original inflammation. Many of these cases begin with what the patients themselves term a "heavy cold," but which, instead of terminating like ordinary catarrhal affections, becomes chronic, and ultimates in tubercular deposits. These examples, many of which have come under my observation, are, doubtless, inflammatory—mainly pneumonic—often of a low grade, but always sufficient to produce some form of exudation into the pulmonary tissue. Some of these patients mention hoarseness, sore throat, and cough as the principal symptoms; others advert to chills, fever, rusty sputa, dyspnœa, and all the signs of a pneumonia, while others describe symptoms indicating a bronchial affection.

But whatever may be the particular tissue involved, or the extent of inflammatory action, my own experience has fully convinced me, that a large number of cases of phthisis have their starting point in an inflammatory affection involving some of the pulmonary structures. Of one hundred cases in my private practice, I find twelve in which the inducing cause was pneumonia, and twenty-eight in which the origin was ascribed to "cold." These results were obtained in the histories furnished by the patients; but as the accounts were often very indefinite, it is clearly impossible to decide the actual proportion that were pneumonic. In many of the cases ascribed to *cold*, it is more than probable that some degree of pneumonia existed; and if this be true, it would swell the ratio of such cases to a very high figure. I am inclined, therefore, to the opinion, that pneumonia, in some of its grades, is a frequent exciting cause of phthisis. At least such appears to be the fact within the sphere of my observation; but it is probable that the variable character of our climate, renders the proportion larger here than in many localities.

Numerous examples might be presented to illustrate the class of cases to which I have referred, but only a few will be introduced. A lady, aged forty, of delicate, but apparently sound constitution, and previously in good health, contracted a "heavy cold," which, instead of yielding to her domestic remedies, became chronic, and induced a state of debility. She did not

remember to have had much fever during the primary cold, but was conscious of a *feverish condition*, with cough, rapid emaciation, night-sweats, loss of appetite, and a degree of prostration which confined her to bed. In this condition, *six weeks* from the first attack, I examined her. She was then greatly emaciated, unable to sit up, occasional chills, evening exacerbations of fever, night-sweats, cough, with sputa composed of tenacious, transparent mucus, with yellow masses, of small size, interspersed through it. On a physical examination, I found incomplete expansion of the right apex, dullness on percussion, moist crackling, and greatly intensified expiratory sound. No doubt remained that the patient had been the subject of a slight pneumonic attack, to which tubercular deposits speedily succeeded.

A young lady, eighteen years of age, with apparently a good constitution, having been exposed to cold in the month of March, thinly dressed for a party, was immediately attacked with *acute pneumonia*. Her physician described the case as one in no way peculiar, except that it finally passed into the chronic form, instead of terminating in resolution. I saw the case three months afterward, and found softened tubercles at the apex of the right lung.

Another example occurred in a young man, aged twenty-one, who got an attack of pneumonia about the middle of March; previous health good, but some relatives had died of consumption. Three months after the attack I found cavernous rhonchus at the left apex, and dry crackling at the right.

A man, admitted to the Commercial Hospital, had signs of pneumonia which had been of six weeks' duration; a hard drinker, but without previous cough or known tubercular predisposition. This man had been a constant drinker. Post-mortem inspection revealed the following condition: Abundance of subcutaneous fat; large quantities of fat around the heart and kidneys; beginning fatty transformation of the superficial fibers of the heart; oil globules freely scattered through the inflamed portion of the lung. The left superior lobe of the lung in a state of gray consolidation, with four or five small cavities from softened tubercles. No tubercles in any other part.

These are fair examples of *pneumonia* terminating in phthisis. It is probable that the instances in which this association of disease occurs are more common than generally supposed; but the variable extent of the primary inflammation, and the inaccuracies of patients in detailing the histories of their cases, render their recognition often difficult, and sometimes impossible. In these and similar examples, it becomes a question whether the inflammation is simple, and finally leading to tubercular degeneration, or whether it is not the result of a morbid action occurring in the *tubercular diathesis*. In many of the cases the history revealed an hereditary taint; but in others no such association could be traced. It must be borne in mind, however, that many patients are unable to trace their family history with sufficient accuracy to justify our drawing positive conclusions, while in other instances the inaccuracy of diagnosis would render the whole subject doubtful. A majority of cases certainly reveal a natural or acquired predisposition to tubercular disease; and, as ordinary examples of pneumonia have no tendency to terminate in tuberculosis, we must necessarily admit some special condition which gives rise to such a result. This may be an hereditary predisposition, or an acquired habit, leading, under favorable circumstances, to such a result.

But the question again recurs, may not the inflammation itself, when imperfectly cured, either as a result of improper treatment, delicacy of constitution, or other causes, ultimate in tubercular deposits? The answer to this question would lead us too far at this moment, but it may be here remarked, that the debilitating effects of chronic pneumonia may possibly terminate in tubercles, although no diathesis previously existed. Dr. Radclyffe Hall very sensibly suggests that either the local or constitutional state may precede and occasion the other; thus, impaired blood may disease the lung, or impaired nutrition of the lung may deteriorate the blood. While we admit, therefore, the occasional occurrence of tubercles as a sequence of pneumonia independent of a diathetic state, it must be stated that such a result is most usually met with in those having some hereditary predisposition to tuberculosis.

Many observers have recognized pneumonia as the primary lesion in certain cases of phthisis. Broussais* has detailed numerous examples of this character; and although great allowance must be made for his strong bias on the subject of inflammation, still no doubt can be entertained of the accuracy of his historical remarks. Dr. Stokes† fully recognizes the association of pneumonia and phthisis. He conceives tubercles may follow pneumonia under three conditions: 1. When sthenic pneumonia has been neglected or exasperated in its early stage; 2. Where the disease is only rendered latent by treatment; 3. Typhoid pneumonia.

But the essential relation of pneumonia to tubercles is in connection with the chronic form. When acute pneumonia becomes chronic, or when it has been subacute from the beginning, tubercle may be deposited as the result. In a majority of cases the tubercular transformation, therefore, takes place in connection with the chronic form of pneumonia. The transformation is, indeed, a part of the same process which causes the pneumonic deposit, the result depending very largely on the prevailing or induced constitutional state of the patient. Ordinary acute pneumonia, with early and complete resolution, occurring in good constitutions, bears no relation to tubercle; but the typhoid variety is at times found associated with the adventitious deposit. This latter form of pneumonia, being of a low grade, is much more prone to develop tubercle than when the inflammatory action is of a more exalted character; indeed, typhoid disease (whether in the form of essential fever or pneumonic inflammation) exhibits a marked tendency, in some examples, to develop tubercles. And it is even probable that the typhous action of the system is capable of inducing the diathesis, even without hereditary taint.

In the tuberculous constitution, or in debilitated subjects, the inflammatory process deviates from its usual course, and modified exudations take place; and these exudations, although possibly not tubercular, *de novo*, ultimately undergo softening, with the formation of cavities. At times, the pulmonary tissue

* Chronic Phlegmasiæ, etc. † Treatise on Diseases of the Chest.

becomes extensively infiltrated with semi-plastic deposits during the inflammatory process, in the midst of which, points soften, and patients die rapidly of so-called phthisis. How far such cases differ, in their essential character, from ordinary tuberculosis may be a question; but it seems a fair inference that they may arise, in certain cases, mainly, if not exclusively, from the local disease, without the pre-existing tuberculous diathesis. It is taught by Rokitansky and Virchow that certain products not tubercular ultimately *tuberculize;* that is, soften and undergo all the ordinary changes characteristic of tubercle.

It is difficult to decide, from individual experience, the more common *location* of pneumonia, when that is the form of inflammation. I have observed, however, in a considerable number of cases, that the disease occupied the superior lobes; but in other examples (probably the smaller number) the inflammation was, as in ordinary cases, in the inferior lobes. Nor can I be more definite in relation to the preponderance of pneumonia or bronchitis; indeed, the history of the cases often indicated that the two forms of disease coexisted.

It has appeared to me probable that *broncho-pneumonia* often exercised a more direct agency in the development of tubercles than simple pneumonia. The greater degree of debility arising from bronchial disease, and the long-continued pulmonary stasis, would appear more liable to cause the exudation of tuberculous matter than a higher grade of action. This variety of disease, likewise, is prone to assume a chronic form; and hence the vitality of the system becoming impaired, the slightest constitutional predisposition to phthisis may be aroused into action, and tuberculous material extensively deposited. In cases of this character, the deposition of tubercle may be very extensive, corresponding to the tissues occupied by the bronchial disease. It is doubtless true, that the presence of bronchitis prevents the early and complete resolution of the pneumonia, and hence the plastic deposits may, in the language of Rokitansky, *tuberculize.*

Bronchitis has long been regarded as a fruitful source of tubercular deposits, but opinions have greatly varied on the subject. Tissot, Hufeland, and Baumes regarded bronchitis as one of the most common causes of phthisis; but Laennec did not consider that it had any direct agency in causing the deposit of tuber-

cles. Andral has entertained different opinions on the subject; but the last is, that in order that bronchitis shall produce tubercles, a predisposition must exist. Fournet mentions *cold* (which he seems to regard as synonymous with bronchitis) as a common cause of phthisis; but Chartroule suggests that these protracted coughs are rather the result of granular deposits in the lungs, and, therefore, the bronchial affection is merely an effect. It does not appear to me, however, that this view is correct; on the contrary, it is more probable that the "colds" referred to by Fournet were something more than bronchial affections, and, in fact, extended to the pulmonary parenchyma. Sir James Clark dwells forcibly on disease of the larynx, trachea, and bronchi as inducing causes of tubercular deposits, and that when the slightest predisposition to tubercles exists, it becomes a potent cause. There is reason to believe, however, that bronchitis is less frequently than pneumonia a cause of phthisis; and the reason may probably be found in the fact that bronchial inflammation does not tend to cause *exudations*, and, consequently, neither tubercles nor their analogues are deposited in the pulmonary tissue. It is found, indeed, that persons may long labor under chronic bronchitis without deposits taking place. Louis observed, in forty-two post-mortem examinations of persons having pulmonary emphysema, with long-continued bronchial disease, in only ten of whom any degree of tubercular deposits existed. Still it must be admitted that bronchitis does at times induce tubercular deposits; but this occurs mostly when the predisposition is well marked, and the morbid action extends more or less to the pulmonary parenchyma.

Pleurisy can not be said to be, in any direct manner, an inducing cause of phthisis. True, it may, by causing debility, precipitate an attack of consumption in persons strongly predisposed to the disease; but without such predisposition it can hardly be ranked among the inducing causes. A case is recorded by Chartroule, in which a common pleurisy, occurring in a sound constitution, free from hereditary taint, was speedily followed by the development of tubercles. Still, such cases are infinitely rare, and constitute merely exceptions to the rule.

Pulmonary *congestion* doubtless often plays an active part in the production of tubercular deposits. When the congestion is idiopathic (that is, when it does not arise from cardiac disease) and profound, or long continued, the stasis of blood strongly predisposes to exudation, which may be either serum, albumen, or tubercular matter. If the constitutional condition is tuberculous, and the blood already in a favorable condition for the deposit, a stasis in the pulmonary capillaries becomes a cause of great power and certainty. Indeed, many cases of phthisis doubtless originate in this manner; and it is by inducing this condition of the pulmonary capillaries, that a damp and cool atmosphere acts so unfavorably on tuberculous subjects.

Closely allied to the preceding condition is that of *pulmonary hemorrhage.* By this term I mean active hemorrhage, and not that slight expectoration of blood which occurs as a symptom of tubercular deposits. Pulmonary hemorrhage occurs independent of heart disease, or affections of the thoracic vessels, or, again, of tubercular deposits; but it is the result of congestion, temporary or profound, and may give rise to important secondary changes. The seat of pulmonary hemorrhage is either the parenchymatous tissue or the bronchial mucous membrane; but in a majority of cases, I apprehend, more or less blood is effused into the areolar tissue of the lungs, which remains to be removed by absorption. Here the morbid action consists in an adventitious deposit, with fibrin remaining as a foreign substance; and it is easy to conceive that this foreign substance may, under certain contingencies, (such as the tuberculous diathesis), become the seat of tubercular deposits. I have frequently met with cases in which active hemorrhage was the first symptom of pulmonary disease; but after the lapse of a longer or shorter period of time, tubercular deposits took place. Nor was there any reason to doubt, judging from the clinical history of the cases, that the hemorrhage was antecedent to the tubercular deposits, and became, in fact, an inducing cause of that condition.

The following striking case will throw light on this subject. A man, aged forty-two, presented himself for examination, June 8th, 1858, and gave the following history: Ten or twelve years ago was subjected to a "heavy strain," and immediately

bled freely from the lung; next day, went to work, and suffered no further inconvenience at that time. Several years after, (could not be precise as to dates,) had another slight hemorrhage, and another four years since—both, like the first, from overexertion. In January last he worked hard, and exerted himself with a shovel in throwing earth, following which he raised a tablespoonful of blood, but did not discontinue the labor. Some days after this exertion, while lying down, hemorrhage came on, and, during the night, lost at least a quart of blood—some present thought half a gallon. Following this hemorrhage, had some cough and pain in chest. Four weeks ago, hemorrhage commenced again in the night, (he having been walking the day preceding,) a considerable quantity of blood was lost; and following this, cough, especially in the morning, occurred. At the present time, raises about half an ounce of yellowish sputa in the morning; slight uneasiness in the chest; has lost some weight after the last hemorrhage, and observed slight dyspnœa. Appetite, digestion, and bowels natural. The patient is not aware of any hereditary tendency to consumption; his mother spit small quantities of blood at the age of sixty, had a cough, but lived to seventy years, and the physicians said she had not consumption. Does not think his grandparents, uncles, or aunts had consumption.

A physical exploration of this patient revealed the following condition: Expansion incomplete; resonance, on percussion, proportionally diminished; auscultation revealed moist crackling at both apices; respiration feeble on right side. At the left supra-scapular region decided moist bubbles. Spirometer indicated a capacity of one hundred and ninety inches, the hight being five feet seven inches.

This case clearly indicates the effects produced by pulmonary hemorrhage. There is no reason to believe that the patient had tubercles at the time of the first hemorrhage; nor was there cough, emaciation, or other symptoms indicating pulmonary disease, until within comparatively a recent period. Now he has well-marked signs of tubercles, evidently advanced to softening.

SECTION II.

RELATIONSHIP OF INFLUENZA, PERTUSSIS, AND ASTHMA TO PHTHISIS.

Influenza has been regarded as a cause of phthisis, and some of the English physicians have drawn attention to the subject. Sir James Clark declares influenza to have exerted a most unfavorable influence over the progress of phthisis, and apparently being the inducing cause. Indeed, nearly all the English physicians who have made observations on the subject, concur in the statement that patients laboring under phthisis were seriously injured by an attack of influenza; while many others dated the beginning of the tubercular disease at the time of the appearance of the epidemic. It is true, some report differently; but the positive testimony is always more reliable than the negative.

In regard to true *epidemic* influenza, it may be remarked that there exists not only mucous irritation and inflammation, but also *nervous depression;* and it is to this latter condition that we must ascribe much of the evil effects of the disease. But independent of this, some examples will evince a comparatively high grade of febrile action, or even local inflammation, and thus become the exciting cause in some cases, while it will necessarily aggravate those already in progress. Still it is alleged that the Reports of the Registrar-General of England do not show an increase of consumption during the years in which influenza prevailed; but this might be true, and yet the disease may have been aggravated when already in existence, but may have been in the incipient stage, and, therefore, not added to the list of mortality.

Pertussis has been alleged by many to be an exciting cause of phthisis. In a few instances which have come under my observation, hooping-cough seemed to be the inducing cause of consumption; but I can not state that any such case has been observed in which some degree of hereditary predisposition did not exist. When, however, the tuberculous constitution is present, pertussis is certainly competent to hasten the development of tubercles. But it may be remarked, that the early

age at which the cough occurs, is unfavorable to the development of tubercles, and, perhaps, this is one reason why the relationship seems comparatively insignificant.

According to the observations of Rilliet and Barthez, tubercular deposits frequently follow hooping-cough, the deposit taking place either in the bronchial glands or the substance of the lungs. Thus, of three hundred and fourteen tuberculous infants, hooping-cough was the probable or certain cause in twelve—or one in twenty-six; and when we consider that in much the largest number the relationship was unknown, it becomes a fair inference that the relative proportion will rise much above that mentioned. The same authors detail one remarkable example in which tubercles were positively known to have been induced by pertussis. A child, three years old, well formed, born of healthy parents, and free from disease prior to an attack of pertussis, entered the hospital in the third week of the disease. At the end of two months and a half the hooping-cough was ameliorated, but the cure incomplete, and cough continued. The child gradually sank, and, on examination, extensive tuberculization, both in the substance of the lungs and in the bronchial glands, was found. This case is peculiarly instructive, and can admit of no misinterpretation.

Asthma is another form of disease which has been supposed to favor the development of phthisis. We do not possess evidence sufficiently definite and precise to determine the exact influence of simple spasmodic asthma in the superinduction of tubercular deposits; but the embarrassed respiration, and congestive action which ensues, if long continued or often repeated, may favor the deposit of tubercles. A number of examples have come under my observation in which asthmatic persons finally became tuberculous; and it appeared evident that the first departure from health was the impaired innervation of the lungs. These cases have so frequently come under my observation, that I can not avoid the belief that asthma tends, in a marked degree, to the production of tubercles.

SECTION III.

THE RELATIONSHIP OF ESSENTIAL AND ERUPTIVE FEVERS TO PHTHISIS.

1. *Relationship of the Typhous Poison to Phthisis.*—Very different opinions have been expressed, in relation to the influence of the typhous grade of fever over phthisis, or the tuberculous constitution. Louis made the observation that young persons imperfectly recovering from typhoid fever, occasionally fall into consumption which speedily proves fatal. The question, however, is fairly raised by Dr. Walshe, whether the disease in Louis's cases did not depend on the deposit of *typhoid* instead of tubercular matter. Dr. Copland, also, recognizes tuberculosis as one of the sequelæ of typhoid fever. On the contrary, Andral's observations led to the conclusion that consumption did not follow typhoid fever; and Rokitansky is of opinion that tuberculous subjects seldom suffer with typhoid fever. Dr. Condie,* of Philadelphia, expresses the opinion that typhoid fever bears no special relation to consumption. He remarks: "I know of no facts that should lead me to suspect that any relationship or association exists between consumption and typhoid fever. The latter disease, it is true, is of much more common occurrence in our city of late years than formerly; but from this fact we have no right to infer that there is any special antagonism between it and pulmonary phthisis, inasmuch as while typhoid fever has been increasing in our midst, there are diseases which have decreased among us to a much greater extent than consumption. Nor, on the other hand, can we suppose that in those who have experienced an attack of typhoid fever, a predisposition to tuberculosis is created; for as the number of such is far greater in this city now than formerly, tubercular disease should have increased instead of diminishing."

Professor Dickson,† of Charleston, S. C., says: "I am led to believe there is the relation of analogy between typhosis and tuberculosis. Yet I am not willing to admit their absolute

* MS. letter.

† MS. letter.

identity, or to regard them as distinguished from each other only as acute and chronic, as some writers have seemed disposed to suggest."

Professor Sweetser,* of New England, writes as follows: "In former years I have seen much of typhoid fever and consumption, especially in New England, yet I can not say that I have ever observed any *peculiar* relation between the two diseases or their causes. No facts have come under my observation leading me to conclude that the specific cause (if there be such specific cause) of typhoid fever has any direct concern in the causation of consumption, or the cause of consumption in the production of typhoid fever. Like many other diseases, typhoid fever will often act as an exciting cause to develop a consumptive predisposition, especially as it most often attacks the young, or at the age most liable to the development of tuberculous phthisis; but I have made no observation leading me to the belief that typhoid fever originates consumption, or produces it, *de novo*, or independent of any inherited or acquired predisposition. They prevail together in like climates, to be sure, but that alone affords no evidence of any relation between them as cause and effect."

Professor John Ware,† of Boston, who has had extensive opportunities for observations on this question, writes as follows: "I have seen no facts which lead me to a belief in any association of consumption with typhoid fever. Patients have, occasionally, after typhoid fever, become phthisical, as the apparent consequence of the disease; but this has not happened very often, and only with those who had probably a predisposition. Indeed, I have not thought that persons with a constitutional tendency to consumption, were at all more liable to typhoid than others."

Dr. Cotton‡ mentions cases in which protracted attacks of typhus fever passed insensibly into confirmed phthisis, notwithstanding there were no previous indications of such a tendency.

In the present state of our knowledge we are obliged to regard this subject as undetermined; nor is it possible, except on a very large scale, to render individual facts available in

* MS. Letter. † MS. letter. ‡ On Consumption, etc.

deciding the question. It has occurred to most practitioners to observe examples in which attacks of typhoid fever would be followed by consumption; but such isolated cases are far from deciding the general question as to the relationship, if any, which exists between the diseases. The most significant fact bearing on this subject, which has come under my observation, is the apparent increase of consumption simultaneously with the prevalence of typhoid fever. It is well known that in the Western portion of the United States, the periodical or malarial fevers were endemic, and in many sections still continue so, and, in those regions where this form of disease prevailed, common observation established the fact that phthisis was comparatively rare. Since the year 1841, however, typhoid fever has often been epidemic, and apparently in proportion to the increase of this fever, so has been the increase of consumption. The observations of the entire profession of the West will attest this fact, whatever may be its true interpretation. It would, perhaps, be a too hasty generalization to say that the coetaneous increase of phthisis and typhoid indicated a positive relationship between the diseases, and yet who is sufficiently sagacious to decide that the typhoid poison may not become at least a predisposing cause of phthisis? Surely such a supposition is not beyond the limits of probability; and as the important fact of the simultaneous increase of those affections is beyond dispute, the conclusion can not be regarded as wholly unwarrantable or unphilosophical.

It may be further remarked that in many portions of the globe where typhoid fever is most prevalent, phthisis is also abundant. In the Eastern division of the United States (New England) typhoid fever is endemic, and our statistics show that in the same locality phthisis is more common than in regions where a different type of fever prevails. The same remark will apply to many other countries, among which we may particularly mention Oceanica. At Tahiti typhoid fever is endemic, and commits great ravages; and there is, probably, no country in which phthisis is so common and rapid in its march.

Still we are not authorized to draw from these facts the inference that there exists any direct relation between the typhous

poison and tuberculosis; nevertheless, it does appear to me that the prevalence of the latter is, to some extent, influenced by the endemic prevalence of the former. The typhous poison, to say the least, exerts a debilitating influence on the animal economy, and it may thus favor the production of phthisis. Whether any more intimate relationship than this exists between these diseases, our present state of knowledge leaves undetermined.

2. *Relationship of Malaria to Phthisis.*—The influence of *malaria* over the prevalence of phthisis is presumed to be of a negative character; and that, instead of producing the disease, there is a positive antagonism between the two morbid actions.

Looking at the prevalence of phthisis on a broad scale, we shall be struck with some important and suggestive facts. In the Eastern division of the United States (New England) malarial diseases are measurably unknown, but, as already stated, *typhoid* fever is endemic; and, in the same locality, consumption is very prevalent. Now the exact relationship of these facts can not be determined with absolute certainty. For example, we have no positive data to decide the question whether the absence of malarial, or the presence of the typhoid poison, is the determining cause; or, in fact, whether phthisis does not prevail independent of either condition.

In order to determine this question we must look to other facts, and the disease as met with in other regions. Thus, in the Western division of the United States, miasmatic disease has been exceedingly rife from the early settlement of the country; but as the lands were cleared up and cultivated, malarious affections (periodical fever) diminished; and *apparently in the ratio of this diminution has been the increase of phthisis.* The united observations of the entire profession, together with the community generally, attest the fact that consumption has increased proportionally to the diminution of periodical fevers; and it is further remarked that in special localities, where the malarial poison was present in a state of high concentration, phthisis was unknown; but as the malarial influences began to wear out, cases of consumption were immediately met with. This condition existed in a marked degree in the vicinity of Portsmouth, Ohio. We have the testimony of Dr. Hempstead

to the effect that, for a number of years after his location at that place, he never knew a case of consumption to originate within the malarial region; but no sooner had this poison become less concentrated than consumption made its appearance, and has continued to increase, *pari passu*, with the recession of periodical fevers.

But we must advance one step further, and inquire how this question stands in the Southern division of the United States. In this portion of our country it is well known that malaria prevails to a large extent, and often with great malignancy. Indeed, the principal diseases of the South are of this character, exhibiting various grades of intensity, ranging from simple intermittents to overwhelming congestive fever. Now in this region, highly malarial as a whole, consumption prevails to a comparatively limited extent, while in the Eastern division, where periodical fevers are unknown, phthisis is exceedingly common. Thus, according to the statistical table given in connection with the geography of phthisis, the Eastern division has a mortality from phthisis of one in three hundred and twenty-eight, while in the Southern division it is only one in twelve hundred and seventy-eight, a difference of three to one in favor of the South.

These are the facts, and although they may admit of a different explanation, yet it seems a fair presumption that the malarial poison exercises a retarding influence over the development of phthisis. It is true we might assume that it was the *warmth* of the climate which produced the favorable influence; but while this may be one of the agents, there are examples to show that mere warmth, independent of malaria, will not exercise this protective agency. Thus in Tahiti the climate is hot, but destitute of malarial diseases, while consumption is exceedingly common.

The testimony of Southern practitioners will generally sustain this view of the question, although I find some expressing the contrary opinion. Dr. Bowling, of Nashville, in a communication on the subject, expresses the opinion that the "condition of the system, superinduced by malarial localities, favors, in a remarkable degree, the deposition of tubercle." Dr. Dick-

son, of Charleston,* gives a more cautious and somewhat different opinion. After expressing the opinion that the full development of malarial poison exercises a prejudicial effect on the system, but that a milder grade, as found in the more elevated, dry, and sandy localities, retards the progress of consumptive cases, he further remarks: "The opinion has hence arisen, and seems to be well-founded, that a dilute malaria, in an atmosphere moderately dry, and in a locality somewhat elevated, does exert in our climate a favorable influence over the tendency to the development and progress of consumption."

There is another view, however, which will not escape the critical reasoner, namely, that the presence or absence of the *typhous* poison must be taken into the account. Thus, in the Eastern states, where typhoid fever is endemic, phthisis is common, while in the Southern regions, where continued fever prevails less extensively, and is of more recent development, consumption is also less prevalent. But while we can not deny the logical inferences which naturally arise, there is more evidence that the malarious poison is antagonistic to phthisis, in these examples, than that the typhous influence is the active inducing cause, although the latter doubtless exercises an influence over tuberculosis. Hence the withdrawal of malaria, and the introduction of the typhous poison, most probably favor the development of phthisis.

The testimony of physicians throughout the world strongly corroborates the view that malaria retards the development of phthisis. Boudin† favors this view, and adduces various facts to sustain it. Thus, Professor Schœnlein says that a locality of Gasterland, situated between the lakes of Wallenstadt and Zurich, where intermittents prevailed, was drained, when the intermittents disappeared, but phthisis, which was unknown before, manifested itself. Again, Dr. Santy observed, in the city of Meze, situated on the borders of a pond, that many of the marshes had for years disappeared, and with them intermittents ceased, but with the diminution of fevers phthisis became more frequent. Hence he concludes that the diminution of fevers

* MS. letter.

† Géographie Médicale, etc.

was replaced by an increase of phthisis. It is also said, by M. Monfrin, physician of Chartillon-les-Dombes, a marshy country, that phthisis is rare, and that during three years there were four hundred deaths in the hospital, only eight being from phthisis, or one in fifty.

Boudin has examined this subject with great care, and on a broad scale, and the following summary embraces his general conclusions:

"1st. The localities which generate intermittents are distinguished by the comparative rarity of pulmonary consumption and typhoid fever.

"2d. The localities in which these latter diseases prevail are remarkable for the rarity and mildness of the intermittents contracted on the spot.

"3d. Draining, while it causes the disappearance of miasmatic diseases, seems to dispose the organism to a new pathological condition, in which pulmonary consumption becomes a conspicuous disease."

Dr. Wells, an English physician, published, in 1811, a paper in the Medico-Chirurgical Transactions, to prove the antagonism between consumption and intermittent fever. The facts collected by Dr. Wells have been carefully tabulated by Mr. Ancell in the following form:

A TABULAR STATEMENT

Of Facts and Opinions collected by Dr. Wells, in his original paper on the Antagonism of Consumption and Intermittent Fever. Published in 1811.

LOCALITY.	REMARKS.		AUTHORITY.
London	During the last century, when Intermittents were very frequent	Consumptions were much less frequent	Dr. Wells.
Lynn, Norfolk	The neighborhood fenny	Where Intermittent Fever prevails Consumption does not	Dr. Marshall.
Hursterpoint, Sussex	Lands lately drained, 1807	Intermittents less frequent since, and Consumption more frequent	Mr. R. Weeks.
Horncastle, Lincoln	Lands lately drained, 1807	Consumption much less frequent in the fenny parts than in those which are high	Dr. Harrison.
Horncastle, Lincoln	Lands lately drained, 1807	Consumptive persons sent to the fens for the recovery of their health	A Clergyman.
Lower Counties of Scotland	Lands more effectually drained	In 67 parishes Ague generally declined. In 7 parishes Consumption increased; others uncertain	Report of Clergyman.
Arbroath	Lands more effectually drained	Agues declined and Consumption increased, within the memory of the medical practitioner	A Gentleman.
Holland	Intermittents frequent	Consumption much less frequent than in England	Dr. Cogan.
Flanders	Parts marshy	Consumption rare. Consumptive students of Liege sent to the swampy parts and recover	Rev. M. Leslie.
Brussels	High, well aired, healthy	Consumption one of the most common diseases	Sir J. Pringle, etc.
Berlin	Dry, sandy, and barren, Agues not generated	Pulmonary Consumption uniformly frequent. (1-5th deaths)	Dr. Wells.
Vienna	Much subject to Agues	Consumption much less frequent than in Berlin. (1-6th to 1-10th deaths)	Dr. Wells.
Petersburg	No positive information as to Agues, probably frequent	Comparatively and relatively to the coldness of the climate, Consumption infrequent	Mr. Malthus.
Minorca	Intermittents very prevalent	Not one word about Consumption; at least very infrequent	Dr. Chisholm.
Portugal	Intermittents very prevalent	Consumption more frequent in high dry ground near Lisbon than in low marshes where Intermittents prevail, as in Alentego	Dr. Sequeira.
Egypt	Intermittents very prevalent	Consumption not known. Intermittents occur, although not so frequent as elsewhere	Dr. Macgregor.
Aleppo	Pure dry air—high parts of Syria	Consumptive patients sent to the sea-coast, where the most malignant Intermittents prevail	Mr. Volney.
Bengal	Remittents and Intermittents prevail	Consumption scarcely known	A Physician.
Bombay	Less infected with Fevers	Consumption not very rare	Dr. Macgregor.
Upper Canada	Intermittents frequent on borders of the Lakes	No mention of Pulmonary Consumption	Dr. Walshe.
Portsmouth, N. H.	Mild climate, Intermittents probably infrequ't	Nearly 1-5th deaths produced by Consumption	Dr. Spalding.
Rhode Island	Free from Intermittents	Consumption probably more frequent than in England	A Gentleman.
New York	Free from Intermittents	Deaths from Consumption 1-5th the whole number	
Philadelphia	Free from Intermittents	Deaths from Consumption 1-6th the whole number. Intermittent Fevers more frequent than in New York	
Azores	The happiest and most equable climate	Generally salubrious, but infested with Consumption	Mr. Graham, Eng. Con.
South Carolina	Intermittents exceedingly frequent	Consumption rare	Dr. Wells.
Bermuda	Very free from Intermittents	Consumption much more frequent than in South Carolina	A Gentleman.
Madeira	Free from Intermittents	Consumption frequent	Dr. Beddoes.
Barbadoes	Since clearing of its woods, Agues rare	Consumption not uncommon	Dr. Hillary.
Jamaica	Very subject to Remittents and Intermittents	Consumption a very rare disease among the whites	Several Authorities.

These observations are valuable, and afford strong evidence confirmatory of the opinion that some degree of antagonism does exist between paludal poison and phthisis.

The canton of Montluel, France, abounds with lakes and marshes, and the inhabitants suffer extremely with various forms of paludal diseases. M. Neppel, a distinguished physician who practiced in that canton, testifies that phthisis was extremely rare. And another practitioner, M. Duteche, whose district was highly malarious, states that he never saw phthisis in those localities where malaria was most concentrated, as shown by the inhabitants being prostrated with intermittents. Numerous other physicians of France, who practiced in the malarious districts, made similar observations. If anything was wanting to render the testimony on this subject complete, the following statement by M. Neppel may be regarded as conclusive:

"That part of the Dombes in which tubercular affections are, as it were, unknown, is formed by a compact, uniform, clay soil, which is quite impermeable to water, and on which eighteen hundred ponds have been formed. These ponds are principally formed by rain-water, and communicate with one another, so that they may be emptied and filled at pleasure, according as water is wanted for rearing fish or tilling the ground. Owing to this system of things, a considerable extent of land is alternately covered with stagnant water, or laid dry for cultivation. In the poisoned waters which fill these ponds, are generally macerating the remains of the previous harvest, the decomposition of which is indicated by a nauseous odor, *sui generis*, and always perceptible in their vicinity. To these ponds must be added innumerable ditches and hollows which constitute so many marshes. The population is homogeneous, disseminated in farms and villages, and exclusively engaged in tilling the land and fishing the ponds. Constantly breathing the foggy atmosphere impregnated with miasmata, working in the mud of recently-drained ponds, drinking bad water, and living on food containing but few nutritious and tonic principles, the constitutions of the inhabitants have become impressed with peculiar characters. This morbid state is always carried to its maxi-

mum of intensity by repeated attacks of intermittent fever. It is in the existence of this organization, to which I would give the name of marshy or aqueous cachexia, that we must look for the physiological reason of the absence of all tendency to the morbid process of tuberculization, as also for the explication of the doubt of MM. Forget and Gintrac. It is evident that the economy thus modified is no longer susceptible of the same acts, and that all predispositions, as also all morbid repulsions, must present a different character. Every individual whose economy has not been modified, at least to a certain degree, by the influence of this cachexia, will not be safe from tubercular affections. It appears evident to me that the more the elements of impaludation are extended and multiplied, and the more the physical constitution of the indigenous inhabitants is deteriorated, the less frequent do tubercular affections become."

It must not be concealed that opposing views have been entertained. Thus, it is argued that, in the West Indies, where miasmatic diseases prevail, there is also a large amount of consumption. But the facts in relation to this region are scarcely sufficiently developed to predicate any safe conclusions upon them.

Many additional facts could be cited to prove the antagonism existing between malaria and phthisis. Thus, in Senegal, a highly malarious country, of nine hundred and sixty-two sick, three-fourths had malarious fever, while not a single case of phthisis occurred. In the hospital at Patmos twelve hundred and forty-three fever patients were received, of whom only two had hæmoptysis—by which is meant that only two cases of tubercle occurred. At Bone, M. Moreau found only twelve cases of consumption in six thousand two hundred and forty-five sick. It has also been observed that at Rotterdam and Amsterdam, where malaria is very abundant, phthisis is comparatively rare.

It has been attempted to be shown, especially by Mr. Ancell, that malarial poison induces a state of the blood antagonistic to that which is observed in phthisis; and hence he assumes that a condition of the fluids is established which effectually prevents the development of tubercle. Thus it is assumed that

the blood in intermittent fever, according to the analysis of Cozzi, exhibits especially an increase of red corpuscles, and diminution of albumen—conditions exactly the reverse of what obtains in phthisis. It is impossible, however, that this analysis of Cozzi, referred to and relied on by Ancell, can represent truly and properly the legitimate blood of malarial fever. Common observations must convince every one who has had much opportunity to observe the effects of paludal poison on the system, that one of its most uniform and constant results is the *diminution* of the red corpuscles. Hence the anæmic appearance of *all* persons who have long suffered with intermittents, or who have continued to reside in malarious districts. The diminution of the red corpuscles is so evident in the general aspect of the patient, that we do not require the aid of chemical analysis to settle the question. But independent of this general observation, the analyses of Andral and Gavarret afford conclusive evidence on the subject. According to these observations the mean of the corpuscles in seven analyses was 104.3—which, contrasted with 127, (the normal proportion,) affords evidence of a most remarkable and important change. The minimum in these analyses exhibited the remarkable reduction to 63.8.

The facts elicited by the analyses of Andral and Gavarret may be made the basis of an argument against the antagonism of intermittents and phthisis. It will be admitted that debilitating agents, in general, exercise an unfavorable influence on the tuberculous constitution; and hence, causes capable of inducing a state of anæmia, may fairly be assumed to be competent to favor the development of tubercle. Hence the malarial poison being of a debilitating character, superinducing anæmia, its natural tendency would be to favor the development of the tubercular diathesis. And such evidently would be the result if there was not some counteracting agency; and we can conceive of nothing capable of exercising a protective influence, except it may be the direct action of the malarial poison itself. Most certainly some degree of antagonism must exist, or the prevalence of phthisis in miasmatic districts would be increased by the debilitating effects of the poison, and thus become coextensive with the paludal influence. Indeed, if no antagonism

existed, phthisis would be endemic where intermittents prevail, and should, under certain circumstances, become even epidemic.

In conclusion, I feel free to state that the most reliable facts seem to me to clearly indicate some degree of antagonism between marsh miasmata and tuberculosis, and that where the one prevails, *cæteris paribus*, the other will not be found. In those examples where intermittents and phthisis are equally prevalent, as in the West Indies, secondary agencies will be found operating to change the ordinary course of events. The habits of the people, the cool and damp nights, together with the general insalubrious character of the climate, are more than enough to explain the seeming discrepancy. In addition to this, most of the statistics have been drawn from the English troops, which would afford no evidence of the effects produced on the native population.

3. *Relationship of the Eruptive Fevers to Phthisis.*—The influence of the *eruptive fevers* in the production of phthisis has not been definitely determined, but some important facts have been observed. Sir James Clark expresses the opinion that *measles* often becomes an exciting cause of tuberculosis, in persons having a tendency to the disease. According to Rilliet and Barthez, twenty-two out of three hundred and fourteen cases, or one in fourteen, became tuberculous, and in many of the examples the relationship of cause and effect was placed beyond doubt. They found, also, that a larger proportion of children who had been the subjects of measles died of phthisis than of those who had not been affected with that disease. Thus, of seventy-three who had been affected with measles, fifty-four, or seventy-four per cent., finally died tuberculous; while of one hundred and seventy who had not had measles, ninety-five, or fifty-five per cent., became tuberculous. These statements must be regarded as very extraordinary, and certainly do not accord with the experience of the profession in this country. It is true, something may be due to the confined condition to which children are subjected in Parisian hospitals, and that under more favorable circumstances, different results will be obtained. It may readily be admitted, however, that the occurrence of *pneumonia* during the progress of measles, may exercise a de-

cided influence in the development of tubercles, especially if any predisposition already exists.

In regard to scarlatina, opinions differ. Rilliet and Barthez declare that if the individual is laboring under tuberculization, the development of scarlatina retards the march of the pulmonary affection; but if tubercles do not already exist, the eruptive fever exercises no influence in that direction. On the contrary, Sir James Clark and Morton, observing the tendency to affections of the lymphatic system following scarlatina, believed it exercised a decided influence in the development of pulmonary disease. It does not appear to me, however, that the testimony is conclusive on this subject, but that it is highly probable scarlatina exercises no direct influence over the development or march of phthisis.

Variola and *vaccinia* have been supposed to variously modify the development of phthisis. Rilliet and Barthez regard small-pox and phthisis as antagonistic, and hold the following strong language on the subject: "Variola and tuberculization are diseases of different natures and mutually repel each other." It is difficult, if not impossible, to reach satisfactory conclusions on this subject; for neither statistics nor personal observations have been or probably can be made, sufficiently definite to be regarded as reflecting a law. In the absence, however, of conclusive information, it has been my impression that small-pox affords some degree of immunity against tuberculosis. It has not occurred to me to meet with many examples of persons having had variola and subsequently becoming tuberculous; it is true some such examples have come under my observation, but they have not been sufficiently numerous to remove the general impression on the subject. One remarkable example came under my notice in which a predisposition existed in a family to tuberculous and scrofulous disease, and one member, who seemed to have the same constitution, suffered a severe attack, at twelve years old, of confluent small-pox, and now, at the age of thirty, remains free from tubercular disease, although manifesting a strong scrofulous tendency at an early age. This is but a single example; but I am inclined to believe that attention to the subject would reveal many more. The decrease

of consumption in England (if found true) affords no valid argument against the opinion above expressed; for although variola is greatly less frequent than formerly, the hygienic improvements, greater accuracy in early diagnosis, and more enlightened therapeutics, are sufficient to explain the diminution of consumption. But I do not insist on the correctness of this statement, but merely offer it as a plausible conjecture.

In relation to the influences of vaccinia over the development of phthisis, the opinion is entertained by some observers, that it exercises an unfavorable tendency. Rilliet aud Barthez incline to this opinion, and furnish the following statistics on the subject.

Of two hundred and eight children vaccinated, the following results were noted:

Died tuberculous.....	138, or 66.7	per cent.
Died non-tuberculous.....	70, or 31.2	"

Of ninety-five children not vaccinated:

Died tuberculous.....	30, or 31.5	per cent.
Died non-tuberculous.....	65, or 68	"

Dr. J. B. Thompson, of the East Indian service, reports impure lymph as "a cause of tubercular disease in the East and in the Colonies," but does not develop the facts on which the assertion rests, (Ancell.)

These statements and statistics are striking and important, but still far from being conclusive. The statistical observations of Rilliet and Barthez are certainly highly significant, and strongly arrest the attention; but the careful observer will patiently await further developments, before assuming a dogmatical position on the subject.

SECTION IV.

RELATION OF VARIOUS CONSTITUTIONAL CONDITIONS TO PHTHISIS.

The relation which tuberculosis sustains to certain diseases originating within the system, or causing constitutional affections, either as it regards a tendency to the production of tubercle in other morbid states, or the existence of a certain degree of antagonism, is interesting and important to the practitioner. Thus, the relationship which subsists between tuberculosis and syphilis, cancer, diabetes, gout, rheumatism, pregnancy, etc., are highly important questions to be decided.

1. *Secondary Syphilis.*—The convertibility of the syphilitic into the tubercular material has already been discussed, and the opinion expressed that such conversion does not take place, but that by depressing the vital powers, and exciting a general morbid action, syphilis may lay the foundation of phthisis. In other words, syphilis may become an inducing cause of phthisis, even when the hereditary tendency does not exist. There is no sufficient reason, indeed, to conclude that morbid products so widely different as those of syphilis and tubercle can, under any circumstance, become convertible; nor is it necessary that such conversion should take place, in order to give to secondary syphilis the position of an inducing cause of tuberculosis. The mode in which phthisis and scrofula are induced by the syphilitic poison is, doubtless, the result of a general derangement of the nutritive functions, by which the vital actions are so changed as so produce tubercle. And that syphilis may, in this manner, become an inducing cause of tuberculosis, I can not entertain a doubt; indeed, numerous examples have come under my observation in which the relationship was so easily traced as to appear conclusive. It seems impossible that alterations so profound as that induced by secondary syphilis can fail to modify, in a most serious and extensive manner, the nutritive functions, and thus lead to numerous organic diseases, among which tuberculosis is the most prominent.

The great misleading error of those who have investigated

this subject consists in an attempt to establish the identity or non-identity, the convertibility or non-convertibility, of syphilis and tubercle or scrofula; whereas the true question lies in the ability of syphilis to act as an inducing cause, and, by deranging and lowering the vitality of the system, place it in a favorable condition to develop tubercular material. Thus, Lugol believes syphilis and scrofula to be identical; while Rilliet and Barthez, taking up the same line of investigation, succeeded in demonstrating that they are very different affections. But this leaves the actual question undecided, and the facts adduced afford no evidence against the proposition, that secondary syphilis becomes an exciting cause of scrofula and tuberculosis. The agency of syphilis as an inducing cause of phthisis can not, at least in the present state of facts on the subject, be determined by statistics, and we are left to the light of general experience and observation. The facts, however, adduced by Mr. Whitehead and others, seem conclusive that some such relationship as that indicated does in truth exist; and to this every practitioner will add his own individual testimony. For myself, I can truly affirm, that numerous examples seemed to depend, beyond doubt, on that cause. Many cases have been observed in which not the slightest hereditary taint could be traced, and the persons remained in good health until syphilis was contracted; after this, the sequences of secondary disease, the influences of debilitating treatment, and mental anxiety, completely subverted the general health, and, finally, phthisis was formally announced. In one example, (which may serve as a *type*,) the patient was without known hereditary taint, and well up to the age of twenty-one. At this period he contracted syphilis, which became secondary, ran through a protracted treatment, and he never regained health. Five or six years after the primary attack occurred, a slight cough was observed; and at the age of twenty-nine, I found him in the last stage of phthisis, from which he soon died.

Some highly-important observations have been made on this subject by surgeons in the United States army, in relation to the occurrence of scrofula and phthisis among the native Indians. It is well known that by intercourse with the whites, the natives

contract syphilis; and owing to a want of appropriate treatment, the disease often becomes protracted and inveterate; indeed, the affection usually pursues an uninterrupted course, and affords excellent opportunities to study its natural history. And it has been observed by a number of the surgeons, that these Indians become peculiarly prone to scrofula and phthisis; and some have expressed the opinion that a direct relationship existed between those affections. It can only be added here, that these observations are replete with interest, but that they require further inquiries to elucidate the subject.

2. *Diabetes.*—It is a common observation that diabetes is peculiarly prone to develop or become connected with tubercles, and it is remarked by Dr. Copland* that he has seldom met with a case which was not, more or less, complicated with pulmonary symptoms, and Bouchardat asserts that all persons dying of diabetes have tubercles in the lungs. But, conversely, *phthisis* is rarely complicated with diabetes, and hence the conclusion that the relationship is less direct than the first proposition would seem to indicate. It is asserted by some that the pulmonary affection precedes the morbid state of the urine, and hence the relationship of cause and effect is very direct; but this is contrary to the examples which have come under my observation. In a case recently observed, the patient, a stout and vigorous man, free from hereditary taint, suffered for a period of five or six years with diabetes, but without pulmonary symptoms; finally, however, phthisis supervened, of which he finally died. In this example the diabetes gradually subsided as the pulmonary symptoms advanced, and at the time of death he no longer complained of the urinary secretion.

It is evident, however, that diabetes is a most active inducing cause of phthisis; and if cases of the former disease continue uncured, they almost certainly pass into the latter affection.

3. *Gout and Rheumatism.*—We have no conclusive testimony, statistical or rational, that any special relationship exists between gout, rheumatism, and tuberculosis; that is to say, we have no evidence of their acting, on the one hand, as inducing causes,

* Dictionary of Practical Medicine.

or, on the other, that any antagonism exists between these affections. It is said, however, that gout and tuberculosis are antagonistic, and Fournet declares they never coexist. It is certainly true that tuberculous persons do not become gouty, nor do the gouty become tuberculous; but such facts are far from establishing any relationship as to cause and effect. The truth, doubtless, is that tuberculous persons are not prone to gout, and, consequently, gouty persons *can not* have a tuberculous constitution. Beyond this there is no evident relationship between these affections.

4. *Cancer.*—Rokitansky, Walshe, Paget, Simon, and most other observers agree that cancer and tubercle seldom occur in the same system. That the habits and constitutions laboring under these two classes of diseases are widely different, can admit of no doubt; and when we add to this the demonstrative fact that the two affections are seldom found, post mortem, to coexist, the law is clearly established that there is some degree of incompatibility between cancer and phthisis. Mr. Paget* expresses the opinion that they exclude one another, and are incompatible. He also details a case in which scirrhus, which had proved intractable, measurably healed during the evolution of tubercles; and another example in which active tuberculous disease of the lungs was arrested immediately before the appearance of scirrhus in the breast. And furthermore, that many who die of cancerous affections exhibit evidences of arrested tuberculous disease, which would strongly indicate the incompatibility of the two morbid conditions.

Dr. Walshe† draws a lucid distinction between cancer and tubercle, based on the anatomical location of the two affections; thus, the lungs are almost the invariable seat of tubercle, while they are as rarely affected with cancer. And the same rule applies to other organs, the two forms of deposit generally selecting different viscera. It is true, however, that in some rare instances cancer and tubercle have been declared to exist together in the lungs. One case has been recorded by Dr. Bristow, and another by Dr. Jenner,‡ in which the coexistence

* Lectures on Surgical Pathology. † On Cancer, etc.

‡ Medical Times and Gazette, 1852.

of cancer and tubercle in the lungs seemed to be demonstrated. In Dr. Jenner's cases, Dr. Walshe, Dr. Bright, and Dr. Hall Davis concurred with the opinion that the two morbid products were present in the pulmonary tissues. The patient, a male, died at the "middle period of life." In both examples, the tubercular formation is stated to have been of the *gray* variety, which very obviously modifies the whole question; for it would at once become a question whether the deposits were not the result of inflammation.

5. *Pregnancy.*—A very general belief has existed for many years, that pregnancy exercises the influence of arresting, more or less completely, the progress of phthisis. But as the influence of the puerperal state must depend largely on the stage of the tuberculous condition, no less than the constitution of the patient, it is evident that general conclusions and sweeping opinions must embrace much that is erroneous, and fail to reach the true scientific essence of the subject. Among those who have entertained the opinion that pregnancy impedes the march of phthisis, may be mentioned Rokitansky, Clark, Williams, Andral, Chapman, Burns, Denman, and, indeed, a large majority of observers. Dubreuilh, however, in a memoir presented to the Academy of Medicine, obstinately maintains the opposite opinion, in which he is sustained by the authority of Grisolle.

In commenting on this subject, Grisolle is of opinion, that in most cases in which phthisis and pregnancy coexist, the latter occurred first, and the pulmonary affection made its appearance during the progress of pregnancy. This is a highly-important position, and, if fully sustained by facts, would at once subvert the belief that pregnancy is in any degree antagonistic to tuberculosis; on the contrary, pregnancy appears to have been the inducing cause of tubercles, which Grisolle, indeed, distinctly asserts. Grisolle, in common with Dubreuilh, expresses the opinion that pregnancy not only fails to modify the symptoms of phthisis, but that the puerperal condition hastens the process of disorganization. This aggravation, according to Grisolle, arises from various accidental symptoms occurring during pregnancy, and which serve to impair the nutrition of the maternal system, and to diminish the duration of the

disease. Thus, the mean duration of all the cases complicated with pregnancy was nine and a half months; which is considerably lower than the average duration in non-pregnant females. Hence it is declared that pregnancy, instead of prolonging life in cases of phthisis, hastens the fatal termination by inducing exhaustion of the vital powers directly, and through the agency of various accidents connected with the puerperal state.

But, contrary to what would be anticipated from these assumed adverse effects *during* pregnancy, Grisolle contends that accouchement, and the puerperal state, do not, as generally believed, accelerate the fatal issue of even advanced cases of phthisis. It must strike every reflecting person as extremely problematical, that pregnancy manifests such a marked injurious influence over the progress of phthisis, and greatly curtails its duration, while accouchement and the puerperal state, with all their attendant evils, fail to exert any prejudicial influence over the march of the pulmonary disease; but, on the contrary, the disease goes on as before, uninfluenced by the puerperal state, or in the less intense cases, "it is more or less perfectly arrested." (!) (Grisolle.)

We may well close the last sentence, which is a quotation from Grisolle, with an exclamation; for it is utterly inconceivable that *pregnancy* should not only fail to mitigate the progress of phthisis, coexistent or superinduced, but, in fact, hasten its progress or even cause its development, and yet *parturition* and the puerperal state (all actively debilitating) should either exercise no control over its march, or even more or less perfectly arrest its progress. There is reason to believe that this distinguished observer has been misled by placing too much reliance on a limited number of incomplete statistics; indeed, conscious of their imperfections, he concludes his article with the declaration, they are not offered as absolutely correct.

The question which these investigations seek to elucidate is, whether pregnancy will arrest the progress of tubercular deposits after the local phenomena have been fairly manifested; but there is another and even more important view which should take precedence of all others, and that is, will preg-

nancy, or the frequent bearing of children, modify, arrest, or aggravate the *tubercular predisposition?* Dr. Edward Warren* has very ably investigated this subject, in all its relations, and he appears to have established quite conclusively, at least this latter question, and concludes that even when local disease exists, it is antagonized by pregnancy. My own convictions on this subject have been deduced from personal observations, and although not in the form of statistics, are, at least to myself, not the less conclusive on that account. It is my conviction, then, that in the tubercular predisposition, or even the *precursory* stage of phthisis, the occurrence of pregnancy, under favorable circumstances, and frequently repeated, so changes the vital actions as to delay or entirely arrest the impending local deposits. And what I mean by *favorable circumstances* is, that the person shall be in the enjoyment of a fair degree of general health and strength, that the pregnancy progress regularly to its natural termination, and that the subject during the time be placed under proper hygienic conditions in regard to exercise, clothing, diet, and habitation. Where these favorable conditions are present, I am convinced that pregnancies occurring, say once in two years, exercise a material influence in preventing the development of tubercles. But, on the contrary, if the patient be of very delicate conformation, or suffering from general debility, and ripe, as it were, for development of the local disease; or, again, if the subject be imperfectly nourished and clothed, or live in ill-ventilated or damp habitation, then the progress of gestation will rather add to the debility, and consequently prove injurious.

In order that gestation may exercise a beneficial influence over the tubercular tendency, the system must be well sustained with healthy nutriment and good digestion. This proposition is sufficiently evident. The growth of the fœtus necessarily draws on the fluids of the mother for a large amount of nutritive material; and if this be not replaced by a good primary digestion of abundant healthy food, the system emaciates and general debility ensues. If, therefore, the nutriment is scanty

* Prize Essay, etc.

or defective, or if the digestive powers are greatly impaired, the process of gestation will favor rather than retard the development of tubercles.

In regard to the second branch of the proposition, that is, the influence exercised by pregnancy over the *progress* of tubercles after they are deposited, I think there are several important qualifying circumstances. If the tubercles are but of recent date, limited quantity, *and not softened*, and the patient has good strength and digestion, the puerperal state may still retard the progress of the local disease; but whether the influence will become permanent, or cease with the termination of the labor, will be variously determined by the contingencies of different cases. But if the tubercular deposits be very extensive, and especially if softening has taken place, the influence of gestation will almost inevitably prove injurious, and accelerate the progress of the disease. I am unable to call to mind any case in which softening had occurred, that was, in any material manner, benefited by gestation; but, on the contrary, most of the examples have seemed decidedly accelerated. In this respect, I agree with the observations of Grisolle, that fully developed phthisis is not ameliorated by pregnancy, but that, in most instances at least, such patients become debilitated, and the disease, therefore, advances.

The same general laws regulating the effects of pregnancy on tuberculous disease, are equally applicable to the process of *lactation*. Anterior to the actual development of tubercles, lactation will do no injury, provided the system is well nourished during the whole period; but if the disease has advanced, a tendency to debility exists, the digestive powers are apt to fail, prostration will ensue, and thus nursing becomes extremely prejudicial.

SECTION V.

INFLUENCES OF DISEASES OF THE HEART.

The opinion has been entertained, by many careful observers, that any condition which interferes with due oxygenation of the blood, such as open foramen ovale, mitral regurgitation, pulmonary emphysema, and the drunkard's dyscrasia, exercise an influence antagonistic to consumption. Rokitansky, Hasse, Simon, and others, entertain opinions of this character, and adduce various facts to sustain them. We have not much positive information on this subject; for, although we may admit that a carbonized state of the blood is unfavorable to the development of tubercles, it is still difficult to connect any individual case with such protective agency. It can never be known, indeed, that any case of cyanosis would, without that condition, have become tuberculous; and as the statistical evidence is too limited to furnish data for a general conclusion, we must leave the question undecided.

Dr. Thomas K. Chambers has examined this question with the light of statistics, and seems to entertain no doubt of the infrequency of the association of cardiac and pulmonary disease. The following is the table furnished by Dr. Chambers:

	In 503 Cases of Tuberculosis of the Lungs.	Per Cent.	In 1667 other Cases.	Per Cent.
Pericarditis	11	2.1	125	7.5
Old internal adhesions of the pericardium	11	2.1	77	4.6
Old external adhesions of the same, (perhaps irregularly recorded,)	7	—	10	—
White spots	39	7.7	160	9.6
Recent fibrin deposited on the valves	4	0.7	39	2.3
Thickened valves	20	3.9	137	8.2
Atheroma of valves	15	2.9	182	10.9
Hypertrophy alone	13	2.5	156	9.4
Hypertrophy and dilatation	13	2.5	143	8.6
Dilatation alone	46	9.1	248	14.9
Atrophy	7	1.3	12	0.7
Excess of adipose tissue	5	1.0	43	2.5
Fatty degeneration (irregularly recorded)	3	—	10	—

It will be observed that this table exhibits diseases of the heart as comparatively rare in tuberculosis. Thus, thickened valves occurred in tuberculosis in the proportion of 3.9 per cent., while in other cases the per cent. was 8.2. Hypertrophy gave 2.5 per cent. in tuberculosis, while it reached 9.4 in general diseases. Dilatation was found in the proportion of 9.1 in tuberculosis, and 14.9 in other diseases. It will be remarked, that the affection of the heart which gave the highest percentage, was dilatation.

The inference which Dr. Chambers draws from these statistics, is, that instead of cardiac disease preventing the development of tuberculosis, the law is rather that tuberculosis does not tend to develop affections of the heart. And this appears to be a fair inference from the facts revealed by these statistics; but, at the same time, about all that can be definitely stated is, that the association of tuberculosis and cardiac affections is of infrequent occurrence.

It will be perceived, however, that the questions suggested by Rokitansky and Chambers present very different etiological relations to tuberculosis. Thus, according to the views of Rokitansky, it is those forms of cardiac disease which give rise to *cyanosis* that become antagonistic to tuberculosis, and, consequently, many forms of heart disease would be simply negative in that relation. According to Dr. Chambers's view, a tuberculous state of the system rather tends to prevent the development of cardiac affections; but this opinion, even if fully established, would not, in the slightest degree, militate against the doctrine that cyanosis is antagonistic to the development of tubercle. The two questions, indeed, are radically distinct, and both present many points of interest.

The relationship of phthisis to various diathetic conditions might be further pursued, but our information on many of these questions is not sufficiently definite to justify positive conclusions. Dr. Walshe mentions diathetic skin diseases, (such as pemphigus,) hysteria, leucohæmia, etc., as being more or less antagonistic; and fatty diathesis, Bright's disease, insanity, glycohæmia, leucohæmia, etc., as more or less attractive to phthisis. Dr. Cotton regards various cutaneous affections as

more or less antagonistic to phthisis, and mentions particularly psoriasis, strophulus, and lichen. It is evident, however, that we have much to learn in relation to the affinities and antagonisms of phthisis and other forms of disease.

It may be remarked, however, that if tubercle, as intimated in the preceding pages, possess *specific* properties, it might reasonably be anticipated that various morbid conditions would exhibit more or less antagonism to the formation of that specific product. These antagonisms will, doubtless, be found in other specific conditions, induced by various poisons and diatheses.

PART THIRD.

SEMEIOLOGY OF PHTHISIS.

SEMEIOLOGY OF PHTHISIS.

CHAPTER I.

SYMPTOMS OF CHRONIC PHTHISIS.

THE symptomatology of phthisis, especially at an early period of the disease, demands the most accurate observations, and the clearest interpretation of phenomena; for it is on our accuracy of diagnosis in the very inception of the morbid action, that the main hope of successful treatment depends. There are few diseases of so fearful a nature which approach so silently and insidiously, and none in which early detection is more important. It is abundantly evident that the curability of phthisis is inversely as to its duration, and that early and discriminating treatment is the *sine quâ non*. That the disease may be detected, even in its forming stage, I believe can be fully demonstrated; but the means of diagnosis, although clear and undoubted, are complex and difficult, and demand a large amount of careful observation and experience. The investigations must proceed in the most careful and systematic manner, embracing the history of the case, the rational symptoms, and physical signs. It is impossible to exaggerate the importance of physical signs, when the disease becomes fixed, for on these the diagnosis must largely depend; but, at the same time, the general or rational symptoms throw the greatest light on the forming stage, and without a just appreciation of this early symptomatology, every step would be doubtful and uncertain. Indeed, these two

methods of diagnosis mutually aid each other, and it would be the hight of indiscretion to rely on either one alone. The one marks the failing functions, and the depressed vitality; while the other reveals the physical phenomena arising from local changes.

It is evident, therefore, that the rational and physical signs are equally important in a general sense; but it must be remembered that in different stages of phthisis one class of symptoms or signs necessarily becomes more important than the other. A careful examination of the subject will clearly prove, that in the forming or precursory stage of phthisis, the constitutional or general symptoms are of the greatest importance; for although physical signs are not entirely wanting, yet, anterior to the development of local disease, they are comparatively slight and largely negative. But as the disease advances, the physical signs become the most prominent means of diagnosis; indeed, it may safely be affirmed that the presence of tubercles can not be positively known except by the aid of auscultation and percussion.

In an examination of the symptomatology of phthisis, it is indispensable that our investigation begin with the earliest inception of morbid action; for if, with most systematic writers, we direct our attention mainly to those prominent and well-marked signs and symptoms which characterize the full development of the disease, we shall accomplish little more than discover an incurable affection. And without justly incurring the charge of being improperly censorious, I may be permitted to remark, that the fault of a large number, if not most writers on this subject, is the enumeration of marked and prominent symptoms characteristic of fully-developed disease, to the exclusion of those less obvious, but even more important phenomena, which indicate the forming stage. I shall begin, therefore, with what seems to me the earliest indications of the disease, and trace the progress of the morbid action to its more complete development and better-defined symptomatology. And in doing this I shall venture to rely, to a considerable extent, on my own observation, either as confirming, extending, or contravening the opinions of cotemporaneous writers.

In examining the symptomatology of phthisis the following stages must necessarily be recognized:

1. The precursory stage.
2. The stage of tubercular deposits.
3. The stage of softening.
4. Stage of excavation.

SECTION I.

SYMPTOMS AND SIGNS OF THE PRECURSORY STAGE OF PHTHISIS.

Definition.—The phrase *precursory stage* is designed to indicate a morbid state, existing intermediate between the mere diathesis, on the one hand, and the deposit of solid tubercles in the lungs, on the other. The *diathesis* is a constitutional predisposition to the disease, which, under favorable circumstances, may never become developed; the *precursory stage*, on the contrary, is the beginning of a positive morbid action, which, if not arrested, surely and steadily progresses to the deposit of tubercles.

Phenomena.—The special symptoms indicative of this precursory stage are divisible into those which affect the system at large, and those which spring directly from the pulmonary organs and respiratory passages.

1. *State of the General System.*—In a large number of tuberculous subjects the vital powers, as a whole, become impaired, the general strength diminishes, the body loses slightly in weight, and the individual functions are all more or less lowered and irregular in their action. The failure of strength and the diminution of weight vary remarkably in different instances. In some examples these phenomena exist in a very prominent degree, and rapidly increase, while, in others, the deviations from health are so slight as to escape the attention of the casual observer, and are not considered important by the patient. Thus it is that, in a large number of cases, this precursory stage passes unnoticed, and the patient dates the onset of his disease from the period of open and well-marked local symptoms.

When, however, we examine such cases with due discrimination, it will be found that the general strength has failed, and that no evident cause can be assigned for such a condition. The failing strength may not have been preceded by any form of appreciable disease, general or local, and appears to be, *per se*, the morbid condition. This state of the system is marked especially by the inability to sustain great fatigue, or the extremes of heat and cold, the circulation and respiratory movements become easily excited, the appetite is variable, though not generally deficient, and food loses its due nutritive effects. Still, these changes are often very limited, and progress so slowly that the subject fails to perceive the derangement until a more serious class of symptoms becomes developed. The loss of weight must necessarily advance, *pari passu*, with the impaired strength; indeed, the emaciation springing directly from impaired nutrition must take precedence of debility, just as the former, arising from diminished nutritive action, is the primary symptom in the whole series of derangements. But, inasmuch as the loss of weight remains for a time trivial, the patient will not perceive its existence; and it is only by accurately weighing the subject that definite conclusions can be reached. When this is correctly done it will nearly always be found that the body has lost in weight proportionately to the diminution of general strength.

The appetite and primary digestion, as already mentioned, present variable conditions; but the actual dyspeptic state, so universally described, is, according to my observations, generally not present. Patients eat freely and even largely, digestion takes place readily, and usually without local disturbance; when, however, the appetite is craving, (as often happens,) and crude articles of diet are indulged in, evidences of indigestion speedily arise. But so long as the diet is duly selected I have not found, as a general rule, that actual indigestion was manifested, although the function more frequently becomes deranged than in a sound constitution.

Chills and Febricula.—This state of the system is further evinced by the variable condition of calorification and innervation; patients become readily chilled, the hands and feet are

habitually below the natural temperature, and, in general terms, the power of resistance to cold is much diminished. The diminished temperature occasionally reaches a point which constitutes an actual chill, with consecutive reaction, so that a transitory febrile state is established, which recurs at variable and uncertain intervals. But there is no evidence that the precursory stage establishes any other febrile condition than this irregular ephemeral vascular action; and the more profound febricula, which has been described by some writers as simulating, to some extent, a hectic state, has no existence, except as the result of some form of positive disease superadded to the tuberculous state, and, therefore, does not properly constitute a precursory symptom. It may be remarked, however, that the nervous system, in the precursory tuberculous state, manifests a high grade of irritability, and that slight causes are capable of exciting a reactive force, which gives rise to fever. This form of febrile action is necessarily modified and governed by the producing cause, and, consequently, can have no definite or uniform characteristics, either in regard to phenomena or duration. Still, these febricula constitute an important class of symptoms, as indicative of lowered vitality and diminished power of resistance. In subjects presumed to have inherited a tuberculous diathesis, no class of precursory symptoms are more calculated to arouse serious apprehensions than the occurrence of irregular chills, followed by slight febricula; and especially are these phenomena to be viewed as pretubercular signs when they are associated with diminished strength, loss of weight, and other evidences of weakened vitality. It must, however, be carefully remarked that the chills here described are not those indicative of miasmatic origin; on the contrary, they manifest the greatest degree of irregularity, and are only partially amenable to the antiperiodical remedies.

A febrile state, slow, progressive, and almost perpetual, has been described by some writers as indicative of approaching phthisis. It has not appeared to me, however, that such a state, as a legitimate precursory sign of phthisis, had any real existence; on the contrary, a febrile condition exhibiting a degree of intensity and continuance, as thus described, manifestly arises

from some irritating cause more potent than the mere precursory state of tuberculosis. In fine, the chills and fever, characteristic of the precursory stage of phthisis, are ephemeral, irregular, and interrupted; and anything approaching continuance of excitement must be ascribed to other and more acute conditions.

State of the Circulation.—It may be safely assumed that, exclusive of the febricula already described, the action of the heart and of the arterial system generally, manifest a degree of power below the physiological state. That is to say, the pulse is feeble, (corresponding to a weak cardiac action,) with a variable degree of frequency. In some examples the frequency is slightly increased, while in others it is below the physiological standard; but in all cases the number of pulsations is readily increased by mental or physical causes, thus manifesting a latent excitability altogether morbid. It is in this manner that a slight febrile movement, physical exercise, or mental emotions arouse the frequency of the pulse, but without a corresponding increase of force. Such a pulse is rather irritable than inflammatory, and may be regarded as an index of a state of debility of the vital powers with irritable reaction.

It must be remarked, however, that the force and frequency of the pulse necessarily vary greatly with temperament, age, sex, habits, constitution, and other modifying conditions; and hence a pulse so nearly physiological that its deviations escape notice, may exist coincident with the precursory tuberculous state, or its deviations may be very marked and distinct. But my own observations induce me to believe that this preliminary stage, following as a sequence of the *diathesis*, is nearly always indicated by a state of debility of the heart, arteries, and capillaries, as shown in the weak impulse, feeble radial pulsation, and diminished capillary action. And if we add to this state that of irregular excitability, we shall have before us phenomena, at least well marked, if not pathognomonic of the state of the system which immediately precedes tubercular deposits. It may be distinguished from other forms of debility by the absence of any evident disease or tangible cause competent to produce such a condition; and if we add to this a tuberculous predisposition,

as revealed by the personal history of the patient, this weak or languid circulation becomes a sign of great significance in diagnosis.

State of the Fauces and Larynx.—The condition of the mucous membrane and the glandular structures of the fauces and larynx present an exceedingly important part of the symptomatology of the precursory stage of phthisis. Systematic writers have dwelt but little on the condition of the pharynx in the early stage of tuberculosis, and the exact relationship of this local affection to the pulmonary disease involves several questions of great practical importance, although at this time but little understood. In the more advanced stages of tubercular disease, the affection of the throat has been fully described by nearly all writers, and is well known to practitioners; but that insidious form of disease connected with the precursory stage of phthisis, has either been measurably overlooked, or confounded with other affections radically different in their etiological and pathological relations.

I am fully satisfied that, in a large majority of cases passing into consumption, the pharyngo-laryngeal structures become early and permanently diseased. The character of the morbid action and the tissue involved, vary in different cases. In some examples the mucous membrane exhibits diffuse redness, or ramiform injection; while in others, follicular and tonsillar disease are the prominent features. Dr. Horace Green, of New York, has drawn attention to these affections, and especially to the diseased state of the tonsils. He is led to regard the tonsils as, in some sense, the analogue of the lungs, and that the glandular disease very constantly precedes the pulmonary affection.

The form of morbid action, to which the tonsils are subject appears to be of a suppurative character, and, as believed by Dr. Green, also tubercular. At an early period the glands become slightly hypertrophied, but *enlargement* is not the ordinary or permanent condition; on the contrary, the tendency is to a suppurative or even ulcerative action, with, ultimately, absorption or destruction of almost the entire glands. Rokitansky observes that scrofulous subjects often become affected with a peculiar blennorrhœa of the tonsils, the secretions forming

tubercular or cheesy plugs and chalky concretions. Wedl and Höffle have drawn attention to tonsillary concretions which have been mistaken for *sputa cretacea*, and were supposed to have come from the lungs or air-passages. The more common form, however, of the tonsillary secretion is the blennorrhœa mentioned by Rokitansky, or the cheese-like substance occupying the involutions and follicles of the gland. As commonly observed, the secretion has the consistence of putty, and may be readily pressed from the gland; and, in a more advanced stage, probably exists as the cretaceous or calcareous masses.

It is a question as to the exact character of the cheese-like substance observed in the tonsils. Rokitansky calls the substance "tubercular or cheesy plugs," and there is reason to believe that it is of a tuberculous character. I have carefully examined this substance with the microscope, and find it consists of irregular granular matter, but I have not observed the presence of cells. Acetic acid produced no obvious effect; certainly it did not dissolve the substance, which forbids the idea that the material was simply chalky. Upon the whole, it appears to me that this cheesy substance is of a tuberculous character, and that it may undergo the cretaceous transformation as tubercles do in the lungs.

It should be observed, however, that in an early period of the precursory stage, or where the disease is only moderately developed, the affection of the tonsils may be very slight, varying from a limited enlargement, and hyperæmic condition, to a state of blennorrhœa, or suppurative action. But in a large proportion of cases, more or less disease of the tonsils, extending often to the general mucous membrane and follicles of the fauces and larynx, will be observed. Hence, taken as a whole, the lesions of the throat, as peculiar to the precursory stage of phthisis, will be found to embrace affections of the mucous membrane, follicles, and tonsils, varying in extent and activity, and in the predominance of each particular variety of morbid action.

The symptoms indicating the morbid changes in the throat vary with the intensity and special character of the disease. It is an important fact, however, that the subjective symptoms are

by no means proportioned to the extent or intensity of the local affection; on the contrary, the patient will often make no complaint of the throat, and yet, on inspection, we may find important and profound lesions. In some examples, patients complain of dryness, in others of a sense of fullness, or a dull pain, often radiating to the upper portion of the chest. There is often a slight cough, varying with the intensity of the laryngeal irritation; or, the affection of the larynx may induce merely a *clearing* of the throat, accompanied, in certain cases, with a variable degree of hoarseness. This latter symptom is sometimes very obstinate, and may exist for a long period with but little manifestation of any other throat affection. Patients often speak of a slight degree of uneasiness about the throat, imparting a sense of weight and constriction to the chest, and upon careful examination it becomes evident that there is a restriction in the movements of the thorax, corresponding very accurately to the subjective symptoms.

The constancy with which this throat affection is manifested, its persistence and gradual increase, indicate that it sustains an intimate relation to the precursory stage of tubèrculosis, at least in a certain class of cases. I do not pretend to assert that it is always a precursor of tubercular deposits in the lungs, for there are cases in which the disease is ushered in with a rapid deposition of tubercles, without the usual preliminary stage; but, on the other hand, there is a large class of examples in which this condition occurs as one of the earliest signs, and evidently precedes most other manifestations of disease. Nor will I go so far as to maintain that the pharyngo-laryngeal disease can be regarded as a cause of the local deposits; still, it is by no means certain that this condition is not a primary local lesion, incident to the tuberculous state, and which, impeding and otherwise modifying the respiratory process, at least hastens the pulmonary affection. It has appeared to me that in persons predisposed to tubercular consumption, the throat-affection was usually early and prominently developed, and that in proportion as this morbid action increased or persisted in duration, would be the probabilities of deposits in the lungs; and furthermore, that when this primary lesion was early and promptly

subdued, the organic affection of the lungs was either prevented or delayed. It has occurred to me so frequently to observe the fact, that all the precursory signs of impending consumption have been modified or removed by remedies applied to the throat, I can no longer resist the conclusion that the lesion in question is, in a certain class of cases, closely allied to local pulmonary disease.

I do not wish, however, to be understood as indicating that the affection of the throat creates the diathetic state; on the contrary, it is but the local expression of a constitutional predisposition, and is, therefore, a mere symptom. But even with this limitation, the disease of the throat does not become less significant, for although itself a symptom, it may bear such a relation to other and more profound lesions, as to impart to it a character of primary importance in the precursory stage of phthisis.

Finally, it should be remarked, that this state of the throat occurs coincidently with the other signs which have been mentioned, namely, emaciation, chills, fever, languid circulation, and cough. It may either precede or follow them, but my opinion is, that it is more frequently the precursor of other signs, and, therefore, should be regarded in some sense as an initial symptom. Or, if other signs, (such as loss of strength and weight, febricula, etc.,) are observed first, the state of the throat follows so nearly simultaneously, that the distinction is often difficult, if not impossible.

Cough and Sputa.—The cough and sputa which occur in the precursory stage of phthisis, are usually trivial in character, but nevertheless sufficiently significant to indicate the progressing lesions. Cough is by no means constant or regular, and yet it always occurs as one of the preliminary symptoms; it is slight, at first dry, and in consequence of not harassing the patient, often attracts but little attention. It will be observed, however, that this species of cough is remarkably persistent; it continues for a long period, independent of common catarrhal or bronchial irritations, and often without the patient being able to assign any appreciable cause for its origin or continuance. In many cases it is so slight that patients deny its existence, and

it is only by close examination that the facts can be elicited. Various grades of intensity are witnessed, although the milder variety is the most common. In its true and uncomplicated condition, this preliminary cough is entirely independent of bronchial disease, and, therefore, is to be distinguished from an accidental affection, brought on by exposure to cold or other causes capable of developing bronchitis. Its special characters are its mildness and persistence.

The immediate cause of the cough can be traced, in most instances, to the throat-affection previously described, and its intensity varies with the local disease on which it depends, progressing, *pari passu*, with that affection. The degree of perceptible disease in the fauces is not, however, always a true indication of the state of the larynx, for the former may remain but little reddened, while the latter partakes of considerable irritation.

It is an undetermined question, whether the state of the pulmonary circulation and innervation, during this preliminary stage, becomes so modified as to be capable of exciting cough, independent of the associated laryngeal irritation or accidental bronchial disease. It will be remembered, however, that the functions of the lungs become materially modified as the throat-disease advances, which is shown by the altered sensibilities and breathing powers; and it is not improbable that, in this modified condition of the pulmonary apparatus, sufficient excitement may be established to induce occasional cough. It has appeared to me, in watching the course of such cases, that in a certain proportion there was evidence that the cough originated deeply in the structures, but was independent of common bronchial disease. Under these circumstances it appeared probable that the altered innervation and circulation of the pulmonary structures, originating in part, at least, from the affection of the throat, and possibly, in part, also, from the changed conditions of the general system, were capable of producing cough, and were to be regarded as one of the causes of that symptom. But by far the most common cause has been, according to my observation, the disease of the larynx and fauces.

The *sputum* in this stage is usually scanty, at least so long as

the local affection remains of moderate intensity and free from complication with pulmonary disease. It consists of thin transparent mucus, a gray gelatinous substance, or small, rounded, gray masses of considerable tenacity. As the disease advances, the sputa become yellowish and more abundant, even anterior to the occurrence of pulmonary tubercles.

Hemorrhage.—The attenuated state of the mucous membrane, the irritated condition of the throat, and want of free expansion of the chest, are conditions which, theoretically, might be supposed to favor hemorrhage. And in confirmation of this opinion, cases have frequently come under my observation in which even copious hemorrhage has occurred without the signs of coexisting tubercles. Thus, a young man became subject to repeated attacks of hemorrhage, during which from four to eight ounces of blood would be lost. These attacks were preceded by some degree of oppression of the chest, accompanied by signs of pulmonary congestion; but there was no evident cause for the disease except a delicacy of constitution and seeming tendency to tuberculosis. In this case none of the physical signs of tubercular deposits existed, and there is no evidence that the hæmoptysis proceeded from any other cause than the precursory tubercular state. In this case several years have now elapsed since the first hemorrhage, and the person bears marks of increasing constitutional disease, such as cough, emaciation, and general debility. These general symptoms leave but little doubt that tubercular deposits have succeeded the hæmoptysis, although it has not been verified by examination. In another remarkable instance, pulmonary hemorrhage commenced at the age of thirty, became copious and occasionally repeated, so as to debilitate the system, but was not followed immediately by signs of tubercular disease. This person consulted me *seventeen years* after the first hemorrhage, and was then in the last stage of pulmonary consumption. The son of this man has had nearly a similar experience. Pulmonary hemorrhage occurred while he was apparently in good health, having lost no flesh, nor had other signs of pulmonary disease; but speedily following the hæmoptysis, cough, emaciation, and other symptoms were developed, and when first consulted I found large caverns.

Numerous cases have come under my observation in which patients declare themselves to have been in perfect health, entirely free from cough, emaciation, or any appreciable symptoms of disease, when suddenly, and often without premonition or evident cause, *copious* hemorrhage has occurred, and which was speedily followed by evidences of tuberculosis. In a case just examined, the patient declares he was in perfect health eleven months ago, when copious hemorrhage (from a pint to a quart) supervened; and since then cough, emaciation, chills, etc., *gradually* came on, until now he has lost twenty-six pounds, has evidences of cavities, and all the signs of advanced phthisis. The patient states his parents and grandparents were free from consumption; but one brother has had a cough for six years.

These and similar examples seem to warrant the belief that *copious* hemorrhage may occur anterior to the deposit of tubercles, as a precursory symptom, and one which is more or less speedily followed by the local affection, unless it be happily averted. But it is difficult to conceive that such copious hemorrhage could have proceeded from the very small deposits which must have existed at that time, if indeed any were present; for it will be observed that in one case the most careful and repeated examinations could detect no tubercles, while in the other many years elapsed before the pulmonary affection became developed; hence it is fair to infer that either none or very small deposits were present. If this be admitted, we must also conclude that the hemorrhage arose from some other cause than local deposits.

2. *Physical Signs.*—Under the head of physical signs, the question will at once be forced upon us, Can this precursory stage, in which tubercular deposits have not taken place, give rise to phenomena disclosed by auscultation, percussion, and inspection? I answer, most unequivocally, in the affirmative, and that these signs, although less marked, are equally characteristic with those which supervene upon the advent of tubercular deposits in the lungs. The physical signs are revealed by inspection, percussion, and auscultation, and those means which measure the movements and vital capacity of the chest. Let us examine these separately.

Inspection.—Examination of the movements of the chest reveals important modifications of the physiological state, although the phenomena are widely different from those witnessed after the deposit of tubercles. The condition of the chest in this stage appears to be one of debility of the moving powers of the parietes, and, as a consequence, the movements are restricted and dilatation becomes comparatively incomplete; hence inspection, during tranquil respiration, reveals limited expansion, *extending equally to both sides.* The distinctions between this condition and those which occur in tubercular deposits are very marked and characteristic, and can leave no doubt as to the state of the parts. Thus, the diminished movements of the precursory stage are equal on the two sides, and exhibit merely *restricted action* and not *change of character;* the expansion being sufficiently uniform, although restricted. In ordinary tranquil respiration in this stage the expansion is comparatively small, and the movement proportionally less at the apex than the base; but a full inspiration restores, almost perfectly, the harmony of movement, the dilatation taking place gradually from below upward, the ribs swelling outward, as in the physiological state. Forcible inspiration, therefore, restores the diminished expansion; and herein consists the especial difference between the movements in this state and those which occur after tubercles have been deposited. In the latter condition, the expansion of the apex can not be restored even by forcible inspiration, nor is the action of that physiological type which exhibits a gradual swelling from below upward. Another distinction is derived from the expansion being equal on the two sides before deposits take place, but necessarily unequal where one apex alone is involved in tubercular disease. Finally, inspection reveals diminished expansion during tranquil respiration, but which may be nearly completely restored by forcible inspiration, those movements falling but little below the natural standard, and at the same time exhibiting the physiological type of expansion.

Percussion.—The evidences of morbid action afforded by percussion, although necessarily less distinct than in the stage of consolidation, are sufficiently well marked to lead to important

results. In consequence of the diminished mobility of the thorax, and its contracted state, the sound elicited by percussion is less clear than pertains to a perfectly physiological type. This diminished resonance extends over a large surface; and, although its most marked condition is the superior part of the chest, it has a greater extension than could be anticipated if it proceeded from tubercular deposits. In addition to these characteristics, it will be observed that the dullness is equal on the two sides, instead of being developed exclusively at one apex, as usually occurs in the tubercular deposits. In these examples the parietes of the chest seem more rigid and unyielding than in other conditions; and although the percussion sound is not positively dull, as when a solid substance is interposed, there is, nevertheless, an appreciable diminution of natural resonance.

But a still more important distinction consists in the fact, that a forcible inspiration will so far restore the dimensions of the chest, that dullness is either absolutely removed or reduced to so low a degree as to render it inappreciable.

Finally, we may enumerate the following points as characteristic of dullness in the precursory stage: Dullness slight and diffused; equal on both sides; never flat, and removed by forcible inspiration; parietes more or less rigid and resisting.

Auscultation.—The phenomena revealed by auscultation are not less important than those previously enumerated. There are two special characters developed in this state, namely, weak respiratory murmur, and *jerking* inspiration. The limited thoracic movements weaken the tone of the respiratory murmur, which can be fully developed only by a forced inspiration. This weakness extends to every part of the chest, which exhibits a strong contrast to the *partial* changes which occur in local disease.

Jerking or interrupted respiration is one of the most constant signs. It is, however, more *diffused* and less distinctly marked than in tubercular deposits. Doubtless, it arises from weakened and irregular parietal movement, instead of parenchymatous obstruction. Its equal and extensive diffusion, together with a less complete development, will serve to draw a distinction

between this sign as indicative of the precursory stage, and its more marked conditions in tubercular deposits.

It will be remarked, therefore, that, according to this explanation, weak or wavy respiratory murmur does not necessarily indicate the presence of tubercles. But the debilitated state of the respiratory muscles will be found a sufficient cause of these signs, inducing in some cases simply feebleness of the murmur, while in others, the unequal expansion gives rise to wavy, jerking, or interrupted sound; or the two signs may coexist.

Finally, my observation has taught me to believe that the precursory stage of phthisis may be readily recognized; that it has well-marked constitutional symptoms, and clearly defined physical signs. The constitutional symptoms embrace loss of weight, irregular chills, febricula, variable appetite; while the local signs include faucial and laryngeal derangements, cough, hæmoptysis, diminished expansion of the chest, weak and jerking respiratory murmur. These symptoms, occurring in a constitution predisposed to phthisis, can admit of little doubt or misconstruction.

SECTION II.

PHENOMENA OF THE STAGE OF TUBERCULAR DEPOSITS.

When tuberculosis has so far advanced as to induce deposits in the lungs, most of the symptoms and signs peculiar to the precursory stage acquire increased force, while some new ones become developed, characteristic of the local disease.

I. CONSTITUTIONAL SYMPTOMS.

Those general or constitutional symptoms, embracing emaciation, chills, and fever, become particularly prominent during the period of tubercular deposits, and usually advance, *pari passu*, with the local disease.

Loss of Weight.—Emaciation, and a corresponding loss of weight and strength, may be regarded as the most significant

of all the general symptoms. Indeed, so unerring is this condition, when not depending on appreciable causes, that it may, with almost infallible certainty, be regarded as indicative of the tuberculous state. Of course, the usual concomitant symptoms, such as cough, deranged respiration, circulation, and innervation, more or less developed, will be observed. It is important to remark, however, that there are varying degrees of emaciation, corresponding not only to the stage and extent of the deposits, but modified also by constitutional peculiarities; and hence, some examples exhibit a rapid and extensive decline in weight, while others evince but little departure from the normal condition. Two cases have recently been presented to me, illustrating the last remark. In one of these, a patient whose normal weight was one hundred and sixty pounds, lost thirty pounds within a period of three months; while in the other case, a lapse of eleven months had not reduced the weight five pounds. And, contrary to what might *à priori* be assumed, the emaciation is not always proportional to the extent of the local deposits, for instances occur in which considerable cavities exist with but trifling loss of weight, while in other cases a greater change is observed even before local disease occurs.

The peculiarities of constitution which most favor rapid emaciation are met with in the lymphatic temperament, and where the deposit of fat exists in considerable abundance. In the first class of cases the small power of resistance readily leads to rapid diminution of weight; while in the second variety the absorption of the adipose substance gives a greater loss from an equal degree of derangement. Another consideration, explanatory of the emaciation, is connected with the function of digestion; thus, if the appetite is diminished, or primary digestion becomes impaired, the loss of weight is proportionally rapid, without reference to the extent of local deposits. But, independent of all these conditions, there is a peculiarity of constitution in which the assimilative equilibrium is readily disturbed, so that absorption becomes the predominant state, and loss of weight is the necessary result.

It is mentioned by Dr. Walshe that this loss of weight observes irregular fluctuations, rising and falling at uncertain

intervals without evident variation of appetite or other appreciable cause; and Dr. Robert Williams believed these changes were regulated by a law of periodicity, but did not fix any given time.

The general law governing the loss of weight indicates that a slow and gradual diminution occurs more frequently than a sudden and rapid change; indeed, the latter condition must usually represent some acute affection, which at once disturbs the function of nutrition. But there are some examples in which the loss is quite sudden and rapid; for example, a patient in three months lost thirty pounds, which was very different from that slow and progressive change which marks ordinary cases of chronic phthisis. The rule, therefore, is, that in chronic tuberculosis the loss of weight is very gradual but regularly progressive, in a majority of cases, unless interrupted by adventitious causes; while in the acute forms of the disease an equal diminution may occur within a comparatively brief period. Thus a month will produce, in the acute form, a diminution of weight equal to what would occur in the chronic variety in a whole year.

According to the observations of Dr. Hutchinson,* the physiological weight is regulated, to some extent, by the hight of the individual; and although the rule is certainly far from being absolute, yet in persons of regular conformation, and not excessively corpulent, it may possess some value in diagnosis. The following table exhibits the relationship between the hight and weight, according to Dr. Hutchinson's observations:

OBSERVATIONS ON 2650 MALES AT THE MIDDLE PERIOD OF LIFE.

		MEAN WEIGHT.				WEIGHT INCREASED BY SEVEN PER CENT.†			
Feet.	Inches.	Stone.	lbs.		lbs.	Stone.	lbs.		lbs.
5	1	8	8	or	120	9	2	or	128
5	2	9	0	"	126	9	9	"	135
5	3	9	7	"	133	10	2	"	142

* Medico-Chirurgical Transactions.

† "*Weight increased by seven per cent.*" signifies that *excess* of weight diminishes the breathing capacity, but not until it reaches seven per cent. above the mean weight.

		MEAN WEIGHT.				WEIGHT INCREASED BY SEVEN PER CENT.			
Feet.	Inches.	Stone.	lbs.		lbs.	Stone.	lbs.		lbs.
5	4	9	13	or	139	10	9	or	149
5	5	10	2	"	142	10	12	"	152
5	6	10	5	"	145	11	1	"	155
5	7	10	8	"	148	11	4	"	158
5	8	11	1	"	155	11	12	"	166
5	9	11	8	"	162	12	5	"	173
5	10	12	1	"	169	12	13	"	181
5	11	12	6	"	174	13	4	"	186
6	0	12	10	"	178	13	8	"	190

It is scarcely possible to make a rule so mechanical as the above applicable to the varying states of the human organization, and especially in the early stages of phthisis, when the changes are often so very slight; but in the absence of more positive data, it may be well to avail ourselves of every means which comes within the range of probability, or which is capable, even with considerable variations, of general application. In summing up the subject, Mr. Hutchinson states a more general rule, which is of easy application, and may be made available when the weight of the patient has not been previously ascertained. In 2976 healthy males he found the *average* weight to be one hundred and fifty-five pounds; while in seven hundred and ten cases of tubercular disease it was reduced to one hundred and eleven pounds in males, and one hundred and four in females. These facts, however, are more important in their general than special application, for while they clearly indicate the progressive diminution of weight in tuberculosis, each case, nevertheless, must rest on its own peculiarities.

It is a question how far emaciation is a *constant* attendant upon early phthisis, or, indeed, whether *embonpoint* may not be preserved up to a period when the disease has made some progress. According to the observations of Louis, only one-half of the cases exhibited emaciation from the beginning. Fournet found ten subjects in one hundred and ninety-two maintaining their fat. Lehmann observes that in some cases emaciation does not occur even when extensive disease is present; and Walshe has known plumpness maintained with feeble appetite and occasional diarrhœa. And to this testimony I may

add my own in favor of such occasional exceptional instances. An instance has occurred to me recently, the patient being destroyed with pneumonia, in which the subcutaneous fat was abundant, and also that around the heart and kidneys. Tubercles in the lungs existed to a considerable extent, several masses being softened. Still, all such cases must be regarded as exceptional, for it is clearly established that tuberculosis, as a general rule, is associated with emaciation, beginning at an early period, and steadily progressing as the disease advances.

The tissue first invaded by tuberculous emaciation is the adipose, which may be almost entirely removed; the areolar tissue, membranes, skin and mucus, vascular tunics, voluntary and involuntary muscles, and even the bones, all suffer as the disease advances, until the emaciation becomes extreme and almost universal. It appears, however, from the observations of Dr. Clendenning that the viscera are comparatively exempt from atrophy; hence the liver, spleen, pancreas, and kidneys maintain their ordinary size and weight. The heart, however, is an exception to this rule; for, notwithstanding the statement of Dr. Boyd that this organ is slightly *increased*, I have so constantly found it attenuated, weak, and flabby, as to indicate, beyond doubt, a marked degree of atrophy. I do not mean to express a doubt, however, that even *hypertrophy* of the right ventricle may occur, for such a state has been observed. But it has not occurred to me to witness this change as frequently as some have seen it.

According to Dr. Boyd, the aggregate weight of the viscera was increased above Dr. Clendenning's physiological standard 25.71 ounces in males, and 14.48 ounces in females.* These statements, however, must be received with great caution, for although the viscera do not emaciate to any obvious extent, still there is but little reason to conclude that there is much if any increase of volume, except in the examples of fatty deposits in the liver and kidneys. The only method, indeed, by which the weight of the viscera can become augmented is by adventitious deposits; and as these do not occur constantly, no

* Ed. Med. and Surg. Journal, vol. lxi, p. 288.

reliance can be placed on the opinion that the organs become, in any degree, hypertrophied.

It should be remarked, also, that the progressive diminution of the fluids of the body, no less than the loss of structures, is one of the means by which the weight is diminished. Indeed, in many examples this loss of fluids must be the condition immediately connected with diminished weight, and which, therefore, may be considered the starting point.

Finally, emaciation is so nearly a constant attendant upon the early periods of phthisis that it becomes an important and significant symptom, which should always be carefully observed by the practitioner, and its progress duly noted. For this purpose it becomes necessary to weigh patients, in the most accurate manner, at least once a week, and thus be able to determine the fluctuations which occur.

Chills and Febricula.—The occurrence of chills and fever during the stage of tubercular deposits is quite variable, depending much on the constitutional peculiarities of the patient, and the circumstances by which he is surrounded. In most cases chills followed by fever are observed to occur at irregular intervals, and in varying degrees of intensity, depending greatly on the delicacy of constitution and exposure to which the patient may be subjected. According to Louis, rigors were absent in one-sixth of the cases; but a degree of coldness, short of rigors, is probably more frequently observed, being in fact nearly universal. Louis's observations, however, apply to the *whole course* of phthisis, so that they do not fully represent the different stages, as indicated in this treatise. As a rule, the calorific power is naturally low or becomes greatly reduced, so that even moderate exposure to a cold or damp atmosphere is liable to result in the production of a chill and the consequent fever. The febrile paroxysm, however, is not, in general, very completely marked; the chill is slight, the reaction moderate, and the sweating stage either absent or only slightly developed. But in some cases all the phenomena are distinctly marked, and the paroxysms become complete in each stage, although their recurrence may not be governed by well-defined periodicity. And it may be here remarked, that the occurrence of

occasional chills, or chilly sensations, with coexisting insidious emaciation, constitutes a combination of signs too surely indicative of beginning tuberculosis. I have but seldom observed strict periodicity in the return of these chills, but, on the contrary, they seem to result from fortuitous causes, and, therefore, become the more significant. The chills and fever which occur in this stage do not proceed from inflammation; on the contrary the condition arises from diminished vitality, consequent upon constitutional derangement; and hence the febrile phenomena, when uninfluenced by malaria, are altogether irregular, and seldom assume any considerable degree of intensity.

Pulse.—The pulse, in the stage of consolidation, becomes quickened, ranging from eighty to one hundred, loses its natural tone, and often presents the condition recognized as *irritable.* It must be understood, however, that cases frequently occur in which the pulse is but slightly modified, and, therefore, presents no characteristic or important change. In relation to the pulse, however, the stage and extent of the disease must necessarily be considered, for as the morbid action advances, and particularly when near the stage of softening, the circulation becomes much more frequent. I have observed, also, that mental excitement or physical exercise hurries the circulation, even more than in ordinary cases of debility, so that perfect tranquillity of body and mind becomes essential to a proper appreciation of the state of the circulation. The rhythm of the pulse is seldom intermittent or even unequal, its only variation from health consisting in diminished force and increased frequency. These changes are usually more marked in females, probably owing to their greater nervous and vascular irritability.

II. LOCAL SYMPTOMS.

Cough and Sputa.—The character and degree of cough in this stage of tubercular disease are quite variable. Usually in the beginning it is slight, gradually becoming more severe as the disease advances; but, it is doubtless a possible condition that tubercles may exist in the lungs, at least for a time, without exciting more than occasional irritation, and certainly

without giving rise to a regular or fixed cough. As a means of diagnosis, therefore, cough, independent of other symptoms and signs, can not take a very important position; for in the most incipient stage of the disease, the sign in question is often too trivial and variable to be made the basis of diagnosis, and can scarcely be regarded as more than an incidental symptom.

It is important, however, to distinguish between a fixed and an occasional cough; the former denotes some permanent lesion, while the latter *may* arise from transient causes. If, therefore, a patient acquires a persistent cough, however mild it may be, it should always be regarded as evidence of some serious lesion, demanding careful examination.

The usual course of tubercular cough is to manifest at first a mild character, subject, however, to exacerbations under various influences, and, as the disease advances, to become more constant, severe, and even paroxysmal. Cases occur in which the most violent paroxysms are manifested during this stage of consolidation; and others in which a mild cough, upon the application of an irritant, readily passes into one of severity.

The degree of cough varies not only with the extent of deposit in the pulmonary tissue, but also with the state of the fauces, larynx, and mucous lining of the air-passages generally. In those examples complicated with early mucous irritation, the cough is proportionally severe, and is, therefore, disproportioned to the extent of pulmonary disease. The implication of the bronchial tubes, the larynx, trachea, or even the fauces, modifies in a very marked manner, the character and violence of the cough, and all these elements must be taken into the account. In addition to this, there is, in some examples, a *nervous* condition greatly aggravating the cough; it is often associated with spinal irritation, which may be readily detected by pressure on the vertebral column. These cases are highly important in diagnosis. I have often met with examples, especially in young females, in which a *hacking*, persistent cough was present, with wandering pains about the chest, and increased frequency of the respiratory movements; and yet, upon the most careful exploration of the chest, tubercles could not be detected. But in other cases, nearly similar nervous symptoms exist, and which

are associated with tubercles. In these examples, while the cough is largely nervous, it is, at the same time, tubercular. Hence, a due consideration of this nervous cough is of the highest importance in diagnosis.

The *sputum* of this stage is at first inconsiderable, consisting at most of a little transparent mucus; the cough, however, is often *dry*. When laryngeal irritation exists, the sputum will be more abundant, but not considerable; small grayish masses are at times raised, possessing more or less firmness, or the mucus may present a gelatinous appearance, not unlike a solution of gum arabic. At times the sputum becomes much more copious and frothy, indicating some degree of mucous congestion. All these phenomena are modified by the presence or absence of mucous irritation, such as pertains to the fauces, larynx, or bronchial tubes.

Occasionally the sputa become tinged with blood, evincing more or less *hæmoptysis*, or the hemorrhage may be even profuse. It has appeared to me that the discharge of blood was more common at about the third month after tubercular deposits had taken place; but there must necessarily be much conjecture in such a conclusion. The frequency of hæmoptysis in phthisis is variable, but may be stated at from seventy-five to eighty per cent. Dr. Walshe gives the proportion at eighty-one per cent., while in one hundred cases observed by myself, the number reached seventy-four.

The semeiological value of hæmoptysis is very great. I am fully persuaded that pulmonary hemorrhage, in a vast majority of cases, is the result of tubercular deposits; and when no evident cause can be assigned for the discharge of blood, the symptom should be regarded in a most serious light.

Pain.—The deposition of tubercular matter in the pulmonary tissues is, in its incipient stages, a painless process; indeed, even in extreme cases, patients seldom complain of any acute sensations, so long as the morbid action is limited to the air-cells, or the pulmonary parenchyma. Acute pains, therefore, always indicate either intercurrent pleurisy or neuralgia; but a minor degree of uneasy sensations, increasing at times to actual pain, is almost universal, especially in the advanced stage. The

more common location, however, of the morbid sensations, is the shoulders, or extending from the anterior and superior portion of the chest to the scapula. The feeling is usually described as mere uneasiness, seldom amounting to actual pain; but it is evident that patients frequently mistake a sense of *tightness*, or difficult expansion, for pain, and it requires some degree of care, in many cases, to elicit the actual facts.

The general character and aspect of the pain or uneasiness, especially about the shoulders, is precisely that of rheumatism of a slight character; and it has appeared to me not improbable that very often the cause of the morbid sensations was nearly allied to the rheumatic diathesis; and many persons, indeed, ascribe these wandering and obscure pains to that condition. But while this may be true in certain cases, there are others in which the pain of the shoulders is a reflected sensation, originating in the pulmonary disease. It is to be remarked, that the true tubercular pain of the chest is not increased by a full inspiration; nor is tenderness manifested under pressure or percussion, except some adventitious action is taking place, such as pleuritic inflammation, or an extension of morbid excitability to the muscles. These conditions, however, belong to a more advanced stage.

The practical inferences which we deduce from the character of pain in tubercular affections, is, that any considerable degree of acuteness indicates inflammatory action or neuralgia; and that the morbid sensation characteristic of tubercular deposits, is rather a sense of uneasiness than acute pain.

Digestive Function.—Primary digestion is far less impaired in this stage of tubercular disease than is usually indicated by writers. Most of the systematic writers mention indigestion as one of the early signs indicative of phthisis, and hence has arisen the term "strumous dyspepsia;" but while I admit the occasional or even frequent derangement of primary digestion as a symptom of tubercular disease, it is far less common, in ordinary cases, than is generally supposed. The misconceptions on this subject arise from blending the different stages of the disease and conditions of patients in the same general description, so that what properly belongs to an advanced stage,

or to the mere diathesis, is made to apply to the whole course and every variety of constitution.

There are two special conditions in which the digestive functions become more or less modified: 1. In the strongly-marked tuberculous diathesis; 2. In an advanced stage of the disease, after softening has occurred. In the early (precursory) stage the appetite is often variable, but seldom accompanied by positive indigestion, as previously explained; while in the more advanced condition (stage of softening) primary assimilation, in common with other functions, becomes greatly impaired, which will be mentioned under the appropriate head. At an early period of the stage of mere consolidation, I have not found, as a general rule, either greatly-impaired appetite or deranged digestion; and although this function, like most others of the system, can be scarcely ever found in a strictly normal condition, its departure from health is often trivial, never characteristic, and much less constant than is generally believed by our profession. I have often observed patients, throughout the whole of this stage, maintaining a good appetite and digestion, showing evidences of derangement only when adventitious circumstances were brought into action, such as the supervention of chills, and even then no more than would arise from the same amount of chills and fever in persons free from phthisis.

There is nothing notable in the condition of the bowels. I have usually found the alvine evacuations regular and natural, becoming deranged only under accidental circumstances, or when indigestion existed.

It will be perceived, from the preceding statements, that I attach much less importance to the symptomatology of the digestive function than most writers; but, at the same time, it must not be understood that this function is unimportant in reference to tuberculosis, for its derangements possess a much greater degree of interest in their therapeutical than diagnostic relations, and, therefore, demand careful attention. I mean only to be understood as discarding the prevailing opinion that "strumous dyspepsia" is a common antecedent of phthisis, or that it is at all pathognomonic in that relation.

In certain exceptional cases, however, digestion becomes early

and persistently impaired; but the exact pathological condition is exceedingly variable. There is, in fact, no characteristic derangement of the digestive organs or function in phthisis, and hence whatever deviation from health occurs must be regarded as accidental. It is true, indeed, that, as the general and local disease advances, there will be observed a gradual lowering of the vital powers, in which all the functions more or less participate; but the digestive acts are usually maintained equal if not superior to the co-ordinate functions, and hence there is no special derangement.

In some examples, however, there is early and persistent gastric derangement. An almost total anorexia will characterize some cases, while others will be marked by great irritability of the stomach, and others by deranged biliary and other secretions. When merely anorexia is present, the tongue will exhibit a slight and often broken coat, whitish, and very delicate. When irritability is manifested the tongue is more or less red, and often with elevated papillæ. But when the secretions become prominently deranged the tongue is coated more or less heavily, and there is corresponding loss of appetite. The bowels occasionally become torpid, though they are usually regular. The urinary secretion is at times feverish.

In a certain proportion of cases, and particularly in the bilious temperament, the hepatic function becomes early and prominently deranged. This derangement is manifested by impaired appetite and digestion, coating of the tongue, torpid bowels, and often more or less uneasiness in the right hypochondriac and scapular regions. The skin is generally sallow, and the urinary secretion scanty and highly colored. Emaciation does not progress as rapidly in this as other forms of the disease.

III. PHYSICAL SIGNS.

We now approach the most important considerations in connection with the stage of consolidation, namely, the *physical signs* indicating the presence of tubercles; and it is essential to a correct diagnosis that this portion of the subject be fully comprehended. The physical signs of tubercular deposits are

embraced under the general heads of inspection, percussion, palpation, vocal vibration, and auscultation; and the application of these means of diagnosis, in a combined form, is indispensable in all cases; for however pointed the general or vital symptoms may appear to be, the physical signs are required to render the conclusions certain and reliable.

Inspection.—My observations accord with those who discard the idea of malformation of the chest, or even a slight deviation from the true symmetrical state, as being in any way connected with the deposit of tubercles; and where deviations from what would be regarded as the *ideal* of a true physical conformation have been observed, they are to be regarded as a result, and not the cause of the pulmonary disease. It has occurred to me so frequently to witness phthisis in those possessing the best formed chests, and who had been placed under the most favorable circumstances, and, conversely, to have observed the most contracted and ill-formed to entirely escape, that I have ceased to attach the slightest importance to the natural contour of the thorax. It is important, however, to distinguish between these natural imperfections and those changes which supervene upon morbid action; for while one is simply a physiological state, the other becomes the representative of a pathological condition.

It may be stated, as a leading proposition, that the movements of the chest become restricted in freedom, and altered in character, in proportion to the quantity and extent of the tubercular deposits; hence, the changes in expansion will vary from an almost inappreciable degree to a state of comparative immobility. In an early stage, and when the matter deposited is small in quantity, it is evident that no appreciable diminution of the expansion-movement exists; in other words, there is a conceivable state in which the local obstruction is so small that it does not interfere with the expansion of the lungs to an extent appreciable to the eye or instruments. It is a question, however, to what extent deposits may proceed without notably diminishing the expansion of the chest, and if not diminished, what causes prevent that result. It has been supposed, first, that the expansion of the healthy side becomes

equally impaired, or, secondly, that enlargement of the air-cells adjacent to the deposits compensates for the condensing influence of the tubercles. The compensating action, however, of co-existing emphysema could not account for the result, because that condition itself limits parietal movements; and while it might prevent flattening of the part, or possibly produce even some degree of bulging, it would clearly be impossible that it should favor the expansion-movements. But there can be little doubt that the unaffected side may partake, to some extent, of the limitation of movements, due mainly, if not exclusively, to the general loss of muscular action and breathing force, as previously explained in connection with the precursory stage. There is, in fact, a tendency in all these cases to a restriction of thoracic movements independent of mechanical obstruction, and it is certainly true that the unaffected side partakes, at least to some extent, of the same condition; but it is evident that the presence of any considerable quantity of tubercles must, at an early period, render the difference in the movements of the sound and diseased sides sufficiently obvious. Hence, by comparison, and especially after a full inspiration, the expansion-movement of the diseased lung will be found diminished, and proportionally replaced by elevation-movement.

Semeiological Value.—The value of diminished expansion during tranquil respiration, as a diagnostic sign, is, *per se*, insignificant; but when it coexists with dullness on percussion, corresponding flattening, and other signs appropriate to this stage, it assumes a higher value, and should always be carefully observed. In applying this sign to the early stage of tubercular deposits, the possible pleuritic adhesions are excluded; but when this condition exists, there will be still greater limitation of movements.

A modification of contour—*depression* or *bulging*—takes place at some period during the existence of tubercular deposits. In the earliest stage, no appreciable change can be detected; there is neither bulging nor depression, as exhibited to the eye or by the aid of mensuration; but, as the disease advances, clavicular depression, more or less marked, occurs in a majority of cases. This depression arises from obliteration of air-cells, or the

contraction of exudation-matter, either within the pulmonary parenchyma, or in the form of false membrane arising from circumscribed pleurisy. Depression, however, is not so constant at an early period as many suppose, but belongs, as a characteristic sign, rather to the stage of softening; but it often occurs at the middle stage of consolidation, and is occasionally witnessed quite early, although its frequency necessarily increases, *cæteris paribus*, in proportion to the advanced stage of the disease. Its occurrence, however, will be modified by accidental circumstances, such as the coexistence and contraction of exudation-matter, and the more or less extensive obliteration of bronchial tubes and air-cells. Or, depression may be entirely prevented by coexistent emphysema.

Semeiological Value.—Depression, like deficient expansion, taken singly and alone, indicates nothing positive in regard to the cause by which it is produced; but when explained by diminished expansion, dullness on percussion, and other signs, its significance is very marked and important. Thus, previous pleurisy would be capable of producing depression; but when the history shows that the progress of the case has been unattended with acute disease, the conclusion is strongly in favor of its tubercular origin.

As to infra-clavicular *bulging*, there is every probability that it seldom arises from distention caused by the deposits; on the contrary, when such a sign exists, it is to be usually ascribed to coexisting emphysema. I have witnessed, recently, one well-marked case of infra-clavicular bulging. A patient with well-developed tuberculosis, which had reached the stage of softening, exhibited considerable bulging some distance below the clavicle, or at the upper portion of the mammary region. The extent of bulging was ascertained by the callipers, and was found to be half an inch. It did not arise from emphysema, for the part was perfectly dull on percussion. The most careful examination left no room to doubt that the prominence was due to extensive tubercular deposits. It is, however, an exceedingly rare condition.

Percussion.—The results of *percussion* in tubercular deposits are not as uniform and definite as we might, *à priori*, suppose.

Theoretically, the deposition of tubercular matter in the substance of the lungs displaces a certain amount of air, and to the same extent reduces the pulmonary tone when percussion is made over the part; but while this is true, in the main, there are many conditions which disturb the general rule, and hence it must not be received in an absolute sense.

Under ordinary circumstances, percussion over tubercular deposits yields a sound more or less dull, varying with the quantity and compactness of the morbid substance. The tone necessarily varies from the slightest appreciable reduction below the normal condition, to almost complete flatness. The points where the dullness will usually become first manifest, are the regions corresponding to the apices of the lungs, anterior and posterior; and hence the clavicular and scapular regions are those where dullness will be first detected. As a general rule, the inner part of the clavicular region (including the spaces just above and below the bone) are the points where dullness will be first manifested. It was held by Laennec that the supra-clavicular space did not possess sufficient elasticity to be of value in percussion; but diagnosticians of the present day entertain a different opinion, and, indeed, attach great importance to this region as one of the first where dullness becomes manifest. A single finger, with the palmar aspect applied to the region, may be used as a pleximeter, when, with gentle percussion, consolidation of the apex of the lung beneath can be readily detected. In percussing the inner portion of the clavicular region, it is important to remember that the proximity of the trachea may impart an unnatural degree of clearness, unless the force of the blow be directed *from* instead of *to* that organ. The supra-scapular region, also, requires to be carefully examined in the early stage of tubercular deposits, for, in a certain proportion of cases, the disease is manifested first at this point.

In making percussion, various methods and precautions deserve attention, but as these may be readily obtained from systematic writers, I shall mention only a few of the more important. As a general rule, the fingers are preferable as the instruments for percussion, particularly where delicacy of manipulation is desirable. It is not usually necessary to

strike with much force; on the contrary, a very gentle blow, with one or two fingers, will be quite sufficient to give an accurate idea of the condition of the part beneath. In some cases, however, where tubercles are deep-seated, a more forcible blow is required; and if the deposits be scattered through a considerable extent of pulmonary tissue, it is requisite to percuss on a broad surface, for which purpose several fingers may be employed.

The degree of resiliency or elasticity of the parietes of the chest should be duly noted while making percussion, and the ability to do this while the hand is applied, renders this mode of percussion ordinarily preferable. The diminution of elasticity is proportioned to the extent of the tubercular deposits, and hence observations on the degrees of resiliency and dullness may be made simultaneously. Instead of the fingers, we sometimes employ the hammer for percussion, using, at the same time, an ivory pleximeter, or the finger may still be applied. Where a forcible blow is required, the hammer is often useful; and also in hospital practice, where many cases have to be examined, it may be used to relieve the fingers from injury. Again, some persons, especially beginners, will use the hammer with greater facility and dexterity than the finger, and hence, to such it becomes a useful instrument.

It must be particularly remembered that the results of percussion can be made definite and satisfactory only by comparison; that is, the sound side must be compared with that which is diseased. In a perfectly natural condition, the sounds of the two sides are so nearly similar, that we may, for all practical purposes, consider them identical. Hence, it is the disparity in the resonance of the two sides which becomes instructive to the diagnostician. Another important precaution is to make comparative percussion at the close of a full inspiration, by which it will be shown that the resonance of the diseased side increases much less than the sound portion. The erect position, *cæteris paribus*, is the best posture for making percussion.

But the diagnostician must not overlook certain modifying conditions in reference to percussion; for while it is true, as a general law, that tubercular deposits cause an appreciable dim-

inution of pulmonary resonance, there are incidental states of the parts which may render the results nugatory or delusive. In the first place, it must be remembered that, in many examples, the right infra-clavicular region yields a less sonorous sound than the left; and this is especially true of persons who exercise very actively the right hand, by which the pectoralis muscle enlarges. In all such cases, however, the diminution of resonance is very slight, and is not associated with the co-ordinate signs of tubercle. This fact, however, renders dullness of the left clavicular region peculiarly significant.

Another important modifying condition will be observed, in the muscular contraction of the chest incident to the precursory stage. Thus, if the forming stage of tuberculosis has been protracted, the muscles contract, and, consequently, diminish the pulmonary resonance on percussion. Hence, a comparatively small tubercular deposit will give rise to a degree of dullness, disproportioned to the extent of consolidation.

The additional causes of non-tubercular dullness are old pleuritic adhesions, pneumonic exudation, tumors, and pulmonary atalectasis resulting from obliteration of bronchial tubes.

But dullness may be entirely prevented by the presence of emphysema, and, also, by tympanitic distention of the stomach. Dr. Flint mentions the latter condition as modifying the results of percussion, especially at the left apex, and I have made similar observations. Certain conditions, also, such as extensive tubercular consolidation intervening between bronchial tubes and the costal pleura, or dilatation of tubes, may induce a *tubular* sound, more or less obscuring the ordinary results of percussion. I am satisfied, also, that well-marked *cracked-pot* sound may be induced under similar circumstances.

We conclude, therefore, that with these precautions and reservations, percussion becomes a valuable aid in the diagnosis of tubercular deposits.

Auscultation.—The modifications of respiration indicative of pulmonary tubercles are quite numerous and variable. Thus, the respiratory sound may be weak, exaggerated, harsh, bronchial, or perverted in rhythm, the latter manifested by jerking and prolonged expiration. In addition to these conditions, cer-

tain adventitious sounds are heard, such as dry crackling, sibilus, crumpling, cogged-wheel; to which I have ventured to add, *tubercular crepitus*. These signs may be described under the following heads: 1. *Alterations in tone*: weak, exaggerated; 2. *Alterations in character:* harsh, bronchial, and blowing; 3. *Alterations in rhythm:* jerking or wavy, prolonged expiration; 4. *Adventitious sounds:* dry crackling, sibilus, cogged-wheel, crumpling, tubercular crepitus.

These various signs of tubercular deposits are first developed at the infra-clavicular and supra-scapular regions; and when limited to the apices of the lungs, are far more significant of tubercle than when diffused, or located at other points.

I. ALTERATIONS IN THE TONE OF THE RESPIRATORY MURMUR.

This division embraces *feeble* and *exaggerated* respiration; conditions precisely opposite in character, but nevertheless often occurring conjointly. *Weak* or feeble respiration is met with as one of the very earliest auscultatory signs of phthisis, although it does not belong exclusively to the stage of tubercular deposit. The special character of the sound is, in general, that of simple feebleness, (although at times slightly harsh,) occupying a more or less extensive area, and its pathological signification varying almost exactly with its actual extent. It will be remembered that feeble respiration is met with in the *precursory* stage, in which it depends on diminished expansion of the chest; and as this stage is gradually merged into that of tubercular deposits, *feebleness* of the respiratory murmur belongs equally to both periods. Its relative development, however, in these stages, varies widely in different cases; in some examples the precursory stage is of long duration and marked intensity, while in others it is almost or wholly wanting. Thus, feeble respiration will become fully manifested, and occupy an extensive area, when the precursory stage has been of long standing or full development; while, on the contrary, it will be quite limited in extent, and often but partially developed, when arising alone from the mechanical obstruction offered by the tubercular deposits.

For these reasons, when the precursory stage has been fully developed, tubercular deposits will be accompanied, even when small, with very marked feebleness of the respiratory murmur, extending beyond the apex, and occupying a very great extent of pulmonary surface. But when the precursory stage has been slight or absent, then the feebleness will be nearly limited to the clavicular and scapular regions, immediately above and below the former bone, and extending to the second interspace. It is, of course, a more important sign when limited to the apex than when more diffused, for the latter may arise independent of tubercular disease. It is important to observe, also, that weak respiration is often found in juxta-position with the opposite condition, or that of exaggeration; thus, a tubercular mass obstructs respiration, and renders the sound feeble at the point of deposit, but if the stethoscope be removed to the margin of the consolidation, the sound may be even louder than natural. It is necessary, therefore, to observe carefully the varying degrees of intensity as the instrument is changed to different points on the surface.

Feebleness of respiration is often more manifest during inspiration than expiration; indeed, as a rule, the causes which induce a weakness, also, shorten the inspiratory act, and, at the same time, give rise to prolonged and intensified expiratory sound, so that the phenomenon of weak respiration is often associated with prolonged expiration.

Diagnostic Value.—The significance of feeble respiration depends greatly on its location and extent, as well as the concomitant signs. When limited to one apex, persistent in duration, and, above all, when associated with dullness on percussion, and accompanied by prolonged expiration, it may be regarded as certainly indicating the presence of tubercles. When existing independent of other signs, and diffuse in extent, no definite conclusions as to the existence of tubercles can be drawn from feeble respiration. Indeed, it is only by a careful analysis of all the existing signs and symptoms, that feebleness of inspiration becomes available in the diagnosis of phthisis.

Exaggerated Respiratory Sound.—This term is designed to represent a morbid sound, heard in connection with tubercular

deposits, analogous to puerile respiration, and, therefore signifies merely *intensified* normal vesicular murmur. It appears to me, however, that there is a very obvious error in the application of this term, and that, in fact, the sound designed to be represented, is altogether different from, and something more than simple exaggeration of the normal murmur. The true exaggerated respiratory sound (known, also, by the synonyms puerile, supplementary, hyper-vesicular) is heard in a perfectly healthy lung, the opposite one having become the seat of *obstruction*, and the sound is simply intensified normal respiration, preserving its soft and breezy character, together with the relative duration and tone of inspiration and expiration. But systematic writers have designated a murmur exaggerated which occurs in connection with local deposits, being produced by currents of air passing around the point of obstruction; thus, the central part of the obstructed portion may exhibit feebleness of sound, while the marginal regions give rise to exaggerated murmur. A little attention, however, to the phenomena will enable us to perceive that the marginal murmur is something more than simply *intensified* respiration, and that it partakes of certain special characters, which are better expressed by the term *harsh* than exaggerated. In addition to this, it will be observed that expiration becomes prolonged and intensified, which is directly opposed to what occurs in true supplementary respiration.

In view of these facts, I conclude that exaggerated respiration does not arise from the part involved in tubercular deposits, and that the sound heard is, in fact, *harsh* respiration; but true exaggerated murmur is met with in the unaffected lung, and may thus be made available in diagnosis, by observing the increase in the side which remains free from deposits.

Semeiological Value.—Exaggerated or puerile respiration has a comparatively limited signification in diagnosis, and becomes valuable chiefly by enabling the auscultator to contrast the healthy with the diseased side, and thus the more readily to detect *feeble* respiration. The value of exaggerated respiration, therefore, is rather negative than positive, its existence indicating a healthy lung instead of tubercular deposits.

II. ALTERATIONS IN CHARACTER.

This division embraces harsh, blowing, and bronchial respiration, alterations which arise from the same physical causes, and which insensibly pass into each other.

Harsh respiration is regarded as one of the early auscultatory signs of phthisis, but, nevertheless, it requires a considerable amount of deposits before that quality of respiration will be developed. If it depend, as all must admit, on physical changes, it is evident that scattered tubercles, in small numbers, may exist without producing harsh respiration; but in all cases where tuberculization gradually progresses, this quality of respiratory sound is ultimately developed. It conveys to the ear a sense of harshness and dryness, of variable intensity, at times barely perceptible, and again merging into actual blowing sound. It occupies the clavicular or scapular regions, gradually diminishing in intensity downward, and may be associated with feeble respiration. Thus, the expansive property of the lung being impaired, respiration becomes, in general, feeble; but simultaneously with this condition the deposit of tubercles occasions coexistent harshness; hence the two qualities may be met with in the same lung. But harshness may exist independent of feebleness, the result depending entirely on the degree of expansion; when the deposits are moderately numerous, and the power of dilatation not materially impaired, harshness, without feebleness, will be manifested. As the disease advances, and consolidation becomes more complete, harsh respiration gradually merges into diffused blowing, and, finally, moderately developed bronchial respiration. When nearly of the character known as diffused blowing, harshness takes on a peculiar sharpness and roughness of sound of a somewhat hissing character.

Harsh respiration, according to most observers, is characterized by prolonged expiration, and it is the expiratory sound that partakes first of the alteration, but which finally involves likewise the inspiratory murmur. This statement, however, requires material modification. A case at this time is under my charge, in which the rule referred to is not sustained. In this example

the right lung contains caverns, while in the left there is dry and moist crackling, and harsh respiration, which, on making a full inspiration, is readily merged into distinct blowing; and yet all the harshness and blowing occurs with inspiration, expiration maintaining its natural state.

There are certain examples, in which feebleness coexists, and in which harshness can be clearly perceptible only by a *forced* inspiration; and in such cases the expiratory sound does not become similarly affected, or if so, to a much more limited extent.

Semeiological Value.—The value of harsh respiration depends on the care with which all the signs are analyzed, for if such causes as dry bronchitis, thickening of the mucous membrane, or emphysema, can all be *excluded*, and moreover, if the limitation of the morbid sound is accurately defined by the clavicular region, then it is strongly characteristic of tubercular deposits. So constantly, however, are other signs associated with harshness, that we are seldom required to rely on that sound alone, and it is so evidently qualified by other signs that its interpretation can hardly be mistaken.

It is necessary to remark, however, that some degree of harshness is natural to the right apex, and, therefore, the sign is of less value at that point than the opposite; moreover, that in females, in consequence of the active dilatation of the upper portion of the chest, a degree of loudness, often approaching harshness, is usually witnessed.

Blowing and tubular sounds are merely exalted degrees of the preceding condition. Diffused blowing, as the term implies, occupies an extent of surface equal to the consolidation, and presents an exalted degree of harshness, partaking of a blowing character, but stopping short of an actual tubular sound. In the *tubular* form the consolidation is more complete, and the sound exhibits the characters of breathing through a tube, with more or less of the metallic element. This latter condition, however, when well-marked, is indicative of consolidation from coexisting pneumonic exudation.

Semeiological Value.—Blowing and tubular respiration indicate consolidation of the pulmonary tissue; and when located at the apices, and above all, when associated with the other

signs belonging to that period, is indicative of the presence and extent of tubercular consolidation.

Alterations in Rhythm.—The alterations which occur in the rhythm of the respiratory movements consist in increased frequency, jerking or wavy murmur, and prolonged expiration. The intrinsic value of these several conditions depends on so many qualifying circumstances that it is difficult to assign to either one that pre-eminence which is often claimed for them, and the subject, therefore, requires a cautious analysis in order to avoid serious errors.

Frequency.—The frequency of respiration, even in the early stage of consolidation, is often notably increased. Assuming the normal standard to be twenty to the minute, we will often find, even in an early stage of consolidation, an increase to twenty-four. It must not be supposed, however, that there is any evident degree of *dyspnœa;* on the contrary, the increase is so slight and gradual that it usually escapes the attention of the patient, and is to be detected only by accurately counting the movements. But even with this moderate increase, patients will often observe that upon active exercise, such as rapid walking or ascending a flight of stairs, they become short of breath with evident dyspnœa. Much will depend, however, on the degree of consolidation; there is, indeed, a conceivable state of local deposits in which no variation can be detected; while in the more advanced cases the slightest exercise produces very marked symptoms. But even in extreme cases, *tranquil* respiration is often normal in frequency, but becomes hurried and oppressed with physical exertion.

Jerking Respiration.—We come now to consider an important modification of the respiratory sound, which consists of interrupted inspiration, and, more rarely, expiration, denominated *jerking* or wavy, and which is regarded as evidence of tubercular deposits. I have fully satisfied myself by careful observations, made under the most favorable circumstances, that jerking inspiration may exist, independent of tubercular disease, or even a tuberculous tendency, and that, unaided by other signs, it can not be relied on as evidence of tubercles. The errors on this subject doubtless arise from a misconception of the causes

capable of producing interrupted or wavy inspiration; and, furthermore, its frequent association with phthisis has induced many to overlook its connection with other abnormal conditions, which largely qualify its diagnostic value.

Jerking or wavy inspiration is the result of incomplete parietal and vesicular expansion; and any condition, tubercular or otherwise, capable of impairing pulmonic and thoracic expansion, may occasion the phenomenon in question. Thus, quite opposite causes are capable of developing jerking inspiration, such as pleurisy, pleurodynia, asthma, various cardiac affections, nervous conditions, the precursory tubercular stage, and tubercular deposits; *and any causes inducing loss of nervous and muscular power of the chest,* and consequent incomplete and unequal expansion. It is, therefore, a condition which may exist wholly independent of tubercular deposits, or even a tuberculous tendency, and is not, *per se,* a sign of phthisis.

But the most constant and invariable relation of jerking inspiration is its development in connection with tubercles; and when other signs concur, such as dullness on percussion, it may safely be regarded one of the most constant alterations of the respiratory sound. It has occurred to me, however, repeatedly to observe that tubercular deposits, as determined by the most unequivocal signs, may exist without jerking respiration; that most of the other elements, such as crackling, harsh, and even blowing respiration, with diminished expansion and dullness on percussion, may be present, and yet this sign of jerking or interrupted respiration may be wholly wanting. Still, in a majority of cases of tubercular deposits, it *is* present. It is not, therefore, the frequent absence of interrupted respiration in phthisis which renders it an uncertain sign; but it is the fact that the same modification of sound is of equally frequent occurrence in conditions wholly free from tuberculous disease.

As ordinarily heard, jerking respiration occurs during inspiration, and is revealed by occasionally two, more frequently three, and rarely four, puffs or jerks, involving generally inspiration, but frequently conjointly expiration, and rarely expiration alone. I have met with a few well-marked examples in

which three distinct jerks occurred with *expiration*, inspiration remaining entirely free from any such phenomenon.

There is another important modification which deserves attention, namely, jerking respiration may be chiefly developed *on the sound side.* Thus, in a case at this moment under examination, the signs on the *left* side are characterized by dullness on percussion, feeble respiration, and dry crackling; the *right* side has no morbid sound except *jerking* respiration, which is manifested by two jerks during tranquil respiration, and *four* occurring upon a *forced* inspiration! Here is an example in which the dullness, feeble respiration, and dry crackling, clearly indicate tubercular disease of the left apex, *but without jerking respiration;* while the right side is free from dullness and crackling, but has a remarkable development of jerking respiration. It is evident, therefore, that jerking respiration does not indicate, in all cases, the *location* of the disease, but, on the contrary, that sign may be developed on the side least and probably not at all involved.

Semeiological Value.—Jerking respiration has no characteristic pathological signification, and, therefore, possesses no intrinsic semeiological value in tubercular disease. It may be developed in any case where incomplete expansion occurs; and hence, to become of any importance in tubercular disease other signs are required to denote the cause which produces it. Independent of dullness, dry crackling, or localized feeble, or harsh respiration, we can not predicate anything absolute and positive on jerking or wavy respiration; but when it occurs in association with the other signs, it is then *one* of the evidences of tubercles. It is, to my mind, the least reliable, *per se*, of any of the reputed physical signs of tuberculosis. It is probably more valuable in the *precursory* than the stage of actual deposit.

Prolonged (Intensified) Expiration.—The opinion that prolonged expiration becomes a sign of disease is based on the idea (so commonly promulgated by writers) that the movement of the chest in expiration is comparatively short, and that its relationship to inspiration becomes reversed. Thus, it is assumed that the duration of inspiration exceeds that of expiration in the ratio of three to one, or, according to Fournet, of

five to one; and, consequently, that a reversal of these states indicates a morbid condition. After very careful and repeated observations, it has appeared to me that the time occupied by expansion and contraction are nearly equal, the difference, if any, being too small to be of material importance; but the *sound* produced or rendered audible during these acts is much more prolonged and distinct during inspiration, and does not, therefore, bear a direct relationship to the *duration* of the movement. It follows, therefore, that only about one-fourth part of the expiratory act produces a murmur, while the remainder is inaudible; but during inspiration sound is emitted throughout the whole movement, and thus exhibits comparative prolongation.

It is apparent, therefore, that the term "prolongation" does not represent what actually occurs, for the sound is merely an intensified or exaggerated act, and not one of increased duration of contraction. In a morbid condition, the expiratory sound is heard during the whole movement, (instead of one-third or one-fourth, as in health,) and hence, it is truly an *exaggerated or intensified* murmur.

The exact import of intensified expiratory murmur, and its importance in the diagnosis of tubercle, is not definitely settled; many observers, however, attach the highest value to it, as an early sign, and regard its presence as strongly indicative of tubercular deposits. According to the observations of Dr. Jackson, and after him of Fournet, intensified (prolonged) expiration is met with very constantly among the early signs of phthisis. Dr. Walshe thinks its importance somewhat overrated, while Dr. Theophilus Thompson regards it as one of the most important and reliable of the early signs. There can be no doubt, indeed, that intensified expiratory murmur occurs with a fair degree of frequency in early tubercular deposits, and that it is, therefore, an important sign; but, at the same time, there are so many qualifications necessary to render its significance clear and undoubted, that the sign loses much of its intrinsic value, except in the hands of the most experienced auscultators.

It is admitted by all writers that this sign occurs in emphysema, bronchitis, pulmonary congestion, pneumonia, pleuritic

effusions, pneumothorax, and, indeed, any form of obstructive disease. But it apppears to me there is another condition, independent of local deposit or induration, in which prolonged expiratory murmur becomes evident; namely: when the expansive power of the chest is diminished, and its elasticity proportionally impaired, as the result of general disease. The condition in which I have observed this state most frequently is in cases of nervous prostration, especially involving the sympathetic system of the chest. In many of the nervous affections, involving more or less the heart, (inducing especially weakened cardiac action,) it will be found that the chest loses, in a varying degree, its elasticity, and that the expiratory murmur becomes proportionally prolonged. Under these circumstances, however, there is neither harshness, blowing, nor other alteration of quality, the only change consisting of increased duration, often equal to inspiration. And hence, as pointed out by Professor Flint, the *pitch* of the sound becomes an important element in determining its pathological signification. When due to tubercular consolidation the pitch is raised, while in most other examples the note is low.

It is difficult to determine the frequency with which intensified or prolonged expiratory murmur occurs in phthisis, or how far it may be made a means of diagnosis in the stage of consolidation. Dr. Theophilus Thompson* states that in two thousand patients it proved to be the most remarkable physical sign in two hundred and eighty-eight, of whom ninety-one had more or less hæmoptysis. In a statement of this character, however, we reach no definite conclusion; for if two thousand consumptive patients manifest prolonged expiration in only two hundred and eighty-eight cases, it certainly is too infrequent to be regarded as little more than an occasional sign, and, therefore, its absence is comparatively unimportant. In addition to this, it should be remembered that the expiratory murmur is naturally intensified on the *right* side, and especially so in females; hence, existing alone and independent of all other signs of tubercles, its occurrence on the right side is of little

* Clinical Lectures on Pulmonary Consumption.

significance. The more this sign becomes restricted to the clavicular region the greater will be the probability of its dependence on tubercles; but when largely diffused, it most usually arises from those general causes to which reference has already been made.

Examples of clearly-marked phthisis frequently come under my observation in which the expiratory murmur is not prolonged, probably arising in part from the particular form of the deposits, and in part from the maintenance of the muscular powers of the chest. But whatever may be the explanation, it is, with me, a matter of simple observation that tubercles occur without inducing prolonged expiration.

Semeiological Value.—The intrinsic importance of prolonged expiration is greatly diminished by its frequent occurrence in conditions unconnected with tubercles; and, also, from the no less important fact that the deposits may exist, and yet the sign in question will not occur. Hence tubercles may be present without accompanying intensified expiratory murmur; or the sign may be well developed when no deposits have taken place. It is only, therefore, by the agency of coexisting signs that prolonged expiration becomes really significant. If dullness, dry crackling, etc., exists, then the presence of intensified expiratory murmur furnishes additional evidence of the presence of tubercle. It is hardly possible for this sign to become fully formed in phthisis without a considerable degree of consolidation being present, as the physical condition on which its development depends; hence intensified expiration of low pitch and *without* dullness is indicative of some other condition than tubercular deposits.

Adventitious Sounds.—In addition to the mere modification of the respiratory murmur, as detailed in the preceding pages, there are certain *adventitious* sounds superadded to those of a physiological character, and which usually denote some degree of tubercular deposits. These include dry crackling, sibilus, cogged-wheel sound, crumpling, and tubercular crepitus.

Dry crackling is an early and very common sign of tubercles. It is heard most constantly at the pulmonary apex, and usually consists in from one to five or six sharp, dry, explosive, and

apparently somewhat distant crackling râles. In a large proportion of examples it is heard only at the close of inspiration, and usually requires a forcible act for its development. Thus, while the patient is breathing tranquilly the râle is not heard, but on making a forced inspiration it may become distinctly audible. Very frequently this forced inspiration will develop only two or three, and, at times, a single sound; often, indeed, will the observer be almost startled by the explosion of a single dry and almost metallic sound, occurring at the close of a forced inspiration. In a few instances I have met with the sound during expiration, but this is infinitely rare, and probably occurs only when the process of softening is about to commence. However, the rule of its development during inspiration is sufficiently general for all practical purposes.

When dry crackling is once developed, its persistence is constant, although it may be more manifest one day than another, or one inspiration than another; but it can hardly be said to cease entirely until it passes into the *moist* variety, which is its natural tendency. I have often had occasion to observe, in examples where crackling was only feebly developed, that on making a full inspiration the sound might be distinctly heard, but would entirely disappear at the next inspiration, although the act was equally forcible; and thus, after a few respiratory movements it would again be heard, and so on. This fact is important in obscure cases, for without its observance we might readily conclude that the sound was too evanescent to constitute the true tubercular crackling. The more advanced the disease, the more fully does the sign become developed; hence at first it is indistinct and heard only occasionally during forced inspiration; next it is heard at each full act; and finally becomes audible during ordinary respiration. Dr. Walshe admits its occasional disappearance for a day or two; this I have not observed, but it has appeared to me constant when once developed, with the qualifications previously mentioned.

Semeiological Value.—I am led to regard dry crackling as an early and common sign in tubercular deposits; but we are not in possession of accurate data to determine the exact period, or the relative frequency of its development. Fournet declared

that he met with this sign in eight out of ten cases; while Dr. Austin Flint observed it in nine out of twenty-two cases. Still it is evident that tubercles may exist without causing dry crackling; and, on the contrary, it becomes a question whether other pathological conditions than tubercles may not be capable of developing this sign. It is not possible, in the present state of our knowledge, to give positive answers to these questions. For myself, however, I am free to admit, that tubercular deposits may take place without inducing dry crackling; but that its occurrence in connection with any other pathological state is, to say the least, extremely doubtful. I have occasionally observed cases in which dullness and coexisting signs clearly indicated tubercles, but without the presence of crackling; still, in all such instances, the crackling may have existed at an earlier period, which, however, would presuppose the possibility of its subsidence anterior to softening—a position far from being, at this time, demonstrable. Dr. Austin Flint, in a communication to the author, states that alone and unaided by other signs and symptoms, he would not rely on dry crackling as a positive indication of tubercles. What causes, other than the presence of tubercles, are capable of inducing this sign, is an undetermined question.

Finally, it is to me abundantly evident that dry crackling is a physical sign of great value in the early periods of tubercular deposits; that when once observed it continues until superseded by passing into the humid variety; and that its absence (although rare) is not to be regarded as contra-indicating the presence of tubercles. Certainly with coexisting dullness this sign may safely be regarded as conclusive evidence of tubercular deposits.

But that crackling may take precedence of dullness, and nearly, if not quite, all the other physical signs, I am strongly inclined to believe. At this moment I have under treatment a case in which there is neither cough nor emaciation; but the patient complains of wandering pains in the chest, occasional slightly hurried respiration upon exercise; and on examining the left clavicular region there is clearly-developed and well-marked dry crackling. The sign is constant and persistent,

having been under my observation for a number of weeks; at each examination precisely the same, and a perfectly characteristic crackling is heard at the close of a forced inspiration. This is the only sign indicating tubercular deposits. The spirometer shows a full vital capacity of the lungs.

Sibilant rhonchi are not enumerated by systematic writers as one of the signs of tubercular consolidation; nevertheless, I have observed cases in which it was evidently present. Thus, I have heard a single fine sibilus (other signs coinciding) at the apex of the lung, especially following a forced inspiration. The mechanism of this sign, as connected with such cases, is doubtful; it may arise from mucus temporarily obstructing a small tube, (for it was not persistent,) or, as I am more inclined to believe, may depend on the compression of a small bronchial tube by a tubercular mass. I have observed it in cases which exhibit signs of scattered masses; and it appeared to me that these were capable of causing the sibilus. Indeed, one is rather surprised that the sign in question is not more frequently developed under such circumstances.

Dr. Walshe has described what he terms a "cogged-wheel" sound, rhonchoid in character, which is presumed to occur in incipient tuberculization. It is characterized as resembling the sound produced by a cogged wheel in rotation, probably caused by glutinous mucus adhering to the bronchial tubes. Certainly a sound somewhat of that character is occasionally heard.

Some of the forms of *pulmonary crumpling*, as described by Fournet, doubtless exist and may occasionally aid in diagnosis. I have frequently heard sounds which belong to this class, but they are variable in character, indeterminate, and, taken alone, insignificant; still, the *true* crumpling (compared to the sound produced by folding tissue paper) is evidence of obstruction, and, with the concomitant symptoms, may indicate tubercular deposits. Fournet met with it in one-eighth of his cases.

In some forms of pulmonary tubercles I have met with a well-marked crepitant rhonchus, wholly independent of inflammation, and presumed to represent a particular phase of tuber-

cular deposit. I have ventured to call this *tubercular crepitus*, as a distinction between this form and pneumonic crepitus. I have usually heard this sound at the anterior apex, more commonly near the junction of the third rib and the sternum, or just above that point. I think, also, it has been most frequently manifested on the left side. The rhonchus to which I allude differs but little from the crepitus of pneumonia; but I can not believe that, in the examples which came under my notice, it represented inflammation. I have heard this crepitus in cases where no other physical sign was present, and in cases, too, where no suspicion of pneumonia could possibly be entertained. In other examples it has coexisted with well-marked signs of tubercular deposits; but, under these circumstances, I have usually observed it below the points of consolidation.

The crepitant rhonchus to which I allude is never heard during tranquil breathing, but becomes developed at the close of a full and forced inspiration. The sound is very nearly that of the ordinary pneumonic crepitus, but I believe is a little finer, and is, perhaps, a dryer rhonchus.

Excluding the possibility of inflammation, (which the clinical history of the cases showed could not exist,) I was led to the conclusion that the crepitus indicated a liquid exudation, tuberculoid in character, either associated with, or preceding solid tubercles. I have certainly heard it in the precursory stage of phthisis, when no physical sign of solid tubercles was present; and it has also been observed in connection with well-marked tubercular deposits.

It does not appear to me that there is anything very remarkable in the development of a crepitant rhonchus in connection with tubercular deposits; indeed, when we remember that solid tubercle is the result of a liquid exudation, the occurrence of a crepitus would rather be anticipated. Probably the reason why this sound does not more frequently occur in connection with tubercle is that the exudation takes place slowly, and speedily becomes concrete; but we can readily conceive of a condition in which the fluid would become more abundant and less readily solidified, and hence the sound might be developed. Such, at

least, has appeared to me probable, judging from what has come under my observation in a number of cases.

The signs derived from the *voice*, although not absolutely unimportant, are less characteristic than might be supposed. I agree with Dr. Walshe that vocal resonance is too variable in health to admit of any precision of application in disease. An example has come under my notice, in which two gentlemen of ability and experience diagnosticated the presence of cavities, (so intense was the vocal resonance,) but *post-mortem* examination proved the lungs to have been sound. Still it may be remarked, that exaggerated vocal resonance of the *left* apex, (the *right* being naturally loud,) when well marked, must be regarded as important in the diagnosis of tubercles. This is the opinion expressed by Dr. Flint,* and his views are entitled to consideration. The *absence*, however, of vocal resonance is not sufficient evidence that tubercles do not exist. The development of vocal *fremitus*, Dr. Walshe is of opinion, is a much more reliable sign than resonance; but it is evidently only in extensive deposits that its importance becomes manifest, and here other signs should take precedence.

While, therefore, both vocal resonance and fremitus are to be duly considered in the physical diagnosis of tubercles, they are chiefly valuable in connection with other signs and symptoms, but, of themselves, possess comparatively little importance.

Undue transmission of the sounds of the heart is classed among the signs of tubercular consolidation. It is necessarily more valuable on the right than the left side, and always occurs, more or less marked, in cases of consolidation of the pulmonary tissue. When the first sound of the heart is very distinct in the right clavicular region, other signs coinciding, it becomes a fair indication of the degree of consolidation. But the transmission of the second sound to the right clavicular region, possesses often a different signification. Numerous examples occur in which even a moderate amount of cardiac dilation (without weakened action) diffuses the second sound over a great portion of the chest, and it becomes very audible under the right clavicle.

* Physical Exploration, etc., Resp. Org.

Dr. Latham has pointed out the existence, in occasional cases, of an arterial bellows-murmur, occurring in the clavicular region, or at the left pulmonary cartilage. I have frequently met with this sign in tubercular deposits, but it is so frequently absent that it is comparatively unimportant. The auscultator, however, should neglect no sign which is met with in even occasional cases.

SUMMARY OF PHYSICAL SIGNS OF TUBERCULAR DEPOSITS.

Inspection: Diminished expansion, contraction, possible bulging.

Percussion: Dullness, increased resistance.

Auscultation: Weak, harsh, exaggerated, interrupted respiration; prolonged expiration, tubular and blowing sound; dry crackling, pulmonary crumpling, cogged-wheel sound, sibilus, tubercular crepitus.

SECTION III.

PHENOMENA OF THE STAGE OF SOFTENING.

I. GENERAL SYMPTOMS.

When the period of softening arrives, many of the symptoms belonging to the preceding stage exhibit a manifest increase. The emaciation increases, the febrile symptoms become more marked, the cough and sputa undergo important changes, and the whole case wears the aspect of great and progressive aggravation. The muscles of the chest and limbs waste most, while the face often exhibits much less noticeable changes. Chills and consecutive fever become aggravated in a remarkable degree, which contribute greatly to the prostration of the patient. The febrile phenomena are of two classes and grades; one is the result of impaired calorification, while the other is connected with the local changes in the lungs. In the first or

common variety, the chills assume something of a periodical type, usually occurring daily during the forenoon, the fever and sweating occupying the afternoon and evening. In many cases the different stages of the paroxysm follow each other with much regularity; nevertheless, they seldom assume all the characters of the intermittent type of fever. Several paroxysms will thus occur for days in succession, when finally a mitigation takes place, and the patient is, for a time, free from fever.

In the second form, (that is, fever arising from the extension of local disease,) the periodicity is less distinct, although there may be daily chilliness or sensations of coldness, with consecutive fever; yet the actual fever more commonly becomes gradually developed toward evening, assuming more distinctly the characteristics of *hectic*. If much inflammatory action supervenes, the disease may assume a state of constant excitement; but the more usual course is for the feverish symptoms to manifest varying degrees of intensity, depending for their aggravation on accidental circumstances.

Associated with the febrile condition will be developed the copious, exhausting, acid night-sweats, so characteristic of progressive phthisis. These colliquative sweats are variable in degree, but are usually proportioned to the gravity of the constitutional disease. As effete material accumulates in the system, there is evidently an effort on the part of nature to procure relief by elimination through the cutaneous tissue; and hence the irregularity of this particular symptom. Doubtless, the accumulation of effete material in the blood favors the febrile commotion in the system, which is followed by copious sweating; and, after a time, as the morbid material diminishes in quantity, the perspiration measurably ceases, and the patient is temporarily relieved from an unpleasant symptom.

As softening takes place, the cough increases manifestly in violence, becomes paroxysmal, and is accompanied by more copious sputa; but these symptoms vary materially in different examples, as well as at different periods of the same case. Cough depends not alone on *bronchial* irritation, but also on the coexisting laryngeal disease, and hence the latter complication renders the symptom more violent and paroxysmal. The *sputa*

are mixed in character; a portion is glairy and transparent, but the mass finally becomes more or less opaque from the presence of yellowish or grayish material. The quantity of transparent sputa increases proportionately to the bronchial excitement. As the stage of softening advances, the sputa become more constantly yellowish, globular, and non-aërated; but the characteristics vary at different periods, and even different hours of the same day. The yellow sputum is usually most copious in the morning, while not unfrequently the transparent variety predominates through the day. As the purulent element increases, opaque striæ, of a buff color, appear, giving the sputum a variegated aspect. In more advanced cases the color becomes a darker yellow, and at times greenish. As the sputum comes to be more purely purulent, it is proportionally non-aërated, and sinks in water. The outline of the masses expectorated vary; in some examples the edges are irregular or jagged, while in others they are quite smooth. In a certain proportion of cases, more or less blood appears, commonly as streaks through the purulent mass, or as rusty sputum, not unlike the pneumonic variety. A case came under my observation in which the rusty sputum appeared daily for a period of six months. Phthisical sputum has a peculiar odor, at times becoming fetid; the taste is saline or sweet. In the case of rusty sputum referred to, the odor was exceedingly unpleasant, and might be called fetid. The microscopical elements of phthisical sputa will be given under the head of diagnosis.

As the disorganizing process advances, respiration becomes somewhat quickened, usually ranging from twenty-four to twenty-eight per minute; but the frequency is greatly influenced by the degree of febrile excitement, exercise, and other incidental conditions. While the patient is tranquil, and especially when in the recumbent posture, the respiratory movements may be nearly normal; but on exercising, such as walking, or ascending a flight of stairs, the breathing becomes notably quickened, and frequently oppressed. Dyspnœa, however, is not an ordinary condition in this stage, and patients are not generally conscious of oppression, except some degree of asthma coexists.

The circulation is increased in frequency about in proportion to the respiratory movements; but when chills and consecutive fever occur, the pulse is rendered quick and irritable. The state of the pulse, however, is quite variable; at times, it is nearly normal, or it may become quick, irritable, or feverish. Constitutional peculiarities, as well as the extent of effete accumulations in the blood, regulate the activity of the circulation; hence, the pulse may vary from an almost normal condition to one of great rapidity and feebleness.

The degree and character of pain connected with this stage are slight and dull, except pleurisy occurs, when more acuteness is evinced. The ordinary sensation is that of uneasiness through the chest, extending to the shoulders, or occupying the sternal region. The disorganizing process in the pulmonary tissue does not give rise to acute pain; but the occurrence of circumscribed, dry pleurisy causes considerable acuteness, which often extends to the intercostal muscles. Pleurodynia is, also, an accompaniment of tubercular disorganization; but the intercostal pains and tenderness are more commonly due to circumscribed pleurisy.

II. PHYSICAL SIGNS OF THE STAGE OF SOFTENING.

The physical signs connected with the stage of tubercular softening, are necessarily those belonging to the first, increased or modified, to which are added certain characteristic phenomena. Parietal depression, in the clavicular and scapular regions, more marked in the former, becomes notably increased; the circumference of the chest is diminished, the expansion greatly reduced, and exhibits more distinctly the elevation-movement. The reduced power of expansion is rendered more evident during a forcible inspiration, and the contrast with the sound or least affected side becomes, in this manner, still more apparent. Depression of the clavicle may obscure to some extent flattening of the walls, and hence the use of the calipers may become necessary to detect the extent of the change. Dullness on percussion is increased in extent, and becomes often wooden or tubular.

Humid crackling is the characteristic rhonchus indicative of tubercular softening. Dry crackling appears to become gradually merged into the moist variety, which latter, when clearly marked, may be considered conclusive evidence of softening.

Some care is required to discriminate between mucous, subcrepitant, and tubercular moist râles. The special characteristic of the tubercular rhonchus is that, at least in an early stage, it is circumscribed, limited to the apex, and is heard during, or at the close of, inspiration, often, indeed, requiring a forced inspiration to develop it. It is at times slightly metallic, and finally merges into the cavernous variety.

Bronchophony and bronchial respiration often become increased during this stage, but afford no evidence of softening; and the same remark is applicable to vocal fremitus. In fact, the signs derived from the voice during the stage of softening are in no wise characteristic.

Finally, the diagnosis of the stage of tubercular softening depends mainly on the occurrence of humid crackling, and yellow or opaque sputa. In estimating the value of the expectorated substance the microscope must be resorted to, for mere inspection may prove deceptive. In some examples crackling is absent, while the sputa and other signs and symptoms clearly indicate tubercular softening.

SECTION IV.

SYMPTOMS AND SIGNS OF THE STAGE OF CAVITIES.

The process of tubercular softening produces important changes in the adjacent tissues, and gives rise to new and characteristic signs and symptoms. A destructive action is speedily manifested, and the bronchi becoming involved in the process are opened or cut off, and the softened matter thus becomes eliminated. In this manner cavities are formed, the sputa change, and the physical signs undergo important modifications.

In the mean time the *general system* suffers severely, and exhibits the most striking evidences of decay. The emaciation reaches its greatest extent, patients weighing one hundred and fifty pounds often losing twenty-five or thirty; the strength progressively diminishes, the hectic symptoms increase, digestion becomes impaired, the circulation is hurried and feeble, respiration short and difficult, the cough becomes greatly aggravated, the sputa abundant and purulent. In a more systematic detail these changes may be thus stated:

1. *The General Symptoms.*—In progressive phthisis, with a fatal tendency, the stage of cavities is marked by a great and rapid aggravation of all the symptoms and signs, general and local. Emaciation advances to an extreme degree, the blood is greatly reduced in quantity and changed in properties, the secretions become correspondingly deranged, and the whole organism bears marks of that extensive decay which rapidly leads to dissolution. In some cases the whole organism becomes nearly equally depressed, while in others particular functions suffer in a prominent degree. Thus, some patients suffer from great dyspnœa, while others are much less distressed in this respect; in some cases, febrile symptoms become prominent, and in others, the gastro-intestinal lesions assume the greatest gravity. Primary digestion often suffers in a prominent manner, and is characterized by uneasy or painful sensations, gaseous distention, eructation, and colliquative diarrhœa. It must be remarked, however, that the *constancy* of the gastric derangement, as manifested by impaired digestion, has been greatly overrated by writers. I have observed many cases in which the appetite remained moderately good to within a few days of dissolution; and, with ordinary care in the selection of suitable food, but little difficulty occurred in digestion. Indeed, few cases occur in which a sufficient amount of nutriment can not be taken to support the system, if that were all that vitality required for sustenance. I have often observed that a good appetite and fair digestion continues throughout the whole course of the disease; and certainly the gastric derangement, in many examples, bears no direct proportion to the gravity of the pulmonary disease.

The variable character of the gastro-intestinal function depends on the extent to which this portion of the system becomes involved in the general tuberculous lesions. Although the stomach and intestinal canal often become affected during the progress of phthisis, yet it must be admitted that these lesions are not uniform and constant, and hence the variable character of the symptoms. The lesions which occur embrace, first, a general attenuation of the alimentary mucous tissue, with more or less inflammatory action, deposition of tubercle, and ulceration. Ulcerations are more or less frequently met with in the fauces, œsophagus, stomach, and intestinal canal; and tubercular deposits are not infrequent in the small bowels, involving the glands and submucous areolar tissue. These lesions are much the most frequent in the small intestines; thus, Louis found ulcers of the pharynx in four cases in one hundred and twenty patients; in the œsophagus six in one hundred and twenty; in the stomach two in ninety-six; while in the small intestines five-sixths of the cases exhibited ulceration. Tubercular deposits were observed in fifty-four of one hundred and twenty cases.

It will be observed that the *stomach* is much less frequently affected than any portion of the alimentary canal, and hence the appetite and digestion often remain good while more or less diarrhœa may be present. It is an important pathological fact, also, that disturbance of the bowels is not always proportioned to the extent of the local lesions, for it is well known to practitioners that constipation and ulceration may exist together. Most phthisical patients, however, are more or less subject to diarrhœa, either occasional, as occurs throughout the course of the disease, or colliquative, as met with in the latter stages. But patients are sometimes constipated throughout the whole course of the disease. It is by no means certain that all of the ulcerative action met with in the intestinal canal results from a deposit of tubercle; on the contrary, it has appeared to me to result very often from what may be termed *tuberculous ulceration*, independent of the presence of veritable tubercle. In this sense many of these lesions are more properly *tertiary* in character, resulting from those ultimate derangements charac-

teristic of progressive phthisis. In regard to the secretions, it may be remarked, that the changed condition of the blood causes a marked variation from the normal state, the most obvious alterations occurring in the gastric, hepatic, urinary, and cutaneous functions. As already intimated, the gastric fluid is evidently deficient in quantity, and probably changed in quality, the hepatic secretion is thin and watery, the urine loaded with lithates, and the cutaneous secretion is frequently extremely acid. In this condition the tongue frequently becomes pointed, red at the tip and edges with elevated papillæ, and covered with a whitish, or occasionally yellowish coating; patients readily vomit, and are often affected with diarrhœa.

The chills, febrile action, and consecutive nocturnal sweats, all undergo marked and persistent aggravation. The chills usually occur in the forenoon, the fever continuing often until midnight, when the skin, which was previously hot and dry, becomes bathed in a colliquative acid perspiration, which continues the remainder of the night.

In the mean time, the evidences of impaired secondary assimilation become still more manifest; emaciation progressively advances, the tissues become extremely reduced, the adipose matter from the general cellular structure is almost entirely removed, membranes and vessels become greatly attenuated, and vitality sinks to the lowest state. The circulation and respiration usually become feeble and hurried, though in both these great functions there are frequent and remarkable exceptions. I have seen the circulation scarcely disturbed, and respiration remain nearly natural to within a few weeks of death. As the powers of life fail, and the blood undergoes still further changes, dropsical effusion, in the form of anasarca, becomes common, and is usually a symptom preceding death but a few weeks.

The *mode* of death is various, but a majority will fall under one of the following heads:

1. Gradual failure of all the functions. 2. Death by apnœa, resulting from extensive consolidation of the lungs, or œdema of the glottis, or hypostatic pneumonia. 3. Failure of the powers of the heart. 4. Hemorrhage. 5. Colliquative diarrhœa.

6. Pneumothorax. 7. Intercurrent lesions. *Sudden* death may result from excessive accumulation of secretions; syncope; opening of a large blood-vessel.

The symptoms which have thus been detailed as characterizing the stage of excavations in *progressive* phthisis, do not, of course, apply to milder and curable forms of the disease. In this latter variety most of the preceding symptoms will be found in a comparatively mild degree; and, if the disease take a favorable turn, may all gradually recede until final recovery takes place.

2. *Physical Signs.*—The stage of excavation or elimination presents, in part, the same phenomena which characterize tubercular consolidation, to which are added certain new signs indicating the physical changes in the condition of the part. Dullness on percussion may remain nearly unaltered, or become extended in area, and flattened in tone; or, as excavation increases, and caverns of considerable size form, the loss of substance removes a part of the dullness, and may even induce preternatural clearness. The resonance necessarily varies with the extent, position, and form of the caverns. When the cavity is small, situated remotely from the surface, or is surrounded with induration-matter, the sound may be completely flat or tubular; if there be intervening portions of sound tissue, *slight* percussion fails to elicit dullness, while a more forcible act will reveal the deep-seated solidification; or, finally, if the excavations be large, and situated near the surface, the sound may be clear, tympanitic, amphoric, or cracked-metal. Moreover, the contents of the cavity exercise a marked influence over the sound; when the cavity is *full*, the sound is necessarily less resonant. The cracked-pot sound (*bruit de pôt fêlé*) is heard when the caverns are large, approach the surface, and probably with several openings. To render it appreciable the patient's mouth should be open.

Inspection reveals different states of the parietes and thoracic movement. The *flattening* generally increases during this stage, not only in degree but extent; thus, at an *early* period the depression is limited to the immediate infra-clavicular region, and then, by contrast, is quite evident; but when softening becomes

more extensive, the parietal depression is correspondingly diffused, often extending to the mammary region; and, indeed, flattening of the entire anterior portion of the chest, where both lungs are involved, is the common condition.

The parietal movements, as a rule, remain limited, as in the preceding conditions, and the *elevation* motion takes precedence over normal expansion. However, as pointed out by Dr. Walshe, these conditions may not occur in certain exceptional examples; thus, when the cavity is large and approaches the surface, there may be not only amphoric percussion-sound, but increased respiration, expansion, and even bulging. The cause of these anomalies will be readily perceived.

The auscultatory signs of this so-called third stage are more characteristic than the preceding, and are embraced under the following heads: Cavernous rhonchus, respiration and cough; pectoriloquy.

Cavernous Rhonchus.—(Hollow bubbling rhonchus, gurgling rhonchus.) Cavernous rhonchus is the earliest evidence of the existence of a cavern. It is usually described as being associated with cavernous *respiration*, and this latter is regarded as the true means of establishing a differential diagnosis between cavernous, mucous, and subcrepitant rhonchi. But at an early period, when the excavation is small, and filled more or less completely with fluid, no sound except the bubbling or gurgling will be heard. In this condition it closely resembles the subcrepitant.

Cavernous rhonchus is characterized by liquid bubbles, variable in size and number, at times, hollow or metallic, and usually coexisting with inspiration and expiration, though much more distinct with the former. The special character of the sound varies with the size, form, contents, and position of the cavern. When the cavern is small and filled with liquid, the bubbles are of small size, possessing little of the metallic character, and very closely resemble the subcrepitant rhonchus with large bubbles. When the cavities are large, contain fluid, and communicate freely with bronchial tubes, the rhonchus is fully developed, and partakes of the metallic or even amphoric character, and is usually associated with cavernous respiration. When very small, it has received the name of *cavernulous*.

These varying degrees and special characters of the rhonchus demand particular attention, otherwise the most serious errors may be committed. When fully developed, and especially if associated with cavernous respiration, it is easily recognized; but if the *cavernulous* form alone exists, it may readily be mistaken for the subcrepitant rhonchus.

Another modification is not unfrequently present, which is a sound approaching the high key of the sibilant rhonchus; indeed, it might fairly enough be regarded as a sibilus, produced by air entering a cavity. The sound is usually loud and shrill, and, no doubt, is developed in connection with narrowing of the tubes by thickening of the mucous membrane, the cavity containing but little liquid. It is, however, often mixed with the gurgling.

Vailed blowing is sometimes heard, but it is of little practical importance.

Semeiological Value.—When associated with cavernous respiration, this rhonchus positively indicates the presence of a cavern, and if at the apex, nearly certainly of tubercular origin. The finer bubbling (cavernulous) may be distinguished from the subcrepitant by being circumscribed, few in number, and located at the apex. If the rhonchi be numerous, and diffused generally over the lung, it can not be regarded as cavernulous. The associated signs and symptoms become the true interpreters of the various grades of gurgling and bubbling rhonchi.

Cavernous Respiration.—(Cavernous blowing; hollow respiration.) This sign is produced by air entering a cavern which contains but little fluid, or the air enters *above* the liquid contents. When completely developed, it is a hollow sound, well imitated by blowing gently into the hands forming a hollow; is heard during both respiratory acts, but is most distinct with inspiration. It usually coincides with cavernous rhonchus, but exists without the latter when the cavities are empty, or the tubes open above the liquid.

The tone and special character of cavernous respiration must necessarily vary with the size and situation of the cavern. When small and surrounded with indurated lung, the sound is less hollow, of a higher key, and closely resembles bronchial or tubular

respiration. On the contrary, when the cavity is large and approaches the surface, the sound is of low note, hollow, and may readily be distinguished from the tubular variety. It must be confessed, however, that the existence of bronchial respiration and diffused *blowing*, is capable of so far masking cavernous sound of moderate development, that much care is requisite to make a correct diagnosis. Indeed, both conditions often coexist, and it is only by placing the stethoscope over different portions of the chest that the localized hollow sound of caverns can be detected.

In making out a differential diagnosis between tubular breathing, resulting from consolidation, (tubercular or pneumonic,) and hollow respiration connected with a cavern, several writers of distinction lay particular stress on the key or pitch of the sound produced. The rule is, that the cavernous variety presents a lower pitch than the tubular. Barth and Roger state that *blowing* respiration has a "higher key;" Walshe says of cavernous respiration, "the pitch" is lower than the tubular; and Flint declares the cavernous sound, as compared with the tubular, "low in pitch." These computations of scale are evidently correct, and a careful analysis of the sounds in question will generally enable us to make a correct diagnosis. Thus, cavernous respiration is of low pitch, hollow sound, and is comparatively slowly developed; or, at times, when the caverns are large, of amphoric quality. It coincides with both inspiration and expiration, but most marked with the former. On the contrary, the tubular or blowing variety is of a higher key, more quickly produced, more metallic, and more or less diffused. In addition to these characteristics, cavernous respiration is usually, but not necessarily, associated with cavernous *rhonchus*.

Semeiological Value.—It is abundantly evident that cavernous respiration possesses the highest diagnostic value; and that its presence, when clearly marked, at the apex of the lungs, is a nearly infallible evidence of tubercular excavation. It is true, other conditions are capable of producing it, such as bronchial dilatations and gangrenous caverns. But the coexisting signs and history of the case will usually enable the auscultator to determine the true condition. Thus, tuberculous caverns are

nearly uniformly situated at the apex, and are associated with corroborating physical signs; whereas bronchial dilatation is seated lower, and is seldom connected with other signs of tuberculosis; while gangrenous excavations, besides being infinitely rare, have peculiar and characteristic signs.

In certain examples there is such a blending of bronchial or blowing sounds and cavernous or hollow respiration, that it becomes difficult to determine which predominates, or whether caverns exist at all. Several small caverns at the apex, surrounded by indurated tissue, may give rise to diffused blowing, which would effectually mask the sounds emitted by the small excavations. But in all such cases of doubt, an observance of the coexisting rhonchi, but more especially the sputa, will generally lead to a correct appreciation of the sounds.

Cavernous Cough.—The sound developed in a cavern by cough, is hollow, more or less metallic, at times amphoric, and may be associated with rhonchi. The forcible shock occasioned by the attendant coughing, produces a very distinct, circumscribed, hollow sound, which is justly regarded as one of the surest evidences of the presence of caverns. It has the same physical causes of cavernous respiration, and the two signs usually coexist.

Pectoriloquy.—*Pectoriloquy* indicates distinct sounds produced in a cavity, and issuing apparently from the chest; hence, literally, *chest-speaking*, or the transmission of articulate sounds directly to the ear of the observer. Under certain conditions this chest-speaking is well developed, and is characterized by a hollow sound, at times ringing, and generally loud. Inasmuch, however, as the articulation must vary with the form, situation, and contents of the cavity, its special character exhibits many varieties; indeed, its perfect production requires so many conditions that it is comparatively rare. A cavity of medium size, smooth interior, superficial, attached to the surface, nearly or quite empty, and with free bronchial communication, will develop well-marked pectoriloquy. But if these conditions are not present, cavities even of the largest size may exist without producing chest-speaking. Thus, when the interior is soft, irregular, or traversed by bands; when there are intervening portions of healthy lung; when very small, or, finally, when the

communications with the bronchial tubes are incomplete, or when very numerous, pectoriloquy will be imperfectly developed, or may be entirely wanting.

In addition to these uncertainties, very perfect pectoriloquy may be produced when no cavities exist; thus, when the walls of the chest are thin and attenuated; when a portion of lung becomes condensed, as by tubercles placed between the bronchi and parietes, a sound, more or less articulate, reaches the ear.

Walshe regards pectoriloquy as a variety of bronchophony, and there appears to be some reason for this conclusion; but, at the same time, the mechanism and pathological signification are so widely different that clinical accuracy demands they should be separated. *Whispering* pectoriloquy, according to the same distinguished authority, is more characteristic than loud articulation, and in this opinion I fully concur. When, therefore, a hollow, circumscribed, and well-defined articulation with *whispering*, is heard, I have but little hesitation in ascribing it to the presence of a cavern. Many varieties, however, must necessarily exist; at times it is loud and piercing, so much so as to become painful to the auscultator; in other examples the sound is amphoric, bearing a relationship to amphoric respiration; or, again, indistinct or entirely wanting, although the physical conditions for its production seem to exist.

Semeiological Value.—The inexperienced auscultator is apt to place great reliance on the presence or absence of pectoriloquy; but of all the reputed signs of caverns it is the least reliable, and deserves the least confidence, and especially so to one whose observations have not been extensive. Thus, the admitted fact that it may exist in cases of mere consolidation, and, on the contrary, may be wanting when a cavern is present, furnish conclusive evidence that singly and alone, its presence or absence is by no means conclusive. Nevertheless, the presence of whispering pectoriloquy, circumscribed, hollow, and located at the apex, may be regarded as of cavernous origin. On the contrary, if the sound be somewhat diffused, is found extending toward the middle of the lungs, although *whispering* produces it distinctly, the sign is to be distrusted, and demands other correctives. Fortunately the same physical conditions

which give rise to cavernous pectoriloquy, also produce cavernous respiration and rhonchus, and hence these signs become the correctives when doubt exists in regard to the vocal sound. If the resonance arise from a cavity, there will generally be coexisting cavernous respiration and rhonchi; or if from mere consolidation, then tubular or harsh respiration become the true interpreters.

Metallic Tinkling.—In certain exceptional cases (doubtless large caverns containing liquid and air, with small bronchial communications) metallic tinkling occurs. This sign, however, is but rarely developed in simple cavities; and, therefore, requires no extended notice in this connection.

Local Symptoms.—These include cough, sputa, hæmoptysis, respiration, pain.

Cough.—The cough during the stage of excavation is somewhat variable, depending in part on the accumulation of secretions in the cavern, and in part on accompanying bronchial and laryngeal irritation. It is, however, in the main, violent and harassing, occurring in paroxysms, and often producing great exhaustion, dyspnœa, perspiration, and excitement of the circulation. The most violent paroxysms occur in the evening, when the irritation is the greatest, and in the morning, when the largest accumulation of secretion takes place.

Sputa.—The sputa of the stage of excavation present different appearances, according to the varying circumstances of the case. The *essential* physical character of cavernous sputa is their globular or rounded form, opaque and non-aërated, the masses remaining more or less distinct. Clinically we may divide purulent sputa into three classes: 1. Small masses, with irregular edges, opaque, yellowish color, a portion of which sinks in water. This form occurs when cavities are small and the expectorated material not abundant. 2. Large masses, smooth outline, varying in tint from a yellowish to a greenish hue, remaining separate even in water, and a considerable portion sinking to the bottom. 3. Ash-colored sputa, which lose the globular form and run into one mass, with lines of lighter color, giving it a striated appearance.

These varieties represent different conditions, and deserve

careful discrimination. The small, ragged masses, coming from small caverns, consist mostly of softened tubercular matter, but few pus cells being present. When the caverns extend, and the walls secrete pus freely, the masses become larger, with more regular outline, and consist mainly of pus, intermixed with mucus and tubercular matter, and disintegrated tissues. It represents an extension of morbid action by the process of suppuration which is taking place in the walls of the cavern. The grayish sputa, which run into a common mass, exhibiting usually the striated appearance, are observed when a rapid disintegration of the cavernous walls is taking place, and consist almost exclusively of pure pus, together with more or less tissue-matter. They are met with in rapid phthisis, and in advanced stages of the more chronic forms.

The appearance of the sputa is frequently modified by the intermixture of considerable quantities of transparent and somewhat glairy mucus. This occurs especially in the first form, when a portion of the small masses sinks more or less completely, presenting the appearance of *boiled rice*. The quantity of mucus varies with the affection of the bronchial tubes, and doubtless, also, with the peculiar secreting surface of the cavern. Thus, during the progress of a case in which large masses of yellowish sputa have been expectorated, a sudden increase of excitement produces an exudation of tenacious mucus, which again diminishes as the irritation subsides.

The quantity expectorated is exceedingly variable; in some cases it is comparatively small, while in others it will reach a pint or even a quart in twenty-four hours. The size of the cavities and the activity of disease are the determining causes which regulate the quantity of sputum. The discharge is often very irregular; in most instances the cavities become filled during the repose of the night, and the greatest expectoration occurs in the morning; in some, a sudden and profuse expectoration takes place, while the following day there will be but little. In some cases large caverns suddenly open, with profuse discharge, which, in advanced cases, may even threaten suffocation. The sputa are occasionally tinged with blood, and profuse hemorrhage at times occurs.

Hæmoptysis.—The occurrence of hæmoptysis is variable in this stage. In some examples there is but an occasional effusion of blood, in the form of striæ; in others, the quantity is larger, and the whole mass of sputa may become grumous; while in another grade the quantity is copious, alarming, or even fatal. I have observed a case recently, in which the sputa during the day presented the ordinary muco-purulent aspect, but at night became bloody, which had continued for weeks in succession. In some cases there will be continuous exudation of blood for months in succession. In such examples the exudation of blood takes place from the decaying walls of the caverns, and is usually intimately blended with the ordinary secretions, though at times appears in considerable quantities and nearly pure.

In a more extreme form of hemorrhage, the gush of blood is copious and may prove immediately fatal. Such events arise from the rupture of imperfectly-closed blood-vessels, traversing, or occupying the walls of caverns. These copious hemorrhages Dr. Walshe has witnessed most frequently in males, and such has been my own observation; this fact, however, if it really exist, is probably due to the more active exercises of this class rather than any special tendency to that result. The hemorrhage may prove suddenly fatal by asphyxia or exhaustion, or more remotely by the exhaustion alone.

Respiration.—The respiratory movements vary greatly in different examples; but it is a curious fact that the frequency often bears no relationship to the extent or gravity of disease. The usual range, even in the worst cases, during tranquil breathing, may be stated at from twenty-four to thirty-two. It is equally remarkable that the ratio of the pulse and respiration is often destroyed. In a case of acute phthisis at this time under observation, the pulse is habitually from one hundred and twenty to one hundred and forty, while the respiratory movements do not exceed twenty-four per minute. It must be remarked, however, that in most cases the respiration becomes hurried and oppressed when the patient exercises, such as walking, or ascending a flight of stairs.

Pain.—The pain which attends this stage is of three forms:

pleuritic, muscular, and neuralgic. Nearly always we find dull muscular pain, simulating rheumatism, most intense on the affected side. And when the pleura becomes involved considerable acuteness is observed; but frequently a lancinating neuralgic pain will be momentarily developed, or at times manifesting some persistence. In many cases, however, but little pain of any kind is experienced.

SECTION V.

DIAGNOSIS OF CHRONIC PHTHISIS.

Summary of Symptoms and Signs.—Having passed in review the main points bearing on the symptomatology of chronic phthisis, it may be useful, before proceeding to the diagnosis, to present a brief *resumé* of the subject, restricting the statement to the most prominent features, in the order of their relative importance.

1. Precursory Stage.—*Symptoms.*—Diminution of strength and weight, (often slight;) lowered calorific power; chills and febricula; slightly impaired vascular action; disease of the fauces and tonsils; occasional slight, nearly dry cough; occasionally hemorrhage, which may become copious.

Physical Signs.—Slight restriction of movement, overcome by forcible inspiration; diminished resonance; weak and jerking respiration.

2. Stage of Consolidation.—*Symptoms.*—Increase of all the preceding general symptoms, except hemorrhage, which is often more frequent but less copious than in the first.

Physical Signs.—Diminished and partial expansion; depression; dullness on percussion; feeble, harsh, blowing, or bronchial respiration; intensified expiratory sound; jerking respiration; dry crackling; sibilant rhonchus; tubercular crepitus.

3. Stage of Softening.—*Symptoms.*—The constitutional symptoms all rapidly increase.

Physical Signs.—Humid crackling; increase of sputa.

4. Stage of Cavities.—*Symptoms.*—The constitutional symptoms become greatly aggravated.

Physical Signs.—Cavernous rhonchus; respiration and cough; pectoriloquy; purulent sputa.

The facility with which the diagnosis of phthisis may be made depends greatly on the stage; thus, few would mistake the stage of excavation, while a still smaller number would detect the disease in its earliest manifestations. In making a diagnosis no single sign or symptom can be relied on; but we must take into view the whole case, in all its bearings, symptomological, etiological, and historical. Thus, if we find an example in which the signs and symptoms are somewhat obscure, arising either from complications or incomplete development, while the *history* reveals a hereditary taint, the presumption is always in favor of tubercular disease. This, however, is but an illustration to meet an extreme case; in a majority of instances the evidences are sufficiently distinct to warrant a positive conclusion.

It is evident that the great difficulty in diagnosis pertains to the early stage, and it is to this period that our attention will, in this section, be mainly directed. In the first place, the *history* of the patient should be carefully investigated: age, hereditary predisposition, occupation, locality in which he resides, previous diseases, duration and mode of attack of the present indisposition. The diagnostic value of these questions may be thus stated: The presumption is in favor of tuberculosis when the age of the patient is between twenty and thirty-five years; when a clearly-marked hereditary predisposition is present; when his occupation has exposed him to a cool and humid in-door atmosphere, great alternation of heat and cold, or the inhalation of irritating gases or particles of solids; a very low and damp habitation, or moderately elevated table-lands, of limestone formation, where dysentery and typhoid fever prevail, malaria being measurably absent; previous exhausting disease, especially dysentery, typhoid fever, or pneumonia; or, if a female, frequent and protracted lactation, or menstrual irregularities; gradual approach of cough, without evident cause, persistent, comparatively dry, and associated with faucial irrita-

tion; some degree of emaciation, and diminished strength. If hemorrhage has occurred, it is still more significant.

But in examining the natural history of the disease, many of the preceding symptoms and conditions may be absent; the patient may not have encountered predisposing causes in regard to hereditary taint, residence, occupation, or previous disease. The only evident signs may be slight emaciation, moderate cough, with or without hæmoptysis, and perhaps occasional slight dyspnœa on exercising; in other words, the patient is conscious of "getting out of breath" more easily than prior to his indisposition. The appetite exhibits no reliable diagnostic condition.

Among all these, the most valuable symptoms are *emaciation, cough, and hæmoptysis.* But the question arises, are these three signs (emaciation, cough, and hæmoptysis) *always* present? And, moreover, when present, do they afford indubitable evidence of tubercular deposits, or may they likewise become the signs of the precursory stage? Let us answer these important questions with care and precision.

1. Emaciation, cough, and hæmoptysis are, neither one, *always* present in tubercular deposits. It is admitted by all that hæmoptysis is absent in a certain proportion of cases; and I have beyond all doubt verified the presence of tubercles *when there was neither cough nor significant emaciation.* The following examples illustrate this statement: Miss M——, aged twenty-eight, eleven months prior to the examination had a tolerably free hemorrhage, (previous health having been good,) followed by occasional streaks of blood in the sputa. The following physical signs were quite perceptible: Slight dullness on percussion, dry crackling and jerking respiration at the right pulmonary apex; left side normal. *In this case there was no emaciation,* and a scarcely perceptible cough. W. W——, aged twenty-four, had slight emaciation, moderate dyspnœa on exercising, wandering pains through the chest; had seen a little blood. The following physical signs were present: Left apex slightly dull on percussion, inspiratory murmur weak, slightly intensified expiratory sound, dry crackling, jerking respiration. *This patient was positively without cough.*

Here are two remarkable cases, one without emaciation, and the other free from cough, and yet the presence of tubercles was clearly demonstrable in both. These are fair samples of cases which occasionally occur; and they clearly demonstrate the fact that neither cough, emaciation, nor hemorrhage are essential signs of tubercular deposits.

2. If we observe cough, emaciation, and hæmoptysis, are they conclusive evidences of the presence of tubercles? Certainly not. All of these conditions may arise from other causes than tuberculosis; such as chronic laryngitis, bronchitis, or pneumonia, to say nothing of other forms of disease. I have witnessed all these symptoms, and yet tubercles were not present.

If, therefore, the *vital* symptoms are not always conclusive, we must bring to our aid those of mere physical origin; and it becomes an important question in diagnosis how far these are positively certain and reliable.

Among the most important physical signs may be enumerated diminished expansion, partial parietal retraction, dullness on percussion, modified respiratory murmur, (weak, harsh, jerking, intensified expiration,) and the adventitious sound of *crackling*.

When all these signs, or even a few of them, (including dullness and the abnormal movements of the chest,) are present, the diagnosis becomes positive and certain; but in the earliest stage the amount of tubercle deposited may be too small to cause perceptible retraction, diminished expansion, or dullness. Nor are the ordinary auscultatory signs more certainly developed at this early period, for there may be neither harsh, weak, interrupted inspiratory sound, nor prolonged expiratory murmur. It has appeared to me, from very careful observations, that *dry crackling* becomes the *earliest, most constant and reliable* of the physical signs; and although it is not invariably present when tubercles exist, yet its frequency is so constant as to invest it with the highest diagnostic value. Hence if I find a patient exhibiting even slight emaciation, and some degree of dry cough, which have persisted for some months, and on auscultation find clearly-marked *dry crackling*, I feel fully authorized to make the diagnosis of tubercles. Even a more restricted symptomatology than this may be conclusive. The following

case is in point. Mr. W—— had observed a little diminution of weight, occasional but slight shortness of breath on exercising, some wandering pains of the chest, but was absolutely without cough. Physical exploration yielded a percussion sound so nearly natural that it would have been unsafe to affirm the presence of dullness, (although the tone *seemed* a shade flattened,) but auscultation revealed clearly-marked *dry crackling*. Here the only positive reliance was the adventitious crackle; and this state of things was observed for three months in succession. Treatment removed the thoracic pains, but dry crackling (the number of sounds varying from two to five or six) continued, and was heard at each examination. This patient passed from my notice, but I learned that he died of phthisis in about two years from the period of the first examination.

It is a question, therefore, whether *dry crackling*, independent of other signs, should be regarded as evidence of tubercular exudation. Certainly it should be, if associated with other well-marked general or local symptoms; but singly and alone, it is regarded by many as of doubtful import. We scarcely know enough of the mechanism of this sign to regard it as positively indicative of *tubercular* exudation, for it may indeed represent exudations not tubercular. Dr. Austin Flint writes to me that he would not rely on dry crackling in the absence of all other signs and symptoms; and Dr. Walshe, in the late edition of his work, expresses the opinion that this rhonchus may proceed from bronchial irritation, wholly unconnected with tubercle.

It must be confessed that the exact pathological signification of dry crackling is undetermined; but that it represents some form of exudation may be deemed tolerably certain. The most frequent relation of this sound is evidently to tubercle; thus, *dry crackling* is often observed to pass into moist rhonchi, with all the indications of tubercular softening. Hence it may be deemed positively established, that the deposition of tubercle does give rise to dry crackling, but it remains to be determined whether any other form of exudation will cause the same sound. My own belief is that fully-developed and persistent dry crackling, heard either at the clavicular or scapular apex, is, singly and

alone, indicative of tubercular deposits. Certainly if any other characteristic symptom or physical sign exist at the same time, the rhonchus in question should be regarded as conclusive. In examinations for life insurance, I have regarded persistent dry crackling as sufficient ground for the rejection of the applicant; and who, let me ask, would recommend a person in whom this sign existed, although the general health might be represented as in no way impaired?

Finally, I will venture to suggest, that *tubercular crepitus* is the true sign of tuberculoid fluid exudation, and that *dry crackling* is the positive representative of consolidated tubercle.

Microscopic and Physical Characters of Phthisical Sputa.—We possess, I think, sufficient knowledge of the microscopic elements characteristic of phthisical sputa, to render the examination of expectorated substances important in diagnosis.

The sputa of tuberculous subjects may, for all practical purposes, be divided into four classes: 1. The simple frothy mucus, belonging to the earliest condition, possessing no peculiar or characteristic elements, which could distinguish it from that arising from slight irritation or congestion. 2. A gelatinous, semi-transparent fluid, which has been compared to a solution of gum arabic or isinglass. 3. Rounded masses, more or less purulent, yellowish or buff-colored portions, often intermixed with transparent or gelatinous mucus, presenting a striated appearance. This variety represents the stage of softening, and is variously modified, according to accidental conditions. It may be wholly yellowish, or striated with lighter portions, or largely intermingled with transparent mucus. 4. Grayish or ash-colored masses, which run together, and which occur in an advanced stage, representing extensive ulceration with breaking down of the pulmonary tissues.

The microscopic characters of the principal varieties of sputa are now very well determined, and afford no inconsiderable aid in diagnosis. In the first variety, or the simple mucus, there is nothing characteristic, and I believe it impossible to distinguish the sputum of this early period from that which occurs in simple mucous irritation, except it may be by the presence of occasional blood-corpuscles. The second variety, or the gelatinous

sputum, has been shown by Dr. Andrew Clark, Dr. J. C. Hall, and other observers, to possess certain characteristics distinguishing it from catarrhal irritation. The corpuscular composition of this sputum consists of ovoidal and spherical cells, which resist acetic acid; others are abruptly defined, some compressed and elongated, while others are filled with fat or pigment granules; and finally, corpuscles with irregular outlines, from which nuclei have been eliminated.* The corpuscles with irregular or "jagged" outlines Dr. J. C. Hall regards as indicative of tubercular deposits. These jagged corpuscles may often be detected at an early period, and when the ordinary physical signs may not be sufficiently developed. Dr. C. Radclyffe Hall describes also *enveloped blood-corpuscles* as met with in the early stage of tubercular deposits. Thus, blood-corpuscles may often be detected when no visible hæmoptysis has occurred, and which must certainly be regarded as highly characterisic of tubercular deposits. In a more general sense it may be stated, as remarked by Dr. J. C. Hall, that when the sputum arises from non-tuberculous irritation, the corpuscles are uniform in their outline, consisting of mucous and epithelial cells; but when tubercular deposits exist, there will be, in addition, cells with irregular outlines, and not infrequently blood-discs.

In the third variety of sputa, consisting more or less of yellowish material, and representing the stage of softening, two *characteristic* elements will be observed—the tubercle-corpuscles, and curled elastic tissue. The tubercle-corpuscles I believe, from my own examinations, to be highly characteristic, and may often materially aid in diagnosis. In doubtful cases of bronchial irritation these microscopic elements afford unequivocal means of diagnosis, and in the absence of well-defined physical signs become highly important. The tubercle-corpuscles are irregular in shape, often fragmentary, and wholly unlike any other substance observed in the sputa; and a microscopist of even ordinary skill will find no difficulty in distinguishing these bodies from mucous, epithelial or pus-corpuscles, with which they are more or less commingled. The elastic tissues

* J. C. Hall, Thoracic Consumption, etc.

are derived from the terminal bronchial tubes, in which destructive action has commenced; and while it may be admitted that any condition in which ulcerative action occurs might produce these fragments of elastic tissue, it is, nevertheless, so far as known, peculiar to tubercular disorganization.

In the fourth variety of sputa, the microscopic elements are pus-corpuscles, epithelia, mucus, at times elastic tissue, and other elements evincing disintegration. Pus-corpuscles, however, predominate, for the condition is one of active suppuration.

CONCLUSION.

Finally, it will be remarked that the diagnosis of phthisis can not be reduced to any single sign or symptom; on the contrary, it is only by a careful and judicious combination of all the means at command—including the history, general and local symptoms, together with the physical signs and microscopic examination of the sputa—that reliable conclusions can be reached. There are some examples in which the general and local symptoms are the most reliable, while in others the physical signs alone can determine the diagnosis; but, in a large majority of cases, a careful combination of signs and symptoms becomes necessary in order to arrive at safe conclusions.

The different stages of phthisis present widely different diagnostic signs. In the precursory stage, the most reliable signs and symptoms are, more or less loss of weight and strength, slight faucial irritation, irregular and inconsiderable cough, wavy and weak inspiration, slight diminution of sonorousness on percussion, and occasionally hæmoptysis. If these signs and symptoms occur in a person whose history reveals an hereditary taint, we should decide the case to be incipient tuberculosis. With or without hæmoptysis, this train of symptoms should never be disregarded, for a misapprehension on the part of the physician would prove an evil of the greatest magnitude to the patient.

Add to the preceding condition any one of the following phys-

ical signs, and we have the probable, if not positive evidences of tubercular deposits: circumscribed dullness on percussion and diminished expansion, feeble or harsh inspiration, (the latter most significant,) intensified expiratory sound at the left apex, dry crackling or tubercular crepitus. With either one of these conditions sufficiently marked to render the sign unequivocal, it will always be safe to make the diagnosis of solid tubercles. Of course, we presuppose the absence of chronic pneumonia, pleurisy, and cancer, which must be determined by the history of the case, as well as the present symptoms. The evidences of softening and excavation are those which have been previously detailed, especially the occurrence of moist crackling, cavernous rhonchi, and respiration.

The persistence of the physical signs at the pulmonary apices, anterior or posterior, while the lower portions remain free from disease, is a strong indication that they arise from tubercular deposits. For, although the pathological law which determines tubercular deposits to the apices is not invariable, still it is so constant in its influences as to render a decision on its universality almost necessarily true.

The sign which I have called *tubercular crepitus* is, it appears to me, of considerable importance, and particularly so in an early stage, and when other signs are absent or imperfectly developed. Thus, I have observed, during the precursory stage, or at least in an early period of the disease, this sign, while all other physical evidences of tubercle were wanting. And it has appeared to me so conclusive of the existence of tuberculous exudation, but without appreciable solidification, that I could not hesitate in regarding it as indicative of that condition. The frequency of its occurrence I am unable to determine, but probably it exists in a considerable number of cases.

But the diagnosis of phthisis is not always so palpable and direct as this brief statement would indicate; for in a certain proportion of cases more or less obscurity will be observed, arising either from the incomplete development of the symptoms and signs, or the modifying influences of coexisting diseases, such as chronic pneumonia, bronchitis, pleurisy, or heart disease. But in the most difficult and obscure cases, a careful

analysis of the general and local symptoms and the physical signs, will usually enable us to make at least a probably correct diagnosis.

If the physical signs are fully developed, the diagnosis can, at once, be safely made; but in the absence of clearly-defined signs, what class of general symptoms afford evidence of tuberculosis? This is a difficult question to answer; nevertheless, the experienced practitioner, in whom the *tactus eruditus* is well developed, may often detect the existence of phthisis when the physical signs are indecisive. But this will not avail the inexperienced physician; and the question recurs, what amount of general and local symptoms, unaided by decisive physical signs, justify the diagnosis of phthisis? I would answer the question thus: if the history reveals an hereditary taint, and the present symptoms show gradual loss of weight, a persistent non-catarrhal cough, sputa, purulent or not, with more or less hæmoptysis—the condition having persisted for at least three months—I would not hesitate to diagnosticate phthisis, although the physical signs might be merely negative. It must be remarked, however, that obscure cases will often arise, in which all classes of phenomena are too indefinite to admit of positive and unconditional conclusions. In all such examples, the only practicable course is to give due attention to the history of the case, analyze carefully all the symptoms, present and past, note carefully the results of auscultation and percussion; and then, as a matter of judgment, decide in the most enlightened manner possible, according to the probabilities of the case, or as the weight of testimony may incline, in favor of or against phthisis. With this kind of cautious and philosophical investigation, the enlightened physician will seldom fall into serious error.

There are certain forms of disease which so closely simulate phthisis, that the differential diagnosis at times becomes difficult, which is especially the case in chronic bronchitis associated with globular dilatation of the tubes. The distinctive characteristics, however, are usually sufficiently marked to enable us to form a correct diagnosis. In phthisis, the dullness and rhonchal sounds are usually developed in the clavicular or scapular regions; while similar signs, arising from bronchial dilatation,

are located at a lower point, approaching the mammary region. The constitutional symptoms in phthisis are usually more marked and progressive than in bronchial disease; hæmoptysis is rare in the latter, common in the former. The history of the case, also, will usually show bronchitis to have been the primary disease. But above all, will the sensible and microscopic character of the sputa be decisive; thus, in bronchial disease, the cells consist mainly of pus, epithelia, and mucus; while in phthisis the characteristic elements previously mentioned will be detected. The sputa of bronchial disease often have an offensive odor. Finally, it should be borne in mind that dilated tubes is a disease of comparatively rare occurrence, although it may coexist with phthisis.

The *spirometer* affords very little aid in diagnosis. It is, under all circumstances, too variable in its results to admit of practical application in tubercular disease. When, however, phthisis has been clearly diagnosticated, this instrument is often of use in demonstrating the extent to which the breathing capacity has been reduced. Beyond this, the spirometer possesses little value.

SECTION VI.

DURATION OF CHRONIC PHTHISIS.

In estimating the duration of phthisis, we are obliged to begin with the stage of tubercular deposits; and although this method is not strictly correct, yet such is the variable character and manifestations of the precursory state, that no computation of its length can be more than conjectural. Hence our estimate extends from the time tubercles can be detected in the lungs to a fatal issue.

The duration of phthisis must necessarily vary greatly with the accidental circumstances which surround the patient, including hygienic regulations and medicinal treatment. It is not often, at the present day, that we can trace the natural

history of the disease uninfluenced by medicines. Medicinal treatment may prove beneficial or injurious, but, in a majority of cases, more or less influence is exercised over the progress and duration of the disease.

In examining cases of a medium degree of intensity, we find them ranging mainly from nine months to three years. It is true some will fall below the shortest period, while others greatly exceed it; but these are exceptional cases, either manifesting an unusual degree of acuteness, or becoming protracted greatly beyond the ordinary duration.

The mean duration of three hundred and fourteen cases, observed by Bayle and Louis, was twenty-three months. These cases ranged as follows: twenty-four from one to three months; sixty-one from three to six months; sixty-nine from six to nine months; thirty-two from nine to twelve months; thirty-three from twelve to fifteen months; twelve from fifteen to eighteen months; twenty-eight from eighteen to twenty-four months; twenty-eight from three to five years; ten from five to ten years; nine from ten to twenty years. It will be remarked that more than one-half (one hundred and sixty-two) of the whole terminated within nine months; but as ninety-three of these were fatal between one and six months, it is fair to infer that at least a portion of them belonged to the class of *acute* cases. But, in addition to this, thirty-five cases ranged from four to twenty years, extending beyond the usual period. Hence, the average duration, excluding the two extremes, is found to be, in this series of cases, eighteen months. According to the observations of Andral, at La Charité, the average duration is two years, many, however, terminating at a somewhat early period. These observations indicate that a majority of cases range from nine months to two years.

In another series of cases observed by Louis, the following results were obtained. Of three hundred and seven cases twenty-six died within three months; ninety-eight within six months; one hundred and sixty within nine months; two hundred and sixty-four within twenty-four months. Thus more than one-half (one hundred and sixty to one hundred and forty-seven) died within nine months, and of the whole three hundred and

seven, only forty-three survived twenty-four months. In the Reports of the Hospital for Consumption, (London,) of two hundred and fifteen fatal cases (deducting fourteen doubtful) one hundred and twenty-three terminated in eighteen months.

These, however, are the statistics of hospitals, which will not fully apply to private practice. My impression is that the ordinary duration of phthisis, as met with in a good class of private patients, will considerably exceed the estimate of the London hospital, (eighteen months,) or even that of Andral, (two years;) and we may, with some degree of safety, conclude, with Sir James Clark, that the duration, under favorable circumstances, will not fall much short of three years. However, it is not, perhaps, in a majority of patients that these favorable circumstances can be secured, so that even in private cases, a majority die under three years, generally ranging from nine to thirty months; while in hospitals the duration may be stated at from six to twenty-four months.

The influences of age and sex have been noted as exercising some control over these results. Louis expresses the opinion that *age* exercises but little influence, except that acute phthisis is more common in early life. The following results were obtained at the Brompton Hospital in two hundred and fifteen cases:

Ages.	3 to 6 months.	6 to 9 months.	9 to 12 months.	12 to 18 months.	18 to 24 months.	24 to 30 months.
15 to 25.....	11	11	14	14	8	9
25 to 35.....	5	11	12	9	7	7
35 to 45.....	2	7	3	10	5	7

It will be remarked that this table shows the most rapid march of phthisis from fifteen to twenty-five years of age. Thus, between fifteen and twenty-five years, fifty deaths occurred within eighteen months; while from twenty-five to thirty-five, only thirty-seven deaths took place—a difference of one-third; and the proportion is about the same throughout. These facts indicate that from fifteen to forty-five the duration increases about one-third with each decennial period. The great practical fact taught is, that the younger the subject, *cæteris*

paribus, the more rapid the course of the disease, and that, as life advances the duration is greater.

The influence of *sex* over the duration of phthisis is worthy of note. Louis observed that more cases terminated in a year in females than males in the proportion of forty-two to thirty. At the Brompton Hospital the reverse facts were statistically elicited. Thus, it is stated that of the one hundred and twenty-three cases which terminated in eighteen months, eighty-nine, or 60.5 per cent., were males, while only thirty-four, or fifty per cent., were females; but after that period the duration was reversed; of seventy-eight cases, forty-seven, or 31.9 per cent., were males, while thirty-one, or 45.5 per cent., were females. The two hundred and fifteen cases of the Brompton Hospital are thus tabulated:

			PER CENT. IN ONE HUNDRED.	
	Male.	Female.	Male.	Female.
Less than three months	1	0	—	—
From three to six months	17	5	11.5	7.3
" six to nine months	28	8	19.0	11.7
" nine to twelve months	22	8	14.9	11.7
" twelve to eighteen months	21	13	14.2	19.1
" eighteen to twenty-four months	10	12	6.8	17.6
" twenty-four to thirty months	15	8	10.2	11.7
" thirty to thirty-six months	1	5	0.6	7.3
" thirty-six to forty-two months	7	2	4.7	2.9
" forty-two to forty-eight months	3	1	2.0	1.4
Above four years	11	3	7.4	4.3
Doubtful	11	3	7.4	4.3

CHAPTER II.

SYMPTOMS OF INFLAMMATORY PHTHISIS.

THE symptoms of inflammatory phthisis vary with the different forms of disease, the character and extent of the tissues involved, and the peculiarities of each individual case. Pneumonia, bronchitis, and pleurisy are the particular forms of inflammation which give a special character to this form of phthisis; and among these, pneumonia, including what may be termed the parenchymatous and vesicular forms, is by far the most common and important. It is true, however, that bronchitis, or broncho-pneumonia, is by no means infrequent; indeed, the capillary form of bronchial disease, extending to the air-cells, is a variety of morbid action strongly favoring the development of tubercles. In addition to these varieties, there is a lower grade of action, consisting of a congestive condition, with febrile reaction, which may lead to rapid and extensive tubercular infiltration. What has been described as *febrile phthisis* is little more than chronic pneumonia, or inflammatory engorgement, passing into tuberculization. A low grade of inflammatory action occurring in a phthisical constitution, with a greatly disordered condition of the system generally, induces a febrile state, in which tubercular deposits speedily take place, giving rise to all the phenomena of phthisis, with constant fever.

In ordinary pneumonic cases the early symptoms may exhibit nothing peculiar; but it will finally be observed that, instead of resolution taking place, as in common cases, the disease becomes chronic with progressive emaciation, hectic fever, and continued cough, with variable sputa.

1. *Parenchymatous, or Plastic Pneumonic Phthisis.*—By this term I wish to designate ordinary pneumonia, with plastic exudations ultimately leading to tubercular deposits. It is evident that pulmonary inflammation often becomes the direct inducing cause of phthisis, and imparts to the whole course of the affection an inflammatory grade of action; but, as a general rule, this result takes place only when the tuberculous diathesis is present. It constitutes, however, one of the forms of inflammatory phthisis.

The general and local symptoms scarcely differ, in the beginning, from ordinary examples of pneumonia; but it will be observed that the grade of morbid action is comparatively mild, both the subjective and objective symptoms indicating less intensity than is usually witnessed in idiopathic inflammation. Instead, however, of the disease terminating in due time by resolution, it becomes protracted, the patient wastes, and the symptoms of phthisis replace those of pneumonia.

The physical signs of this form of phthisis are more or less obscured by the coexisting pneumonia; but as the disease advances, the dullness extends more toward the apex, the râles are more moist and distinct, and better defined, together with feeble, harsh, or bronchial respiration in the affected part. But the diagnosis will rest mainly on the gradual *increase* of these principal phenomena; thus the dullness, which was diminishing with partial resolution, becomes more marked and circumscribed, and occupies the apex, the cough increases, and the râles become more characteristic. These events occurring, while the case should be, if simple pneumonia, gradually improving, warrant the inference that tuberculosis has supervened.

When the inflammation occupies the superior portion of the lungs, the diagnosis is more difficult; but even here the progressive symptoms become the principal guides. It will be remembered that pneumonia of the upper lobes is comparatively passive, often destitute of marked signs or symptoms, except the evidences of consolidation. Thus, it will often happen that the first exploration will reveal tubular respiration, the disease having already progressed to hepatization. Following this, tubercular deposits would be indicated by persistent dull-

ness, (but of lessened area,) the addition of moist râles, and increase of sputa. In most cases of this character without tubercles, there is but little sputa, either during the forming or retrogressive stages; hence the occurrence of the signs mentioned becomes peculiarly significant, and even diagnostic.

This form of phthisis is marked by a continued febrile action, which hastens the disease through all its stages; the deposits take place rapidly, softening speedily occurs, and the disorganization of the pulmonary structures is often sudden and extensive. All the functions of the economy are more involved than in the non-inflammatory forms; and hence the continued disturbance of the circulation and nutrition speedily exhausts the system, and, in many cases, the disease proves fatal as much through the general derangement as the disorganizing effects of the local disease.

2. *Vesicular Pneumonic Phthisis.*—This form of tuberculosis has been termed gray tubercles, gray semi-transparent granulations, granulations of Bayle, granular phthisis, etc. In a former part of this treatise the characteristics of these granules were referred to, and the opinion expressed that they are of inflammatory origin. According to this view, it is scarcely correct to class granular deposits with phthisis; but inasmuch as these affections appear to a certain extent convertible, it seems best to retain their assumed relationship.

These granules, as previously stated, appear to be deposited in the air-cells, as the result of inflammation of those structures, and hence it constitutes vesicular pneumonitis, or *cellulitis.* These bodies are diffused largely through the pulmonary tissue, coextensive with the inflammation; in many examples they are found principally in the lower and middle portion of the lungs, though at times occupying almost exclusively the superior lobes, or even limited to the apex. I have, within a few days, examined a body in which some degree of textural change had occurred in the right apex, interstitial, and imparting an increased firmness, but short of consolidation; and intermixed through this portion were numerous gray granulations, of the usual size and appearance. The lower portion of the right and the entire left lung were free from the deposits.

In a majority of cases which I have examined post-mortem, there are evidences of general vascularity; thus, the tissues of the lungs exhibit a deeper red than natural, with a degree of engorgement at points approaching consolidation, and at times small portions sink in water. But true hepatization, to any considerable extent, does not occur, the inflammatory action being limited mainly to the air-vesicles, and the exudation involving the parenchymatous tissue only to a limited extent. The intermediate cells remain free from disease, and hence the lung, as a whole, does not become hepatized. The tendency of these granules is to remain stationary; but, in cases where the tuberculous diathesis is strongly developed, the deposits enlarge, change color, and finally break down into softened tubercular masses. The *duration* of this form of phthisis is quite variable. I have known it prove fatal in three or four weeks; but it will, at times, extend beyond this period, especially when the transformation into yellow tubercles is the final result. It may terminate fatally in the febrile stage, or pass on to a more chronic and less phlogistic condition, and thus become stationary or retrogressive.

Symptoms.—The general symptoms of this form of phthisis are fever, (characterized by *frequency* rather than *force* of the pulse,) heat of the skin, dry cough, dyspnœa, emaciation, loss of appetite, and bowels usually constipated. In many cases the access of the disease is sudden, resulting from exposure, inhalation of irritating substances, or other causes capable of developing pulmonary irritation. The respiratory movements become somewhat hurried; sputa absent or inconsiderable; when present, merely mucus, at times viscid and even streaked with blood—the latter condition being very rare. The general course of the disease is rapid, the patient dying within a few weeks, apparently the result of a slow, wasting fever. In other and less intense examples, the febrile symptoms abate, the evidences of pulmonary disease gradually subside, and ultimate recovery may take place. But in less fortunate cases a chronic disease ensues, which either remains as a form of chronic pneumonia, or the deposits take on the true tubercular character, soften, and thus the disease proves fatal, as in ordinary phthisis.

Physical Signs.—Inspection reveals a slight restriction of the parietal movement, but this is often inconsiderable; and, in consequence of its being, in many cases, equal on both sides, there is usually great difficulty in determining the question. It will be observed, however, that there is slightly more tendency to the *elevation* movement, and less uniform expansion. *Percussion* yields nearly similar results. The degree of resonance is slightly diminished; but this being equal on both sides, where the disease is general, renders it measurably inappreciable.

Auscultation is more decisive. The respiration-sound is variable; it may be rough, harsh, puerile, or weak—varieties depending on special but often inappreciable peculiarities. In nearly all cases, however, the respiratory movement is more or less irregular, and jerking inspiration is developed. But the special sign on which most reliance can be placed is, the occurrence of a *crackling*, usually intermediate between the dry and moist. This sound has appeared to me so characteristic, that I have not hesitated to base a diagnosis mainly on its presence; and in a number of examples post-mortem examinations have verified the diagnosis. Under such circumstances the crackling becomes diffused over the chest, coextensive with the granular deposits; and when it occurs over the middle and lower portions, without the concurrent signs of bronchitis, (sonorous, mucous, subcrepitant râles,) may be regarded as pathognomonic.

When the disease progresses, and by continued growth the tubercles enlarge and soften, the physical signs indicate the changes. The percussion sound becomes duller; respiration weak, harsh, bronchial or cavernous; moist bronchial rhonchi; increase of vocal resonance, may be even bronchophonic; increased parietal fremitus.

Diagnosis.—It is not always easy to diagnosticate the presence of vesicular phthisis; still the attentive observer will not often fall into serious error. A febrile disease, with marked but not violent thoracic symptoms, *dry* (or nearly so) cough, with emaciation, and the peculiar *crackling*, will distinguish acute miliary phthisis from *bronchitis*—almost the only disease with which it is liable to be confounded. In bronchitis the rhonchi are more moist, sputa more abundant—viscid or muco-purulent—skin

less hot, and surface more inclined to muddy or dusky hue, while in acute granular phthisis it is often florid, as shown in the face.

The difficulty of distinguishing acute miliary phthisis from the typhoid form has certainly been greatly overrated. Typhoid fever has more of the essentials of idiopathic fever, with less pulmonary symptoms, and usually the nervous system and alimentary canal are much more implicated. In the event of the intestinal glands becoming early involved in tuberculosis, the resemblance to typhoid fever would be greatly increased; but in this vesicular variety, the disease is of purely inflammatory origin, and, therefore, the intestinal glands are not liable to implication. Again, the nearly uniform occurrence of eruptions in typhoid fever serves still further to distinguish these affections. But, above all, the positive pulmonic symptoms, rational and physical, will usually be a sufficient ground of diagnosis.

3. *Broncho-pneumonic Phthisis.*—There is reason to believe that among the inflammatory affections which lead to tuberculosis, chronic bronchitis, or broncho-pneumonia, holds an important position. According to the observations of Sir James Clark, bronchitis, in its chronic form, may become an exciting cause of tubercles. This author remarks that the inflammatory affection, in some instances, begins in the larynx, and extends to the trachea and bronchi. Andral regards the connection between bronchitis and phthisis as frequently very intimate; and although there is some reason to believe that he has attached too much importance to the subject, nevertheless, his observations clearly prove that bronchial irritation is often the precursor of phthisis. Dr. Stokes expresses similar views, and remarks that such cases may continue for a long time prior to the development of tubercles, extending from five to fourteen years, or more.

The exact relationship, however, of chronic bronchitis and tubercles is an undetermined question; and while the observations of the authors above quoted, with many others, establish the fact that a certain proportion of cases of phthisis are preceded by bronchitis, the percentage of such examples remains to be established. It is believed, by most writers who adopt this

view, that bronchitis induces tubercles in such cases only as have a predisposition to tuberculosis, and it becomes, therefore, an exciting and not inducing cause. But on this subject there probably exists a fallacy. If the tubercular diathesis be present, a very slight exciting cause will frequently develop the disease, or it may even progress to local deposits by its own inherent force; but as bronchitis may exist for a long period, (five to fourteen years, according to Stokes,) before tubercles are produced, we have conclusive evidence that inflammation of the mucous tissue is a very weak exciting cause. The question arises, therefore, whether those examples in which bronchitis existed for many years were not cases of phthisis caused by the local disease, without the pre-existing diathesis. This opinion seems the more probable when it is remembered that, in certain examples, when the diathesis *is* present, bronchitis may speedily develop the disease. A case is now under my observation in which the disease commenced as laryngitis, with broncho-pneumonia, associated with persistent aphonia. The case is now of nine months' duration, with well-marked evidences of softened tubercles and large cavities. The diathesis in this case is unknown.

Examples have frequently come under my observation, in which the disease commenced with catarrhal irritation or open bronchitis, with the ultimate development of tubercles; and I have observed that when the diathesis was clearly marked, the local deposits speedily ensued, while in other examples, where no taint existed, they were very slowly developed. It is not at all beyond the limits of probability that long-continued bronchitis, with copious opaque sputa, may, by exhausting the powers of life, deranging the gastric function, and impeding the circulation of the lungs, ultimately cause the deposit of tubercles; indeed, if phthisis can ever be induced independent of the hereditary diathesis, we assuredly have, in the long-continued influence of chronic bronchitis or broncho-pneumonia, sufficient derangement to cause that morbid state. The inducing cause may be limited to the bronchi, or it may extend to the pulmonary substance constituting *broncho-pneumonia.*

Symptoms of Broncho-phthisis.—The symptoms which charac-

terize an approach of broncho-phthisis are those, in the first place, of chronic bronchitis, to which succeed the evidences of a more profound constitutional disturbance. In ordinary examples of bronchitis the constitutional derangements, although often profound and important, remain comparatively stationary; thus, the emaciation usually progresses to a certain point, and then ceases to increase, although the primary disease may continue unabated. But when phthisis becomes ingrafted upon a chronic bronchitis, emaciation becomes progressive, and is often disproportioned to the degree of bronchitic disease. When, therefore, we find a patient laboring under chronic bronchitis, exhibiting *progressive emaciation*, it constitutes a fair presumption that tubercles have been superadded to the primary affection. It will often be observed, also, that the more active manifestations of disease take place; thus, chilliness may occur, with night-sweats, increased dyspnœa, and progressive debility.

In a certain proportion of cases, when the tubercular disease makes its access, more or less hemorrhage supervenes. I have observed examples in which the affection of the mucous membrane would continue for a period of several months, with simply the signs of bronchitis, when, suddenly, hemorrhage would occur, followed by the regular and progressive development of tubercles. But it must not be assumed that hæmoptysis will occur in the proportion observed in phthisis; on the contrary, many more examples will be met with, in which this sign is absent. The relative frequency of the hemorrhagic and non-hemorrhagic cases remains an undetermined question.

Physical Signs.—The physical signs of this form of disease are those which belong to the deposition of tubercle in general. Dullness becomes manifested at the clavicular regions, and the respiratory sounds are modified according to the extent and condition of the deposit. If the ordinary signs of the pre-existing bronchitis are not present at the apices of the lungs, the respiration signs of tubercle will be much more readily detected. When, however, sibilant, mucous, or even cavernous rhonchi (the latter from dilated bronchi) are present, much difficulty will frequently be experienced in making a diagnosis. But, even then, the stationary character of the pre-existing

signs, the more recent occurrence of apex-dullness, together with more marked prolongation of the expiratory act, will usually serve to indicate the supervention of tubercle. I have met with examples in which bronchitis became complicated with pneumonic inflammation of the apex, so that dullness at that point would arise independent of tubercular deposits. When these cases come under observation during the inflammatory attack, no difficulty will be experienced in recognizing the nature of the disease; but if the case is seen for the first time after the subsidence of active signs of inflammation, and often without any accurate history, it becomes extremely difficult to determine the cause of dullness. Usually, however, pneumonic dullness is more extensive than the tubercular, and is associated with more distinctly-marked tubular respiration. But, after all the scrutiny possible, it often becomes necessary to wait for further developments before a positive diagnosis can be made.

4. *Pleuritic Phthisis.*—But little need be said in reference to tubercles caused by chronic pleurisy. It is abundantly evident that chronic pleurisy occurring in the tuberculous constitution may develop phthisis; but, independently of the diathesis, it can hardly be regarded as a cause of consumption. Certainly pleurisy does not bear the same relation to tubercle that is sustained by bronchitis or pneumonia, and, indeed, its effects must generally be incidental or indirect.

It must be admitted, however, that pleuritic adhesions, which limit the expansion of the lungs, may favor tubercular development, and especially so in the diathetic state. I have witnessed a considerable number of examples in which the tubercular deposits occurred in a lung limited in movements by pleuritic adhesions, and under such circumstances as to favor the idea that some connection existed between the diseases.

Febrile Phthisis, as described by Sir James Clark, is clearly inflammatory in its origin. He observes that the attack is usually sudden, coming on after exposure to cold, in persons apparently healthy, but really of the tuberculous constitution. And he justly observes that the post-mortem appearances, as described by Louis and Carswell, are peculiar, consisting of gray granulations, with serous infiltration, or extensive infil-

tration of cheese-like tubercles, but generally with but small cavities. Indeed, the entire description so clearly shows pneumonic inflammation, that no doubt can exist on the subject.

LARYNGEAL PHTHISIS.

This form of phthisis may properly be arranged in the inflammatory class. As described by Trousseau and Belloc, laryngeal phthisis is chronic inflammation, upon which tubercular deposits may or may not be ingrafted. As known to pathologists at the present time, it is a form of phthisis in which the disease locates largely on the larynx and trachea, with ultimate extension to the lungs, or coexistent pulmonary tubercles. It is generally associated with more or less pharyngeal inflammation, which not unfrequently precedes the laryngeal affection.

As this form of phthisis has come under my observation, it has presented evidences of more or less inflammatory action; while the history of the disease clearly revealed that irritation of the larynx and trachea were, in fact, the earliest symptoms. It may with propriety be assumed, that laryngeal irritation bears the same relation to this variety of phthisis that is sustained by pneumonia to the inflammatory form. When accidental excitement of the laryngeal structures occurs in a tuberculous constitution, such local disease becomes the determining cause, and the essential morbid action is located accordingly. Indeed, various predisposing and exciting causes may be sufficient to locate the disease in the laryngeal and tracheal structures; and hence, the inordinate use of the voice, as in public speaking and singing; the inhalation of irritating substances, gastric derangement, and all those agents capable of inducing *chronic laryngitis*, may cause laryngeal phthisis. In other words, those agents which, in non-tuberculous constitutions, may induce simple chronic laryngitis, may, in the diathetic state, give rise to laryngeal phthisis.

Laryngeal phthisis, as now understood, is essentially a tuberculous disease; that is, it is either so in its primitive condition, or by continuance becomes connected with tubercular deposits in the larynx, trachea, and lungs. But to constitute what is

properly laryngeal phthisis the disease must begin in these structures, and predominate in them throughout its entire course. When, on the contrary, phthisis is primarily located in the lungs, and the larynx becomes implicated merely in the progress of disease, the affection of the air-passages becomes a mere symptom, and, therefore, does not give to the case an essential character.

It is evidently rare that laryngeal phthisis proves fatal without the lungs becoming involved in tubercular disease; indeed, all the cases which have come under my observation have been associated with pulmonary tubercles. At the same time we can not deny that true tubercular disease of the larynx and trachea may prove fatal without involving the lungs, or, at least, the pulmonary disease may play a very unimportant part in the morbid action.

The symptoms of laryngeal phthisis point more directly to the air-passages than the pulmonary substance. Upon inspection, the fauces exhibit, more or less, marks of inflammation; the tonsils are nearly uniformly diseased, varying in extent and special character in different cases; and the larynx, so far as it can be examined, shows evident marks of the disease. By depressing the tongue, the epiglottis can usually be seen, and the larynx can be still further inspected, by means of the *laryngoscope*. The epiglottis is usually red, swollen, and eroded or ulcerated; and the same condition doubtless exists in the larynx, and extends along the trachea and bronchi to the lungs. The extent to which the follicles become involved is variable, but they are usually more or less diseased. The general symptoms of laryngeal phthisis do not differ materially from those of the ordinary variety.

The physical signs of laryngeal phthisis are simply those arising from thickening of the mucous membrane, ulceration, and the modifications of secretion. Hence, the laryngeal respiratory sounds may be harsh, dry, or whistling; or mucous and sonorous rhonchi may be developed.

Finally, as a diagnostic point, it may be stated that laryngeal phthisis differs from ordinary consumption in the fact that the morbid action in the former begins in the throat, while in the

latter the pulmonary tissues are the first to suffer. There is, therefore, an *idiopathic* laryngeal phthisis and a *secondary* laryngeal affection, the latter a mere sequence or complication of ordinary chronic phthisis. The laryngeal affection, which is strictly idiopathic, *begins in the pharynx*, and involves, as a general rule, the tonsils, mucous follicles, larynx, and trachea; whereas the secondary form of laryngeal disease is due to the primary pulmonic lesion, and hence does not appear until the latter becomes advanced to the stage of tubercular softening.

PART FOURTH.

THERAPEUTICS OF PHTHISIS.

THERAPEUTICS OF PHTHISIS.

CHAPTER I.

TREATMENT OF CHRONIC PHTHISIS.

In the treatment of phthisis the physician's attention must be first directed to the stage of the disease, the constitution of the patient, the character of the exciting causes, and other incidental circumstances bearing on the nature and progress of the affection. The importance of discriminating between the different stages of phthisis can not be less than in any other affection, and yet it is greatly to be feared that many prescribe for the disease, without much regard to the state of the general system or condition of the local deposits. This indifference has arisen, in part, from the difficulty which many experience in the diagnosis of the early stages of phthisis, and in part, also, from a desire to secure the influence of specifics, or, at least, agents which occupy the position of specifics in the general treatment of the disease. In this manner a single agent is often made to extend through the whole course of the disease, and is employed in every stage and condition. It must be evident, however, to every well-informed pathologist, and to every accurate therapeutist, that the same course of treatment can not, upon any sound application of principles, be employed in the precursory stage, the stage of tubercular deposits, of softening, or of excavation; and yet it too often happens that the same

general course of treatment is scarcely varied in these widely different conditions. Thus, since the introduction of cod-liver oil, and the establishment of its reputation in the treatment of phthisis, many practitioners conceive they have performed their whole duty, and given the patient the best prospect of recovery, when that agent has been prescribed from the beginning to the end. But instead of adopting this indiscriminate course, we should distinguish not only between the different forms of phthisis, but likewise between the stages of each variety. In treating, therefore, chronic phthisis, I shall observe the following stages:

1. The Precursory Stage.
2. The Stage of Tubercular Deposits.
3. The Stage of Softening.
4. The Stage of Caverns.
5. The Complications.

SECTION I.

TREATMENT OF THE PRECURSORY STAGE OF PHTHISIS.

I have already described, at considerable length, the phenomena of the precursory stage of phthisis, by which is meant a morbid state anterior to the occurrence of tubercular deposits in the lungs. It might, with propriety, be termed the *first* stage of phthisis, for it does, in fact, constitute the earliest state of the morbid action; but inasmuch as common usage has fixed the period of deposits as the first stage of the disease, it will prevent confusion by denominating this initial condition *precursory*.

The phenomena of the precursory stage, as previously detailed, indicate a state of impaired vitality, mostly hereditary in its origin, and ultimately tending to the formation and deposit of tubercles. The special manifestations of disease are loss of weight and strength, variable, though not seriously-impaired digestion, weak calorific power, diminished respiration, and

disease of the fauces, extending more or less to the respiratory passages. These symptoms (connected with the *physical* signs previously detailed) are particularly significant in those hereditarily predisposed to consumption, and can not with impunity be neglected. It is true, indeed, that loss of weight and impaired vitality, in a general sense, may occur in persons in no way predisposed to tuberculosis, and in whom that disease may never be developed; but in all such examples there will be found some obvious cause for the symptoms, independent of inherent constitutional changes, and, therefore, without any direct tendency to tubercular phthisis. Besides, there is a characteristic aspect of tuberculous cases, which, although not so well marked as to arrest the attention of the inexperienced, is still sufficient to distinguish it from temporary or accidental debility. In fine, the whole phenomena indicate a state of lowered vitality, which serves as an important indication in treatment.

1. *General Hygienic Course.*—In the precursory stage of phthisis, representing a condition independent of local pulmonary disease, and consisting in a derangement of the general system, the remedial course must necessarily be largely *hygienic;* which consists in the due regulation of the exercise, diet, clothing, change of climate; and, in certain cases, a general tonic course of medication.

The circumstances under which many of these cases originate afford the clearest evidences of the nature of the exciting causes, and the indications for treatment. Thus, persons confined to in-door business, such as merchants, bankers, school-teachers, tailors, shoemakers, who breathe an impure and often over-heated atmosphere, with limited physical exercise, are placed under the most favorable conditions for the development of tuberculosis. And in addition to the circumstances named, such persons (at least in the United States) are usually addicted to the use of tea, coffee, and tobacco, agents which operate most unfavorably in such constitutions. The effects of these agents are pernicious in a two-fold manner; they excite the nervous system, ultimately inducing debility, and thereby increase the metamorphosis of the tissues and favor emaciation; and second-

ly, they impair the functions of the stomach and of primary assimilation in a general sense.

The effects of the agents named are widely different. Tea and coffee stimulate, and by long-continued or excessive use, cause irregular action and finally debility of the nervous system, which latter condition favors the metamorphosis of the tissues; while tobacco impairs digestion, depresses and renders irregular the action of the nervous function and the heart, and strongly increases the tendency to emaciation. Some doubt may exist in regard to the effects of tea and coffee; these articles of diet are rich in nitrogen, and acting as nervous stimulants, have been supposed to impede metamorphosis. The experiments of Böcker and Lehmann favor this conclusion; but, although the observations proved that the excrements were diminished under the influence of tea and coffee, and increased when water alone was used as a beverage, yet they are not conclusive in the premises, and probably stop short of the point which most interests practitioners. It may be, indeed, that the *moderate* use of tea and coffee will sustain nervous action, and thereby impede the transformations of the tissues; but beyond this mere initial state, there are effects of these agents the reverse of a stimulating or sustaining influence, which is, in fact, abnormal and debilitating. Those who drink largely of these beverages (especially *young* persons with little exercise) become "nervous;" that is, the nervous system being over-stimulated, comes to act irregularly, to which debility surely ensues. This state impairs digestion, diminishes the power of resistance, weakens the molecular affinity of the tissues, and thereby favors decomposition. At the same time, excretion is doubtless diminished, (as observed by Böcker and Lehmann,) which rapidly impairs the vital powers. In this manner the free use of tea and coffee, taking the place of substantial food, impairs primary and secondary assimilation, predisposes to debility, and just to that extent favors the development of tuberculosis.

The evil effects of tobacco are more evident and extensive than those of tea and coffee; and whatever doubts may exist in regard to the action of the former agents on the metamorphosis of the tissues, there can be none in relation to the latter. It is a

common observation that the use of tobacco impedes the formation of fat, and is resorted to by many persons for the purpose of preventing obesity. It possesses properties which act with great energy on the nervous system generally, and especially on the heart and stomach, and thus seriously impairs the powers of assimilation, and may permanently affect the nutritive functions. In addition to these effects of tobacco, it evidently exercises an unfavorable influence over the glandular structures of the fauces; and where there exists a tendency to follicular or tonsillar disease, or affections of the mucous surface generally, the use of tobacco must prove prejudicial. Finally, whatever opinions, as pathologists, we may entertain in relation to the immediate effects of these agents on the animal economy, we will scarcely fail, as practitioners, to reach the conclusion, that the liberal use of tea, coffee, and tobacco is highly pernicious in those constitutions predisposed to tuberculosis, and especially in persons subjected to limited exercise.

It must not be inferred, however, that tea and coffee are unconditionally prejudicial. On the contrary, many persons can use these beverages in *tonic* quantities, so that they may prove beneficial rather than injurious. A single cup of coffee in the morning, and tea at night, may often be indulged in without injury; but the personal experience of each patient must determine whether these quantities act injuriously on the nervous function. Large quantities should, I think, always be interdicted. Chocolate is an appropriate beverage, and may often be advantageously substituted for tea and coffee.

The proper hygienic course, under the circumstances detailed, is to change the habits completely and entirely; the use of tobacco, at least, should be abandoned, the occupation changed to free exercise in the open air, a liberal diet of mixed food used, and every measure taken to invigorate the general system. If the morbid tendency has not proceeded too far, a mere change from a sedentary to an active life, and from in-door to out-door exercise, may be sufficient to avert the impending danger. But if extensive damage has been done to the vital powers, and secondary assimilation, as evinced by emaciation, is seriously

involved, the restoration will require a change of climate, and often a judicious course of tonic medication.

2. *Change of Climate.*—It is not my intention to discuss in this connection the general question of a change of climate in tuberculosis, (that subject being reserved for another place,) but merely its relation to the precursory stage of the disease. Practitioners residing in the interior or middle regions of this country, are divided in opinion as to whether patients laboring under phthisis should be sent north or south; but as these views have referrence mainly to the fully-formed stages of the disease, we are unable to cite authority on the subject of the precursory condition. Nor is it possible to bring statistics to bear on the question; and hence individual observation becomes the principal guide. The influences of a *change* of climate on persons debilitated with almost any form of chronic disease, are nearly always beneficial, and it is often immaterial whether the climate to which the patient goes possesses any inherent advantages over that whence he came. It is the mere change of atmosphere, diet, and general associations, acting on both body and mind, which modifies the common condition of the system, interrupts the morbid action, and restores the healthful play of the vital powers. Doubtless it is the mind and nervous system which become immediately impressed with the new objects, influences, and associations; and in the absence of decided organic lesions, the activity of the vital powers may be so far improved as to remove functional disorders, and thus avert the tendency of the general derangement to terminate in local disease.

Thus far it is almost immaterial what change is made, whether it is to a colder or a warmer climate, provided the general associations afford the patient the ordinary pleasures and comforts of new scenery and associations. But it can not be doubted that beyond these incidental influences, there are others of a more permanent character, arising from the different elements of climate, such as temperature, moisture, elevation, and so on, which become important in the treatment of tuberculosis. And the principal question which will occupy the mind of the patient

and physician is, whether a warm or a cold climate shall be sought? whether the mild atmosphere of the South, or the cold of the North, will most certainly change the morbid tendencies of the system, and avert the formation of tubercles? In the United States, the decision will be largely influenced by the geographical position of the parties; if they reside in Northern states, the patient is inevitably sent South; if in the Western, opinion will be divided, some going South, others North. In Europe, I apprehend, most such patients would be directed to the warmer regions.

In determining the question of a change of climate in the precursory stage of phthisis, several important considerations are presented for solution, and on which the decision must rest. In the first place, we are to consider the geographical distribution of phthisis, and thereby avoid sending patients to those localities prone to develop the disease. It would assuredly be unwise to send a patient with precursory but unformed phthisis to a country in which the disease was common among the native population; for although a stranger might resist the endemic influences for a limited period, he would ultimately become liable to the natural effects of the climate, particularly if predisposed to the disease.

The application of this rule to the United States would determine the question in favor of the South, for it has already been shown, by the most extensive researches, and the clearest statistical evidence, that phthisis is three times more common in the Eastern and Northern than in the Southern states, while the Western division holds an intermediate position. Hence, persons residing in the Northern portion will experience favorable results by removing West, and still greater by a residence in the South; while citizens of the West, instead of going North, should migrate to the South.

It must be observed, however, that the preceding remarks have reference exclusively to the winter season, as applied to the South, for it is well known that most of the Southern locations are too insalubrious to permit a Northern or Western man to remain with safety during the summer; besides which, the effects of extreme heat may prove prejudicial in persons

much debilitated by previous disease. In most of the Southern localities malarial fevers prevail during the summer and autumnal months, and as these diseases would prove seriously detrimental in the precursory stage of phthisis, it becomes important to avoid those localities where they are commonly engendered. The whole South, indeed, is more or less malarial; but the extent of its development necessarily varies in different districts, so that comparatively salubrious locations may be found even during the warm season.

The main point on which I insist is, that persons threatened with phthisis, residing in the Northern or Western states, should seek a winter residence in the *South;* and in using this word I mean the southern portion of the United States, the south of Italy, France, or Spain, or even the East Indies. In fact, a change from a cold to a warm climate, (provided the other elements of climate be favorable,) I hold to be highly important, and often essential as a preventive to the further progress of the morbid action. But it will be readily anticipated that mere elevation of temperature is not the only meteorological condition which exerts an influence over the phthisical constitution; on the contrary, it is equally important that the locality should possess a considerable altitude, and be free from excessive humidity. Indeed, nothing is better established by observation, than the injurious effects arising from warm, damp, and low situations, such, for example, as the sea and gulf coasts of the Southern states.

In selecting a proper situation, therefore, in a southern latitude of the United States, due reference must be had to the prevailing humidity of the place. It is true, indeed, that the Mississippi Valley becomes more humid as we advance south; but still, great differences will be observed in particular localities. Thus, it can not be doubted that a greater degree of humidity exists along the Gulf coast generally, than in the interior and more elevated situations. Thus, the eastern portion of Tennessee, the high pine woods of the Carolinas and Georgia, the middle and northern portion of Texas, together with similar positions, afford valuable retreats for those affected with the forming stage of phthisis. There is reason to believe, also,

that New Mexico, Santa Fé, California, and Oregon possess climates admirably adapted to the precursory stage of phthisis, and are even superior to other regions of the same latitudes.

In selecting a Southern latitude with the view of securing the full effects of a change of climate, it is essential that the stay be more than a transient journey, in order that the system may receive the full revolutionizing effect of a warm climate. For this purpose the patient should actually *reside* South; and with this view, a location should be selected sufficiently free from the dangers of Southern diseases to enable the patient to remain during the entire year. Or, if this is deemed unsafe, he may retreat North to a convenient and mild point, but should not venture into the cold regions. East Tennessee, in the vicinity of Knoxville, affords an excellent intermediate climate, and will be found valuable for summer or winter.

Another important consideration relates to the occupation of the emigrant. The condition of the system demands fresh air, regular out-door exercise, and a generous diet; and it becomes necessary, therefore, that the patient should not be confined to the house, nor should he engage in any pursuit liable to restrict his movements, or expose him to the pernicious influences of night air, humidity, or the intense heat of a midday sun.

With these precautions, there can be no doubt that a Southern residence will prove highly beneficial, and often completely curative, in the precursory stage of phthisis. It is wholly unnecessary to speculate on the *modus operandi* of a warm atmosphere in these cases; it is sufficient that observation and experience attest the fact that such changes are beneficial, and often arrest the further progress of the disease. Examples have often come under my own observation illustrative of the position here assumed, and doubtless most practitioners, placed under favorable circumstances for observation, have reached similar conclusions. It is immaterial, therefore, whether we ascribe the beneficial change to the diminished proportion of oxygen contained in the rarefied air; the effects of heat on the surface; active elimination from the skin; the benefit derived from constant and active out-door exercise; or whether, in still more general terms, we ascribe the beneficial results to the revo-

lutionary influences of a mere *change of climate.* It may be, indeed, that all these influences are brought to bear on the system, and each contributes its share to the favorable results; while other unrecognized agencies may aid the curative process.

In regulating the sojourn of invalids in the South, we must not disregard their degree of strength, peculiarities of constitution, and other incidental conditions; for it is on these peculiarities that the duration of a Southern residence must mainly depend. Thus, if the patients are somewhat debilitated, with a tendency to prostration in warm weather, it would be hazardous for such persons to remain during the summer; instead of which they should seek a cooler region as the hot season approaches. This is a point of very great importance to many invalids, and one which can not be disregarded with impunity. If patients laboring under debility attempt to spend the summer south of the southern borders of Kentucky, corresponding with the thirty-sixth parallel of north latitude, the relaxing effects of heat will greatly augment the debility, and, not unfrequently, induce some form of congestive disease, or precipitate the deposition of tubercles. All such invalids should retreat from the South by the middle of April or the first of May, and seek a location in the cool regions of the West and North. Traveling by gradual stages, patients should remain a few weeks in southern Kentucky and Ohio, and finally, early in June, reach a point where the system will be invigorated by a dry and bracing atmosphere.

There is probably no portion of the United States which affords a more congenial summer atmosphere for tuberculous invalids than the great Northwest, embracing especially the Lake Superior region, various portions of Wisconsin and Minnesota, ranging from the forty-fourth to the forty-eighth degrees of north latitude. The region about St. Paul is probably as salubrious during the summer as any portion of the United States; and as the means of occupation, such as hunting and fishing, offer great attractions to invalids, that locality may confidently be recommended as possessing superior advantages. The special characteristics of climate in all this region are, the dry, cool, and bracing atmosphere. It is, also, free from local

causes of disease, and, therefore, emigrants are in no danger from endemic influences.

We can not urge any special objection to the Northern Atlantic sea-board during the summer; but I should not feel inclined to recommend it. The want of altitude, the moisture, and variable state of the sea breezes, to say nothing of the endemic prevalence of phthisis, would not indicate it as possessing special advantages. At the same time, a transient visit, rather than protracted sojourn, could not be regarded as particularly objectionable, and might, in some examples, prove eminently serviceable.

An invalid, having thus visited the more northern regions during the heat of summer, should again migrate South as the cold season approaches. By adopting this course, the constant revolutionizing influence of a change of climate will be secured, and the patient thereby placed under the most favorable conditions for ultimate recovery. The comparative duration of a residence in the warm and cool regions must depend on the condition of the patient; if much debilitated, his stay in the invigorating atmosphere should be more protracted, extending, indeed, nearly to the beginning of cold weather; and then, as in the former instance, return to the more genial regions of the South, stopping at intermediate points, as the temperature may indicate.

The migratory course here indicated, although introduced especially in relation to debilitated patients, will, in all probability, be found adapted to a majority of cases; indeed, few Northern or Western persons would bear anything approaching an extreme Southern latitude during the entire summer, while many would find it beneficial to retreat to an intermediate position, if not to the cool regions of the Northwest. In a majority of cases, I am inclined to believe, the two extremes will be found preferable; although much must depend on the peculiar conditions, mental and physical, of each individual patient.

I desire to qualify, in one other particular, the indications for a change of climate, which is found in the *temperament* of the patient. There is reason to believe that the *bilious* temperament will not bear the Southern climate as well as other modifications of constitution; while, on the contrary, persons of a lymphatic

temperament can not endure the effects of cold, but bear well the influences of heat. This latter statement is exemplified in the negro constitution, a race exhibiting the lymphatic constitution. It is well known that this race, in the United States, bears the effects of a Southern climate much better than the whites; indeed, the former will remain in good health where the latter perish from the effects of climate. But, on the contrary, the negro is very sensitive to cold, and is, therefore, constitutionally adapted to a warm climate. It is probable, however, that in the white race, the lymphatic temperament, in consequence of its diminished powers of resistance, is not adapted to either extreme, but that a medium latitude will be most conducive to its healthful action.

In relation to the bilious constitution, it has seemed to me very evident that the Southern climate would often promote tubercular disease rather than mitigate its progress. In no constitution is the progress of phthisis more certain, and its arrest more difficult, than this; and if such persons be sent to warm regions, the biliary and digestive apparatus become still more impaired, and the constitutional disease advances with even increased rapidity. I regard it as injudicious, therefore, to direct this class of patients to Southern regions, with a view to a protracted stay; on the contrary, they should not go beyond the thirty-fifth degree of north latitude, embracing portions of Tennessee, North Carolina, and Arkansas. And even then, the sojourn should be more brief than in ordinary cases, and the patient should seek the colder regions at a comparatively early period.

But there is still another class of patients for whom we must make provision, namely, the *residents* of the South. The question arises, Shall those who reside in the South be directed to the tropical regions, with the view of securing a higher degree and more protracted influence of heat? It would be premature and unwise to deny that such a course might not prove judicious and successful. It is, indeed, possible that a native of Louisiana or South Carolina might be materially benefited, and even phthisis arrested by a residence at Madras, Senegal, or the Cape of Good Hope; or we may go further, and say that the presumption is in favor of the beneficial influence of such a change.

But, at the same time, it must be remarked that phthisis prevails to as small an extent in the Southern portion of the United States as in any of the known tropical regions, and that there is, therefore, less necessity for a change than under the reverse circumstances. Moreover, the patient, already residing in a mild climate, does not experience the evil effects of a rigorous winter. While, therefore, it can not be asserted that the tropics might not prove eminently serviceable, yet it is certain that a more convenient and equally safe course may be adopted. The winters of the Southern states are sufficiently mild to meet the wants of tuberculous patients; and to escape the relaxing effects of summer-heat, and secure the influences of *climatic change*, such invalids may, with great advantage, seek a Northern residence. Such a change invigorates the system, and induces those common revolutionary effects which legitimately belong to a change of climate. A summer residence in the Northwestern region, already mentioned, will scarcely fail to invigorate the relaxed system, and thereby aid in arresting the progress of phthisis; while the invalid, returning to his native South for the winter, will escape the rigor of the North, which he is so ill-prepared to encounter.

3. *Medical Treatment.*—When the patient can not avail himself of the advantages arising from a change of climate, or when such an influence seems inadequate to arrest the progress of disease, recourse should be had to a judicious system of medication. The agents which will be found most beneficial in this stage of phthisis are, tonics, (especially the preparations of iron,) cod-liver oil, and alcoholic stimulants. The use of one or all of these articles, or the predominance of either one, must depend on peculiarities of constitution, habits, and idiosyncrasies. But to these must be added the class of alteratives and evacuants, in certain constitutions, which will be hereafter named.

Tonics.—The agents embraced under the class of *tonics* are always useful in this as in other stages of phthisis; and although the peculiarities of constitution, and other incidental circumstances, will influence the practitioner in selecting the particular agent, yet, as a rule, the *chalybeates* are the most important, and, indeed, may be regarded as indispensable.

The preparations of iron which are found most convenient and useful are the phosphate, carbonate, manganate, muriated tincture, citrate, sulphate, and the metallic powder; and among these various preparations there is, in fact, but little choice. For a long-continued use, however, I am inclined to give the preference to the phosphate or carbonate; but it must be confessed that the specific influence of iron on the composition of the blood is nearly the same, whatever may be the chemical combination. A very convenient and often useful preparation is what is known in the shops as the *compound syrup of the phosphates*, the principal constituents being the phosphates of iron, lime, and soda. It contains a large amount of phosphoric acid, which some have regarded as objectionable, if long-continued. A better preparation is what I prescribe under the name of the *syrup of iron and lime*, which is the compound syrup before alluded to, with which is combined an additional proportion of phosphate of lime, rendered soluble by the use of hydrochloric acid. Six or seven grains of the phosphate of lime may be added to each drachm of the compound syrup, requiring one drop of acid to each grain of lime. Another excellent preparation of iron is the *manganate*; indeed, there is, in all probability, as strong an indication for the employment of manganese as the iron, and the two combined are, I think, often more efficacious than either one alone. The preparation which I have generally preferred is the syrup of the manganate of iron.

The vegetable tonics, especially the preparations of bark, are valuable agents in this condition of the system, and especially so, if there is loss of appetite, or very great debility. They may be given separately, or combined with iron, according to the indications of the case. The bark in substance, the extract, or the compound tincture, are eligible forms for exhibition; or the salts of quinia may be advantageously substituted in certain cases. But, notwithstanding the value of these and other vegetable tonics, they can not, under any circumstances, supersede the chalybeates, although they may be employed at the same time. It is true, indeed, we have not the demonstrative evidence of chemical analysis to prove the deterioration of the

blood in precursory phthisis; but the general symptoms indicate, with the utmost certainty, that the circulating fluid is not in a normal condition, and, therefore, the iron is demanded. And it is immaterial whether the impaired condition of the blood is a primary or secondary change; for, in either event, the chalybeates are equally demanded to restore the blood and prevent further deterioration.

The effect of tonics on the system at large is to arrest emaciation, and restore vitality to the different functions; and it is by checking this process of decay, (at least in part,) that we can hope to suspend or retard the process of tuberculosis, which is usually associated at an early period with progressive emaciation. The preparations of iron and quinine will be found peculiarly valuable in retarding the progress of tuberculosis; and, although it is perhaps useless, if not obtrusive, to speculate on the *modus operandi* of these agents, yet I may be permitted to say, it is evident that their therapeutical influences are exerted on the blood and the functions of the nervous system. We are ignorant of the exact agency of the nervous system in the development of tuberculosis; but some eminent pathologists conceive that the disease originates from derangements of this function, and hence the necessity for employing suitable remedies for its restoration. Indeed, the intimate relationship of the nervous system to secondary assimilation and to the metamorphosis of the tissues, strongly indicates the implication of that function in the initial stage of tuberculosis. But, without basing the indication exclusively on this theoretical view, the more convincing proof of clinical observation has taught me that quinine is a valuable agent in the forming stage of phthisis; it improves the tone of the nervous system, imparts new vigor to the capillary circulation, and thus improves the general aspect of the patient. It is important, however, to observe, that quinine should be given in small doses, at least such as exercise merely a sustaining influence, instead of exciting or disturbing the equilibrium of the nervous function; for, if an undue impression is produced, the nervous system will become deranged, and serious injury may ensue. The salt which I prefer is the *muriate;* and I think the observation is correct, that it is better

borne than the sulphate. One grain I regard as a medium dose, repeated three times a day. It may conveniently be combined in the following manner:

℞ Quin. Mur.
Ferri pulv. āā ℈j.
Sulphur sub. ℈ij.
M. Ft. pil. xx.

One pill to be given three times a day.

Cod-liver Oil.—The high reputation attained by cod-liver oil in the treatment of tuberculosis, in *all* its stages, will sufficiently indicate its use in the initial or forming period. If, indeed, this unctuous remedy is capable of exercising any beneficial influence over the progress of phthisis, its curative effects must be more conspicuous at an early than a late period; and, indeed, at the moment that a loss of weight is clearly evident, a nutritive agent, such as cod-liver oil is known to be, would, necessarily, become a valuable remedy. I shall not speculate, at this time, on the manner in which it operates in the precursory stage of phthisis; but the fact that it is a nutritive article, and that one of the earliest symptoms of tuberculosis is emaciation, affords a solution, at least in part, of its therapeutical action. Hence, the indication for the employment of the oil consists in the evidences of emaciation; and its beneficial effects will be found pretty nearly proportioned to the loss of weight. And I may here remark, that there is an obvious difference in organisms as to the facility with which absorption of the tissues (metamorphosis) takes place; there is, indeed, in some constitutions, so to speak, a loose combination of elements, so that the vital affinity is easily impaired, absorption rapidly occurs, and emaciation is the necessary result. In some such constitutions (the phlegmatic, for example) iron and quinine will exercise an important influence in arresting the decay; but, in many examples, a nutritive agent which will supply the carbonaceous element is strongly demanded, and in such cases the cod-liver oil becomes a valuable adjuvant to the tonic remedies. Alone, and independent of tonics and stimulants, its influence is much less than when given in connection with those agents; indeed,

it supplies but a single indication, which will often fall short of meeting the demands of the case. If the vital powers are greatly depressed, it will be in vain that we attempt to fatten the patient by crowding the stomach with a crude and nauseous oil; for, under these circumstances, the appetite for all other food (the nitrogenized elements) will be superseded by the carbonaceous substance; and while the adipose deposits are actually increased, the general tissues will continue to waste, and the patient may pass into a tubercular condition while the process of fattening is going forward. There is no evidence, clinical or chemical, to prove that the morbid tendency in the precursory stage is due to the absence of fats; and if this is not a primary condition, saturating the system with oil will not be found adequate to arrest the morbid action. On the contrary, if the ulterior changes are taking place in the solids and fluids of the body generally, and emaciation and loss of fats occur as a secondary lesion, the former condition is that which furnishes the true indication for treatment, while the latter, although important, is incidental and secondary.

When the cod-liver oil is resorted to, it should be administered in about half-ounce portions, from a half to two hours after meals, and may be conveniently exhibited in ale, or any similar vehicle. The period of its administration is not a matter of indifference. It should never be given when the stomach is empty; but the length of time after meals will vary in different cases. Some will bear it better almost immediately after eating, say half an hour; while, in other cases, it will digest better one or two hours after meals. Something depends on the quantity eaten; if the meal is very light, the oil may be taken within half an hour after eating; when the meal has been of medium amount, an hour will be the most eligible period; but if the person eats a hearty meal, two hours will usually be found the best time to administer oil. In relation to this point, the rapidity of digestion will exercise no small influence; and hence each patient must decide, after repeatedly varying the time, whether half an hour, one, or two hours will be for him the appropriate period. The experience of most

patients proves that ale is by far the best agent to cover the taste of the oil. A table-spoonful of ale, in a wine-glass, on which the oil is poured, completely covers the disagreeable taste, and few patients object to it. It may be given in connection with iron, when that tonic is required; or, if there be much chilliness, quinia may be dissolved in the oil, and which will act as a valuable tonic and antiperiodic. The following formula will be found useful when iron is desirable:

℞ Ol. Morrhuæ Oj.
Ferri Phos. ʒij. M.
A table-spoonful to be taken three times a day.

The oil is contra-indicated when there exist loss of appetite, gastric irritation, constipation, headache, and, according to my observations, in bilious states of the system. If any of these conditions exist, they must be removed before the oil can be advantageously administered. In addition to this, I think the cod-liver oil is comparatively inefficient in the bilious constitution; or it must be associated with the use of evacuants, such as pil. hydrag., in order to secure any good results. When the oil is ill-borne, or is absolutely offensive to the stomach, there will be little advantage in persevering in its administration; indeed, there seems to be often an indication furnished by nature when the article is inappropriate, very much in the same manner that the appetite regulates the administration of ordinary articles of diet.

Alcoholic Stimulants.—The employment of alcoholic stimulants, in the different stages of phthisis, has gained considerable favor with many practitioners, and is usually readily assented to by patients. It is somewhat difficult to estimate the value of stimulants in this disease in consequence of the irregular manner of their administration, and the disregard of the *stages* of the affection in which they are given. As a general rule, they are employed indiscriminately throughout the entire course of the disease, and without regard to the peculiarities of constitutions or temperaments; and, what is still more important, without any rules as to quantities or effects. The quantity

administered, and the frequency of repetition, are often left to the caprice of the patient, and, therefore, subject to the greatest irregularities and the most uncertain results.

The observations which I have been able to make on this subject have resulted in the conviction that alcoholic stimulants are useful, in certain constitutions, in the forming stage of phthisis; and the presumption is, that their beneficial (curative) effects are nearly, if not quite, limited to this early period of the disease. It is unnecessary in this place to enter largely into the effects of alcoholic stimulants in a general sense, further than to remark that they improve digestion, and thus enable the patient to take a larger quantity of nutriment; and beyond this, they augment capillary circulation, excite the nervous system, and thus improve both primary and secondary assimilation. And there is probably beyond these mere stimulating effects an ulterior action produced on the blood; the carbonaceous element is increased, and the transformations of the tissues (emaciation) diminished, and thus the tuberculous process is more or less arrested.

The form in which the alcoholic preparations should be administered will depend on the constitutional peculiarities, tastes, and habits of the patient. Some will be most benefited by the malt liquors, others by wine, brandy, or whisky. Ale and porter, being a dilute form of alchohol, mixed with nutritious and tonic elements, are peculiarly appropriate, and will generally promote digestion, increase the deposit of fat, and improve the general strength. When distilled spirits are employed, whisky, brandy, gin, etc., may be selected; but, as a general rule, I am inclined to give the preference to whisky, although the constitutional peculiarities, and, to some extent, the taste of the patient must be consulted. Whisky appears to act more on the secretions than brandy, and on this account is preferable; it promotes elimination by the urinary and cutaneous organs while it acts mildly as a general stimulant. In the purely phlegmatic temperament, the brandy being more heat-producing in its effects, may be preferable; but in the sanguineous and nervous constitutions, where less excitation is required, the whisky should be preferred. In some portions of the United

States a domestic brandy distilled from apples has been used, and patients have often assured me that its effects were better than other liquors. But, independent of the differences in the effects of brandy and whisky, there is a strong reason why the latter should generally be preferred, namely: the difficulty of procuring the former in a state of purity. The "old Bourbon whisky," and old rye, can certainly be procured in a pure state; but it is exceedingly difficult to obtain brandy which is not entirely factitious.

In some cases wines will be found preferable to either malt or distilled liquors; this will be particularly observed in females or persons of delicate tastes and nervous constitutions. The sharp stimulus of distilled spirits acts with too much intensity, while malt liquors are not only offensive to the taste, but oppressive to the stomach. Under these circumstances, Sherry, Port, and Madeira wines will be found preferable. But few persons will bear the acidity of our native Catawba wine, and although I have known it advantageously employed, it is not generally to be recommended.

But we must not overlook the important fact that there are certain conditions which contra-indicate the use of stimulants. Among these may be enumerated gastric irritation, inflammatory condition of the fauces or larynx, derangement of the liver, bilious temperament, and great excitability of the nervous system. Where either of these conditions exist, the stimulants will aggravate the morbid action rather than promote the healthy functions. I have often observed that when the peculiar irritation of the throat existed, the laryngeal cough would be aggravated by stimulants, and thus the disease would be made rapidly to advance. In all such examples I have found it expedient to withhold alcoholic stimulants, and depend on unirritating tonics to sustain the system. Again, the bilious temperament and biliary derangements are conditions inappropriate for the administration of stimulants, and demand at least preparatory or corrective treatment. Nor will the nervous system, when greatly excited, bear the effects of stimulants with impunity, and if administered, they must be in mild forms and small quantities. Finally, it may confidently be stated that

stimulants are most beneficial in the phlegmatic temperament, and least so in the bilious, and that the effects will proportionally vary as one or the other of these constitutions predominates. The choice of stimulants as based on temperaments should not be disregarded, for in this respect there are some practical points worthy of attention. Thus, malt liquors will be best adapted to the sanguineous temperament, ardent spirits to the lymphatic, while wines are often the most appropriate for the nervous constitution.

With these limitations and regulations there can be no question as to the beneficial influence of the *moderate* use of stimulants in the forming stage of phthisis; but the excesses into which persons habitually taking ardent spirits are liable to fall can never prove beneficial, but are always injurious. This is one of the evils attending the stimulating mode of treatment; the habit of taking alcoholic drinks is apt to increase until it becomes ungovernable, and thus serious evils arise. But this can not be regarded as a legitimate argument against the employment of stimulants; on the contrary, it is the duty of the enlightened physician to advise such remedies as are best calculated to remove the disease, and the remainder must be committed to the discretion and moral firmness of the patient.

The employment of evacuants in the forming stage of phthisis is an important, but not well-determined question, in the therapeutics of that stage of the disease. In ordinary cases, patients do not seem to demand the use of cathartics, emetics, or sudorifics; but when the functions become impaired, either accidentally or by the natural progress of the disease, it is important to remove the obstruction as promptly and completely as possible. But the evacuant mode of treatment, either by emetics or cathartics, carried to an extent that would cause general debility, must necessarily prove indirectly prejudicial, and consequently that method is inapplicable to ordinary cases.

It has been remarked in relation to those cases in which the digestive organs are in good condition, as evinced by a clean tongue, regular bowels, and normal digestion, evacuants are but little required; but there are certain abnormal conditions

in which the assimilative organs become torpid, and the process of elimination through the skin, liver, and kidneys is greatly impaired. There can be no doubt that these conditions demand evacuant treatment, such as cathartics, emetics, diuretics, and sudorifics; and without the preliminary regulation of these important emunctories, neither stimulants nor tonics will produce their usual beneficial effects, but may add to the functional derangements. But it is important to observe that during the administration of evacuants, we must carefully avoid debilitating the system, and they should be so regulated as to produce the necessary influence in the mildest manner, and without inducing any considerable perturbation in the system. Indeed, tuberculosis is not to be arrested by active or heroic medication; on the contrary, the remedies must act slowly, regularly, and continuously, on the organism. Perseverance becomes, as in many other diseases, a cardinal virtue; while rashness is inappropriate and always to be deprecated.

As a special indication in relation to the evacuant treatment, the function of the cutaneous surface demands particular attention. The diminution of this function is always prejudicial in the forming stage of phthisis, and its due regulation is important in every attempt to arrest the disease. To maintain a due action of the skin, the most appropriate conditions will be found in a warm atmosphere, (as in Southern latitudes,) proper protection by means of clothing, internal diaphoretics, and the warm bath. The latter is often highly serviceable, and it should be resorted to every evening, with friction until the surface is properly excited. Occasionally the addition of salt will prove valuable by rendering the bath more stimulative; or, the free use of soap will often be sufficient or even preferable. Even active sweating by means of the vapor-bath, (water or alcohol —the latter being preferable,) will produce in some constitutions the most valuable results; and as this method is less debilitating than the more active evacuants, it is on that account the more important.

During the precursory stage of phthisis, active hemorrhage, as already explained, is liable to occur, and I deem it of the utmost importance to treat such cases in the most prompt and

judicious manner. If any great degree of vascular excitement is present, a moderate amount of blood should be abstracted by means of cups; or if no increased force of the circulation takes place, *dry* cups will be sufficient. The administration of astringents is less important; nevertheless, if the hemorrhage is considerable, common salt, which is one of the safest and best agents, will usually arrest it; or acetate of lead, gallic acid, and similar agents may be used. But the great practical point to which I desire especially to draw attention is to obviate congestion, and to prevent the secondary effects of the hemorrhage. And by the secondary effects I mean a morbid excitement in the pulmonary structures which are so liable to induce tuberculous exudations. Hence, following such hemorrhages, I would strongly advise continued contra-irritation, by means of dry cups, blisters, and pustulation. These agents should be continued until all evidences of morbid action cease; and, indeed, where the signs of local disease are slight, or even inappreciable, I would still insist on some degree of contra-irritation, for there is nearly always an insidious local action which may become the nidus of tubercular deposits. In addition to counter-irritants, expectorants are useful, and among these none will be found better than equal parts of syrup of squills and senega. I believe, also, that the iodide of sodium, dissolved in the fluid extract of sarsaparilla, is beneficial in aiding the removal of sanguineous remains in these cases.

But while we are bestowing so much attention on the constitutional symptoms, it becomes equally important to address remedies to the local affection developed in the throat. As already intimated, the condition of the throat is often the key to the pathological condition of the system, and it is equally important in a therapeutical point of view. The course of treatment should embrace the application of the nitrate of silver, preparations of iodine, and *excision* of the tonsils. The removal of a portion of the tonsils is particularly insisted on by Dr. Green; and, according to his extensive observations, great benefit is derived from this measure. When these glands are found secreting morbid material, and exhibiting diseased action throughout their substance, I am satisfied that great benefit will be

derived from the excision of the diseased portion. Following this operation, the employment of the local applications previously named should be continued, together with the constitutional treatment.

SECTION II.

TREATMENT OF THE STAGE OF TUBERCULAR DEPOSITS.

The stage of tubercular deposits is properly divisible into three periods: *solid deposits; softening; excavations;* and, although these several conditions are but progressive stages of the same morbid process, yet the extension of the lesion, together with the incidental affections which usually arise, render these stages so widely different, both in regard to the local affections and constitutional derangements, as to require modified methods of treatment. Without this discrimination, all treatment must become empirical, and every effort at cure will be based on vague analogies or deceptive observations. It is true, indeed, that there is a common constitutional disease which runs through all the stages of tuberculosis, and a specific morbid element which is manifested in every period of the affection; but the modifications induced by the occurrence of tubercular deposits in the pulmonary structures, of softening, and, finally, of excavations, are too manifest to be disregarded by the enlightened pathologist and discriminating therapeutist.

The treatment of tuberculosis, after the occurrence of local deposits, and anterior to softening, involves the greatest difficulties connected with the whole subject, and requires the most careful attention to the different phases of morbid action, both general and local. Thus, the early period of the stage of solid tubercle still affords hopes that the morbid action may be arrested, the exudations absorbed or rendered inactive, and the disease thus arrested in its forming stage. The practitioner should keep in view the pathological laws governing tubercular deposits, and the possibility of retrograde action on the one

hand, and on the other, the absolute certainty of softening when it has reached a certain point. It is doubtless true that, in the earliest stage, when the constitutional disease is of moderate intensity, or has been mitigated by treatment, and when corresponding to this, the exudations are neither numerous nor extensive, the whole morbid process may be arrested, the tubercular matter liquefied and absorbed without elimination, inflammation, or ulceration. Or, again, the tubercles may undergo a retrogressive action, and thus remain permanently inert. This is the pathological view, and the therapeutical question arises, What course of treatment affords the greatest probabilities of fulfilling these indications.

Advancing beyond this early stage of local disease, and this mild constitutional tuberculosis, we encounter a condition in every sense more profound; the general system becomes more deranged, the exudations increase in amount, and *softening*, with elimination, becomes inevitable. It would be perfectly futile to attempt to render tubercle stationary or inert under these circumstances, and the therapeutical indications, therefore, are to restrict, as far as possible, further deposits, to prevent, during the process of softening, inflammatory exudations into the pulmonary tissues, and thus to secure the elimination without extensive local lesions. There is an extent of morbid action in the pulmonary tissues which can not be repaired; and the object of treatment is to limit the local disease, and thus prevent the fatal degree being attained. Hence, the indications in the treatment of tubercular deposits are, first, to suspend the constitutional disease, and render the tubercular deposits inert; or, if the disease has gone too far to admit of the tubercles becoming absorbed or rendered inert, the second indication is to *limit* the morbid action, and keep it within curable bounds.

The general indication is to suspend the whole tuberculous process, and to render the deposits inert. The condition which we are called on to remedy, in fulfilling this indication, consists in a medium degree of general tuberculosis, and of deposits in the pulmonary tissues. So far as pathology has thrown light on this subject, the morbid changes are embraced in a faulty metamorphosis of

the tissue, (secondary assimilation,) inducing deranged blood, innervation, and secretion, with the ultimate exudation of tubercular material in the pulmonary structures. The deposit of tubercles in the lungs is not necessarily caused by any appreciable degree of vascular or nervous excitement, nor do they, in this stage, act as foreign bodies so as to induce morbid action in the adjacent tissues. And the tubercles themselves are so constituted that, in certain conditions, they may remain stationary, or even slightly contract, and thus become entirely inert bodies. The two conditions, therefore, which require to be changed, are the constitutional tuberculosis and the exudations in the pulmonary tissues—the first to be entirely suspended, and the other rendered stationary or inert. It is abundantly evident that so long as the tubercular elements are formed in the general system, the pulmonary exudations will continue to augment, and hence no method of local medication, applied immediately to the respiratory organs, can be sufficient to remove or arrèst the disease. But, while the constitution is being modified and the formation of tuberculous matter arrested, the pulmonary deposits may, at the same time, be impressed either by the remedies which affect the whole system, or by the additional agents employed for that particular purpose.

The advantages of a *change of climate* in this stage of phthisis, although less marked than in the forming period, are still very great, and every patient should be permitted to enjoy the beneficial influences of a new residence. The question as to the temperature and other qualifying conditions, is obviously important; but what has already been stated, in reference to the forming stage, will apply with equal force to this more advanced condition. I am satisfied that, as a general rule, patients will receive more benefit by changing to a warmer than a colder atmosphere; and if no other reason could be assigned, the simple fact would be sufficient that the powers of resistance in tuberculous subjects are materially impaired, and, therefore, they require a milder instead of a more rigorous atmosphere. The general impression that a cold atmosphere is invigorating, and a warm one relaxing, is true as an independent proposition; but, in considering the effects of climate on the tuberculous constitu-

tion, we must extend our view far beyond this mere elementary influence of heat and cold.

The effects of cold under these circumstances may be well compared to the action of a cold bath, the result depending mainly on the duration of the application. Thus, a cold shower bath, or even a plunge, of momentary duration, will be followed by a healthy reaction, and an improvement of the tone of the general system; but if the application is protracted, the system becomes chilled, the equilibrium of the functions is impaired, and the person will be proportionally injured. And the same rules will apply, on a more extended and complex scale, to the effects of a rigorous climate on the tuberculous constitution. A *temporary* sojourn in a cold climate might produce a favorable reaction in persons whose vital powers have been impaired by the tuberculous process; but a *protracted* residence in Northern latitudes can hardly fail to act unfavorably on a system the vitality of which is already depressed. Under such influences the vital actions are disturbed, pulmonary congestions and inflammations supervene, and thus the local disease augments with great rapidity. If a tuberculous patient should, for example, remove from the thirty-eighth to the forty-fourth parallel of north latitude, the rigorous character of the climate would necessarily prevent much out-door exercise, and the consequences of being confined to the heated rooms of a dwelling could hardly fail to prove pernicious.

On the contrary, the influences of a medium Southern climate would prove in every respect genial, and the constitution would readily undergo those important changes which are necessary to arrest the tuberculous process. If the climate is moderately dry, with a medium degree of heat, the capillary circulation becomes invigorated, the cutaneous function is rendered active, and, in the absence of extreme perturbations of the atmosphere, the equilibrium is duly maintained. The patient is able to enjoy a large amount of out-door exercise, and thus avoid the evil consequences of confinement and want of fresh air; while the climatic influences already referred to are producing important changes in the constitution.

But independent of a change of climate, or in addition to

that influence, patients in the second stage of phthisis imperatively demand appropriate and well-regulated medical treatment. It is no longer a condition in which the conservative powers of nature are competent to arrest the morbid action, but it becomes necessary to interpose suitable medicinal agents, the action of which is to suspend the progress of tuberculization. The morbid action which pervades the system in tuberculosis evinces a natural tendency to augment, and hence the imperative necessity for the intervention of art.

The pathological condition which is to be remedied in this stage consists not alone in the predisposition, but also in the actual formation of tubercular matter; and the indications are to arrest the evolution of the morbid material, and prevent its deposition in the pulmonary tissues. In accordance with the views previously expressed, the morbid action which gives rise to tuberculous matter is connected with the metamorphosis of the tissues of the body; it is not, therefore, a primary lesion of the digestive function, nor of the blood; but is intimately associated with those ulterior changes which take place in the continued evolutions of the organic structures. It may be termed *a perverted metamorphosis of the tissues;* and the chief object of treatment is to alter this perverted action and restore it to a normal state.

There are different degrees of emaciation in the early stage of phthisis which furnish indications for treatment; thus, in some examples, the loss of weight is slight, and the tubercular deposits proportionally limited, while in others these changes are remarkably rapid. It is true these are but degrees of the same morbid condition, but still the variations are too important to be overlooked, and often, in fact, become the basis of treatment. Leaving out of view, however, this particular symptom, we may, in a general sense, reduce the indications of treatment to three heads: 1. To arrest the evolution of elementary tuberculous material; 2. To promote its elimination; and, 3. To induce absorption.

1. *To arrest the evolution of tuberculous material.*—It is not known that we possess any *specific* agent which is capable of arresting the development of the elementary tuberculous mat-

ter, notwithstanding professional and non-professional attention has been so strongly directed toward that object. But it is equally true that many *supposed* specifics have been discovered, among which may be mentioned cod-liver oil and iodine, to say nothing of the numerous vegetable substances which have been believed to exercise specific effects over the tuberculous condition. It can not have escaped observation that many of these agents are employed precisely as though their specific virtues had been fully established, and that they could be relied on with certainty in every stage, form, and modification of the disease. Such, indeed, is the mode in which cod-liver oil is now employed; it is given in every stage of the disease, regardless of the true indications for its administration, or the evil consequences liable to ensue from its indiscriminate use. But if there is any value in pathological knowledge, or any scientific basis for therapeutics, we must adapt the remedy to the stage of the disease, and select an agent in accordance with its demonstrable effects on particular morbid conditions.

Finding, therefore, no specifics in our materia medica, we must endeavor by less direct, but more philosophical, means to attain the desired object; and, as the transformation of the tissues is directly concerned in the tuberculous process, we will naturally direct our attention first to the morbid metamorphosis which is evinced by the incipient emaciation. The agents which, *a fortiori*, may be presumed to be capable of arresting this process are the stimulants, tonics, nutrients, and, we might add, *alteratives*. But the morbid process being a complex one, some discrimination is necessary in the selection of the agents, for we have not only to remedy the change in the tissues, but must also give attention to the local deposits.

Alcoholic stimulants possess the power in this as well as the preceding stage, of modifying materially the metamorphosis of the tissues, and of arresting, more or less completely, the process of emaciation. The hydro-carbon of the alcohol undoubtedly modifies, in a most marked manner, the blood, and, through it, the nutrition of the tissues; fatty elements accumulate, the process of decay is checked, and the weight of the body increased. These are results of the greatest consequence in the tuberculous

condition, and serve essentially to check the formation of the morbid material. The preparations of iron, cod-liver oil, quinine, and the tonics generally, aid in producing the same result, and thus contribute to the arrest of the tuberculous process. Cod-liver oil, as previously stated, possesses fattening properties, and therefore checks emaciation. Iron sustains the richness of the corpuscular element of the blood, and, through that fluid, assists in subduing the morbid state connected with phthisis; or, if it does not *directly* arrest the tuberculous process, it prevents the blood becoming impoverished, and thus wards off a condition which could not fail to prove seriously detrimental while tuberculous matter is being formed. The iron treatment, indeed, may be regarded as an essential part of the therapeutics of tuberculosis; it is adapted to nearly every form and condition of the disease, and its omission must always lead to a deterioration of the blood. It is true that so long as primary digestion is well sustained, and nutritious food, together with cod-liver oil and similar agents, can be administered, the blood will be maintained in a condition approximating health; but, at the same time, the agency of the iron is more direct and substantial, and, therefore, should never be omitted.

The influence of *quinine* in this stage of the disease is of the greatest importance. It evidently acts differently from either of the articles previously named, and fulfills an indication not met by either alcohol, iron, or cod-liver oil. Without entering into any speculative views in relation to the effects of quinine, it may be briefly stated that it evidently acts on the nervous system, and thereby promotes digestion, circulation, and secretion. It is, in fact, a neuro-tonic medicine, and can not fail to exercise a beneficial influence over the deranged state of secondary assimilation, which prevails in tuberculosis. Besides this, the use of quinine will prevent the occurrence of chills, a symptom quite common in all the stages of phthisis, and always productive of serious injury and great inconvenience to the patient. Thus, quinine may be regarded as an important agent in the tuberculous constitution, both on account of its essential influence in that condition, and also its agency in preventing the occurrence of chills.

My own observations have fully convinced me that the nervous system is too much neglected in the treatment of phthisis. The investigations of chemists have drawn attention so forcibly to the condition of the fluids, that the agency of the nervous system is almost wholly neglected, both in regard to pathological changes and therapeutical indications. It is true we are not able to locate the evolution of tubercle in any known derangement of the organic system of nerves, and, therefore, can not, like Dr. Copland, adopt the nervous theory of the disease; but, at the same time, it is beyond question that an intimate relationship exists between the capillary circulation, nutrition, and innervation, and that the latter function is always impaired, either as a primary or secondary state, where lesions of the former exist. Hence, it is obvious, that in estimating the ultimate derangements of secondary assimilation, the nervous influence must not be overlooked; and, on the other hand, in adapting our remedies to morbid conditions, we must not depend alone on hæmatics, but should likewise employ the nerve-tonics. If the deterioration of the blood is not idiopathic, but depends on anterior changes in the vitality of the system, it will be in vain that we address remedies exclusively to that fluid; but we must proceed a step further, and endeavor to improve the nerve-power, as the great vital excitant, and through that agency arrest morbid action and restore assimilation to its normal condition.

There are other nerve-tonics besides quinine which may be advantageously employed in certain constitutions and conditions, among which are strychnine, Indian hemp, and perhaps electricity. These agents excite nervous action, and may therefore prove beneficial in states of depression of this function. I have thought benefit has resulted from a combination of quinine and Indian hemp, in the following proportions:

℞ Quin. Mur. ℈j.
Ext. Canab. Ind. grs. v.
M. Ft. pil. xx.
One pill to be taken three times a day.

Another formula which has proved serviceable, in the early

stages of deposits, is a combination of the fluid extract of cimicifuga and strychnine, according to the following formula:

℞ Fluid ext. Cimicifuga,
Syr. Prun. Virgin. āā ʒij.
Hall's Sol. Acet. Strych. ʒij. M.
Take a tea-spoonful three times a day.

The exact effect of the *cimicifuga* (actæa racemosa) is not certain; but it appears to act on the bronchial mucous membrane, and also decidedly on the nervous system—a combination of powers which may prove valuable in incipient tubercular deposits. Many years ago, Dr. Hildreth, of Marietta, Ohio, drew attention to this agent in the treatment of the early stage of phthisis; and, although the observations which have been made since that time have not been numerous or accurate, there has been, nevertheless, some additional testimony recorded. My own use of the cimicifuga has been extensive, and my testimony is certainly in its favor. I sometimes combine it with iodine, in the manner to be mentioned hereafter, and as originally proposed by Dr. Hildreth.

Finally, the medicinal agents which have been found most serviceable in arresting the evolution of tubercle, are cod-liver oil, alcoholic drinks, quinine, and iron. The proper combination of these agents must depend on the condition of the patient.

The *hygienic* treatment of this first stage of phthisis is of the utmost importance; indeed, without a proper regulation of diet, exercise, climatic influences, and other conditions capable of affecting the vital actions, mere medication will usually prove unavailing. The following heads will embrace the subject of hygiene in its relation to this stage of tuberculosis: 1. Diet. 2. Clothing. 3. Exercise. 4. Conditions of the atmosphere.

1. *Diet.*—The importance of a due regulation of the diet, in a disease which essentially involves the nutritive functions, can admit of no doubt, but there may be differences of opinion in regard to the classes of food best adapted to consumptives. Regarding the subject of diet in its general physiological aspects, we would necessarily conclude that food of a highly nutritious

quality is demanded in the tuberculous condition, and especially so as the nutritive function appears to become weakened. This proposition may be mainly true, and yet, I am inclined to believe, it requires to be carefully considered, if not materially modified in this disease.

The two great objects of nutrition are to sustain the tissues, and to develop animal heat, which are accomplished by different classes of food. Hence it is requisite, not only in this, but all conditions of the system, to furnish proper proportions of nitrogenous and carbonaceous food; but it can scarcely be doubted that, in pathological conditions, the proportions of these elements of food must be considerably varied from the physiological state. Without entering into the minute doctrines of the subject, I may remark that the presence of oxygen, carbon, and hydrogen in the system, bear a very direct relationship to the metamorphosis of the tissues; when physiologically balanced, the atomic changes will be so regulated that emaciation will not occur, but if the oxygen is either positively or relatively increased, the carbon must be rapidly consumed, transformation becomes active, and emaciation is the result. And it must be borne in mind that the tuberculous material is evolved during the metamorphosis of the tissues, which is, indeed, a perverted act, connected with their ultimate changes. In the tuberculous state there is, as I believe, always a perverted metamorphosis, which is evinced by varying degrees of emaciation; but it is true that, in the incipient stage, the change is often so slight as to be scarcely appreciable, and hence it is a state of *perversion* rather than of active reduction. Now, it is generally believed that this emaciation demands nitrogenous food to supply materials for the wasting tissues, and hence animal substances, in large quantities, are forced on tuberculous patients; in other words, they are enjoined to make beefsteak and other meats the basis of their diet. But there is reason to believe there may be a serious error at the very foundation of this doctrine. Our object, in these examples of disease, is to *check* the perverted transformation, which could hardly be accomplished by crowding into the system large proportions of nitrogenous elements of food. It would appear, indeed, that there

is diminished resistance and perverted action; and, although I would not attempt to argue the question in detail, yet it appears that, in these examples of diminished resistance, the oxygen, which may be called the liquefying element, gains the ascendency, and thus its effects become morbidly active. Hence, instead of crowding the system with nitrogenized food, especially designed to develop tissues, it seems more rational to employ the carbonaceous class, or, at least, those substances which are rich in carbon, and which are calculated to protect the system from the excessive action of oxygen. According to this view, vegetable rather than animal food should be the basis of the diet of tuberculous patients, while at the same time animal food is, to a certain extent, desirable, especially such as contain fats. If the cohesive powers of the tissues be weakened, and the molecules tend to separation, it would appear unwise to crowd the nitrogenous substances into the system, the elements of which can scarcely admit of proper assimilation.

I do not mean, by these remarks, to interdict animal diet, but merely to indicate, that large quantities of nitrogenized food do not appear best adapted to the tuberculous condition, and that the non-nitrogenized should be made the basis. Hence, animal food, in which fats predominate, the various vegetables, especially potatoes, wheat-bread, rice, etc., become more appropriate than a predominance of lean animal food. The system is thus protected by the carbon, while undue quantities of protein-compounds are not forced into the tissues.

But it is equally necessary to observe that the quantity is not less important than the quality. When the powers of assimilation are weakened, it is highly improper to attempt the introduction into the system of a large quantity of nutritive elements; for it is abundantly evident that the nutritive powers having become impaired, the ordinary quantity of food can not be assimilated, and hence the superabundance must be rejected as effete. In this way, in the forcible language of Dr. James Henry Bennett, the system becomes *poisoned*. But by employing, in a somewhat restricted manner, the nitrogenized class of food, and thus permitting the non-nitrogenized to predominate, and at the same time carefully regulating the quantity, it will

result, that the tissues will be reduced to a condition in which the metamorphosis will more nearly approach a normal state, and in this way the evolution of tuberculous matter may be suspended. There is some reason to believe that a milk diet, containing farinaceous substances, such as arrow-root, may be highly beneficial in certain cases, especially when the digestive powers are weak. I need scarcely remark, that the diet must be varied with the climate and the season, condition of the patient, and form or character of the disease. Warm climates and seasons demand less carbon than the cold ones, and hence a variation should be made even during winter and summer. Again, if the patient is able to take active exercise in the open air, his diet may be more liberal; but when his exercise is limited, it is impossible that he can with impunity consume large quantities of food. Other modifications should be made when the digestive system is feeble or irritable. In either condition, the food must be of the most digestible character, free from irritating qualities, and mostly liquid. The *quantity* should never exceed that which can be readily *digested;* it is far better, indeed, to submit a small amount of nourishing food to complete gastric solution, than to crowd the stomach with a larger quantity, and suffer the consequences of incomplete digestion.

Sir James Clark expresses the opinion that injury is often done by administering too much stimulating food, and there is doubtless truth in the opinion; but the qualifying circumstances will usually be sufficient to guide the practitioner. Thus, as observed by Dr. Copeland, when there is debility, a stimulating regimen may be adopted; but if a plethoric condition is present, with a tendency to congestion, the diet should be light and farinaceous. But in all cases, I repeat, over-feeding is improper, and often results in serious injury to the patient. Most certainly, if an inflammatory condition is present, the diet should not be full and stimulating, nor will it be proper in such examples to permit the use of alcoholic drinks. I would remark further, that tubercular patients require a *change* of diet, although the same class of articles may be employed. The system soon becomes accustomed to a given form of diet, and the appetite fails under their continuance, so that a modification is

frequently demanded, in order to preserve the nutritive function in a healthy condition. As to the particular articles, much will depend on the peculiarities of individual cases, but the following may be accepted as embracing, in the several classes, the varieties most appropriate.

Animal Food.—Beef, mutton, venison, birds and chickens, fish, oysters. *Vegetables.*—Potatoes, rice, wheat-bread, (made light with yeast,) corn-bread, tomatoes, turnips, etc. These articles must be regulated according to the idiosyncrasies of patients, the state of the alimentary canal, the stage and condition of the local disease, and the state of the general system. If the emaciation is rapid, without inflammatory action, animal food containing fats becomes necessary; but if there exists irritability of the alimentary canal, a milk diet with farinaceous substances will prove most advantageous. While, on the contrary, if a febrile state of the system is present, a vegetable diet will be preferable to animal, and even the quantity must be restricted to the actual wants of the system.

2. *Clothing.*—It is highly important to regulate the clothing of tuberculous patients, and especially so during cold or variable seasons. The calorific power in such patients is below the physiological standard, and they are, consequently, peculiarly liable to become affected by sudden changes of temperature. Hence, the system should be guarded by woolen clothing, of sufficient thickness to protect, but not to oppress the system. Extremes are never desirable; and while we are anxious to protect the system from the influences of cold, there is such a thing as oppressing it with too heavy clothing, which may become burdensome and injurious. If the body is loaded down with heavy woolen materials, the surface is made to act too freely, and thus debility is induced. It is important, therefore, to regulate the quantity of heavy material with care and judgment, so that while we protect the body from the effects of sudden changes of temperature, it does not become oppressed by the measures designed to protect it.

One of the most important incidental points relates to the dress of females. The tyranny of fashion induces females to dress in thin and delicate fabrics, with the arms and chest

greatly exposed, and the feet imperfectly protected. In this exposed condition, night visits are often made; and the warmth of crowded rooms, the exercise of dancing, and various excitants, cause a free state of perspiration, following which a very slight exposure is sufficient to induce an attack of pneumonia. Many examples of consumption originate in this manner; and it often happens that such cases are neglected or overlooked, the symptoms being regarded a mere *cold*, until the disease becomes fully established. Such cases are often exceedingly deceptive. A feverish condition, moderate cough, perhaps sputa slightly tinged with blood, are usually the earliest symptoms; and unless the pneumonia becomes fully developed, these symptoms remain slight for a considerable time, so that even experienced practitioners may be readily deceived. Females, having the slightest hereditary predisposition to phthisis, should be particularly instructed in regard to the importance of proper protection by clothing, both before and after the access of positive disease.

3. *Exercise.*—The greatest importance should be attached to exercise in the first stage of tubercular deposits; but the question arises as to the character and extent of physical exertions necessary to maintain the system in a state of health. It is abundantly evident that violent or long-continued exercise would be incompatible with the vital powers of the tuberculous constitution; and hence those occupations or hygienic regulations which require great or protracted physical exertions should be prohibited. In tuberculous subjects the great constitutional vice consists in a tendency to a rapid metamorphosis of the tissues, and, consequently, wasting of the whole body; and whether the explanation which I have offered in relation to the evolution of tubercle be accepted or not, it must be conceded that emaciation is the special condition which accompanies the development of the disease. Hence, it is an object of the highest importance to protect the system against this progressive emaciation, and to restore, as far as possible, the equilibrium between supply and waste.

But, while we acknowledge the truth of these general views, it is equally evident that absolute rest is incompatible with the

maintenance of health, and hence some form and degree of exercise becomes indispensable. In attempting to regulate this part of the treatment, much will depend on the previous habits, general strength, temperament, and disposition of the patient. Thus, if the habit has been laborious, such as in active mechanical or agricultural pursuits, it will be proper to diminish rather that to increase the exercise, so that the system may gain repose, the vital powers recuperate, and the morbid metamorphosis be checked. If, on the contrary, the habit has been sedentary, or confined within doors, the patient should be directed to seek out-door exercise, although not of a violent character.

In that class of persons who have been subjected to severe and long-continued exercise, and tubercular deposits occur under such circumstances, it is evident that the habits have not been conducive to health, and, therefore, require to be changed. The exercise may have been too severe for the strength of the patient, and thus the disease is developed by the debilitating influences of over-exertion. A case of this character has come under my observation at the time of writing this section. A gentleman, without the slightest known hereditary predisposition, was subject to great physical exertion in superintending an iron furnace. He was much in the open air, but not necessarily exposed to inclement weather; and, moreover, the occupation itself is usually regarded as healthy, and the facts seem to show that such is the case. And yet this gentleman became tuberculous, his health gradually failed, and, at this time, has softened tubercles of the right lung. Overexertion, long-continued, was doubtless the cause of the disease in this case. Hence, in all such examples, the exercise should be moderated, and the patient counseled to comparative repose.

But it is not physical exercise alone which proves pernicious, but, in addition to this, protracted mental application, especially when associated with anxiety of mind, becomes even a more potent inducing cause than bodily exertion. Many cases have fallen under my observation clearly traceable to this cause, and there can be no doubt the disease often owes its origin, even in persons but little predisposed to the affection, to the perturbating and depressing effects of mental excitement. Un-

der such circumstances the nutritive powers are impaired, disintegration of the tissues rapidly takes place, and when the slightest predisposition to tuberculosis exists, that morbid state is readily developed, and local disease speedily ensues.

It is evident, therefore, that the regulation of the patient's exercise requires care and discrimination. As a general rule, it should be regular, but never violent, nor so protracted as to amount to actual fatigue; and it should be a cardinal point to avoid that kind of exertion which will greatly hurry the circulation and increase the frequency of respiration. Hence, running, climbing mountains, or even rapid walking, become injurious, not only by inducing debility, but also, by causing too active a disturbance of the functions of respiration and circulation. Moderate walking and riding on horseback constitute the most appropriate modes of exercise; and especially is the latter of the greatest service, and is that form in which the largest amount of healthful exercise can be obtained at the least expense to the vital powers. Sydenham's rule was that tuberculous patients should live as persons in health; that they should ride throughout the year, averaging thirty miles a day. These rules are, doubtless, too rigorous; nevertheless, the importance of horseback exercise can scarcely be overrated, although it requires the ordinary exercise of judgment.

But it is important to observe that, in all cases, the great principle is, to effect a *change* in the habits of the patient. If he has been accustomed to in-door business, let him be induced at once to exercise in the open air, moderately but persistently. If, on the contrary, he has already been subjected to inordinate out-door exercise, let him at once change, so as to enjoy more repose, and thus prevent the rapid expenditure of the vital powers.

4. *Atmospheric Influences.*—Atmospheric influences, in promoting or retarding the development of tubercle, are evidently very great, and the subjects of the disease should always be relieved, as far as possible, from the pernicious effects of an unfavorable atmosphere. As a general remark, a pure atmosphere, with considerable altitude, is that which is most favorable; and the most unfavorable condition is low situations, with cold and de-

cided moisture. Hence, low valleys adjacent to water-courses, not excepting even the sea-coast, are, beyond all doubt, highly injurious to persons having tubercular deposits in the lungs. The effect seems to be to prevent cutaneous and pulmonary exhalations, and thus to favor stagnation in the capillaries of the lungs, and, consequently, exudation of tubercular matter. If persons who occupy low positions be changed to a more elevated and less moist atmosphere, very marked improvement will usually be observed. This has been abundantly verified in Peru, by the observations of Dr. Smith. Here, patients removed from the moist localities bordering on the ocean to the mountain regions, immediately improved, and often recovered. There can be no question, indeed, of the importance of this opinion; and patients changing climate, especially on going South, should always carefully avoid low and very damp localities; and hence no point on or near the sea-coast should be selected, but preference should be given to the dry and more elevated regions of Texas, Georgia, North and South Carolina, East Tennessee, and all regions similarly located. Mere altitude, aside from avoiding excessive moisture, has, doubtless, a favorable influence in the tuberculous condition, and hence mountainous regions are usually preferable to plains or valleys. In making this observation I refer to warm climates, or, at most, temperate regions; for, in the colder latitudes, great elevations prove too exciting, and, therefore, defeat the most important objects we have in view. But mountainous regions are usually dry, and hence the patient may enjoy the advantages of a suitable degree of moisture without being obliged to ascend to a great altitude.

But while we inculcate the general principle, that an atmosphere charged with moisture is injurious in this stage of phthisis, it is not less important to avoid the opposite extreme. Thus, a very dry and sharply-cool atmosphere is generally not safe, for the liability to establish excitement in the pulmonary tissues becomes hazardous, and should, if possible, be avoided. Hence, a medium degree of moisture is preferable to either extreme, and, doubtless, exercises a kinder influence over the morbid state of the lungs than extremes of dryness or moisture. It is doubtful, also, whether a rarefied atmosphere, as in mount-

ains of great altitude, can be safely breathed by tuberculous subjects in the stage of local disease; it is questionable whether such an atmosphere would not increase the pulmonary circulation, and thereby predispose to hemorrhage and morbid exudations. But on these points it becomes us to speak with prudent reserve, for the facts are too few to admit a safe generalization.

It does not appear that exhalations from the earth, or breathing an atmosphere charged with gases, exercise any beneficial influence over the disease. Laennec, having observed the infrequency of phthisis on the coast of Brittany, conceived the idea that the exemption was due to the inhalation of iodine, which was given off by kelp; and hence he attempted to create an artificial iodine atmosphere, by placing the plant in the small wards of the hospital. And, at a more remote period, Galen and Celsus sent consumptives to breathe the sulphurous atmosphere of volcanic regions; while Van Swieten thought the effluvia arising from moistened earth highly beneficial. He refers to the *earth-bath* employed by Francisco Solano de Luque, in Granada, which he thinks may have done good by the exhalations. It was employed in the following manner: A pit was dug where no vegetation grew, into which the patients were placed up to their necks, covered with earth, and left until they began to shiver, when they were taken out, and wrapped in linen moistened with rose-water; and, after the lapse of two hours, were rubbed with the "unguentum resumptivum" of Zacutus Lusitanus. He used a new pit each time, and thought the earth safe only from the end of May to October. In England, an impression has prevailed that coal-miners were comparatively exempt from phthisis; and in the United States, strong hopes were entertained, at one time, that the great Mammoth Cave, of Kentucky, would prove a most salutary residence for tuberculous invalids. But whatever foundation there may have been for the opinion in relation to the coal-miners of England, the Mammoth Cave proved a sad failure; indeed, no benefit whatever was derived from its atmosphere, and the experiment was, consequently, abandoned.

Dr. Cartwright, of New Orleans, has directed attention to the

atmosphere of sugar-houses, while surcharged with water and saccharine matter. We can well understand the influences which such an atmosphere may exercise over tuberculous patients; but, as this subject will be alluded to in another section, it will not be pursued further here.

There is no sufficient evidence to prove that any of these emanations, or modified atmospheres, are capable of exercising a curative influence in cases of phthisis; it is true, indeed, that the iodine, if diffused through the air, would exercise a medicinal influence, but its existence in any known locality is too precarious to be depended upon. It is far more philosophical to seek a pure atmosphere, with the qualities previously mentioned; and if it becomes desirable to introduce medicinal substances in this manner, let them be diffused through the air in such way that their actions may be properly understood and appreciated.

2. *To promote the elimination of tuberculous matter.*—If the opinion be true that the tuberculous elements possess something of a specific character, and result from a faulty metamorphosis of the tissues of the body, we can readily conceive that such products admit of elimination from the system, and, possibly, local disease may thus be prevented.

But whatever opinions may be entertained on this difficult subject, we have, at least, two important facts to guide us in the application of remedies. In the first place, it is admitted by all pathologists that the evolution of tubercle involves the whole organism, and is characterized by emaciation; and, in the second place, that the emunctories become weakened in their action, proportionally to the progress of disease. And hence it follows, as a legitimate corollary, that emaciation progressing, and the emunctories failing to perform their proper functions, effete matter of some form must accumulate in the system; and that, acting upon this view, we would not be far wrong, in a therapeutical sense, in attempting to maintain the eliminating organs in a proper state of activity, or even of urging them beyond the physiological degree.

Those organs through which we might reasonably hope to promote elimination, are the skin, alimentary canal, liver, kid-

neys, and the lungs. Speaking of the skin, liver, and kidneys, Dr. Turnbull,* without probably having the full view of the subject before him, remarks: "They are the depurating organs which purify the blood, by removing from it the products of the worn-out tissues, and a healthy activity on their part tends to prevent consumption, and should, therefore, be promoted by appropriate means." There can be no doubt of the soundness of the views expressed in the above sentence; but the author, not entertaining the opinions here expressed, indicates but slight means for accomplishing the important object of sustaining the depurating organs, such as wearing flannel next the skin, cold or tepid bathing, frictions, etc. But these means, however appropriate they may be, will fall far short of the object we have in view. It is true, the *physiological* state should be maintained by proper clothing, diet, exercise, cleanliness, pure air, etc.; but when the morbid action is decided in its character, and the emunctories come far short of their accustomed duty, the hygienic means referred to will fail to accomplish the objects, and we must resort to more positive medicinal agents.

In relation to the functions of the skin, it is important they should be not only maintained in a physiological condition, but, in certain states, it becomes necessary to excite free and full perspiration. Clothing, exercise, and a warm climate are sufficient, in cases not too inveterate, to maintain the natural insensible perspiration; but in certain constitutions, and when the disease has made considerable impression on the system, it often becomes necessary to resort to medicinal agents and warm bathing. Among these, doubtless, the warm bath may be regarded as holding a prominent position; indeed, the use of external warmth, either in the form of an immersion or vapor-bath, will do much to sustain the activity of the skin. The vapor of water or alcohol will readily excite copious perspiration, and if not carried too far, and the skin be thoroughly rubbed with dry cloths, it leaves the function, as well as the general system, in a state of healthy action, without inducing debility. There can be no doubt that the sudoriferous canals

* An Inquiry into the Curability of Consumption, etc.

become contracted and more or less obstructed during states of cutaneous inaction, and active perspiration, or *sweating*, is necessary for the restoration of the impaired function. And the importance of the cutaneous system in tuberculous affections, is rendered evident by the acknowledged sympathy which exists between the skin and lungs. Indeed, there is every reason to believe that obstructed cutaneous action will often seriously impair the pulmonary function, and may even largely favor the deposition of tubercles. But more especially is it important to sustain the cutaneous function with the view of eliminating effete material from the system. In the tuberculous condition, as already intimated, effete matter accumulates in considerable quantities, independent of the immediate tuberculous elements; and hence, in a general sense, we should sustain cutaneous action, as one of the great emunctories of the system. In addition to this, however, it is a fair conclusion that the elementary material of tuberculous matter may, with other effete substances, be thrown off by copious perspiration. Thus we have various reasons and many incentives in favor of copious sweating in tuberculous subjects; and it is, doubtless, equally applicable to the precursory stage, and the beginning of local disease. When the latter condition has become far advanced, the sweating process will prove less serviceable, and must be employed to a limited extent, or entirely abandoned; and in all cases it becomes necessary to guard against inducing debility by oversweating.

Cold bathing is of questionable propriety; but while there are comparatively few tuberculous subjects who can be benefited by this measure, it would be a hasty conclusion to entirely interdict its use. The sensitive state of the nervous system, and the cutaneous debility, will often prevent the vital powers from properly reacting under the influence of cold, hence, it would defeat the object in view. The cold *shower*-bath may be employed in the *precursory* stage with safety and advantage, for here the power to react has not been greatly weakened, and hence, the cold operates indirectly as a tonic. But when the morbid action is more advanced, and positive disease of the lungs exists, the vapor-bath is infinitely preferable, on every

account, to the cold shower-bath. The tepid bath (especially by showering) may be employed in those intermediate cases in which debility has commenced, but has not reached an extreme degree.

The medicinal agents calculated to promote the action of the skin in this form of disease are not numerous, but still require careful consideration. The alcoholic preparations, by stimulating the system, favor cutaneous transpiration, but these require careful regulation in order to avoid the injurious consequences previously mentioned. Moreover, it is only in the incipient stage of local deposits that alcoholic stimulants prove advantageous. The preparations of sulphur and antimony are, I have reason to believe, of essential service in some forms of the disease; and especially is the sulphur indicated when a herpetic eruption coexists. The preparations of antimony require great caution in their administration, and, indeed, it is only the milder compounds, as a general rule, which are admissible. The *pulvis antimonialis* is the preparation most reliable and manageable, when it can be procured pure, and to this we may add the sulphur, in the following form:

℞ Sulphur. Sub. ʒss.
Pulv. Antimon. ϑj.
Sac. Lac. ϑij.
M. Ft. Pulv. x.

One powder to be taken morning and evening.

The particular cases in which these compounds become useful, are those characterized by dry skin, slight febricula, and inactive bowels. Another method of employing the sulphur, and which I prefer to the above, is to add the powder to cod-liver oil, when this agent is employed. Two drachms of sulphur to the pint of oil, carefully shaken before using, makes an eligible and often very serviceable mixture. Whisky and sulphur I have known employed, and it agrees very well with some constitutions.

Another important emunctory, and one which claims especial attention in this connection, is the *liver*. Independently of any temporary change of secretion which may occur, it can not be

doubted that the office of so large an eliminating organ as the liver is highly important in the forming stages of tuberculosis, and should be regularly maintained at a physiological point. We have no direct or tangible evidence that tuberculous material can be eliminated by the liver; but, at the same time, we know not what morbid elements may be depurated by the hepatic system, and, therefore, should carefully guard against its derangements. Analogy would lead to the belief that in nearly all depurating processes the liver must hold an important place. It is true, however, that each emunctory has its own peculiar function; the lungs and liver eliminate carbonic acid and compounds of hydro-carbon, the kidneys nitrogenous elements, while the skin throws off mixed compounds. But these points are too subtile to admit of practical application, in a positive sense, and, therefore, it becomes the practitioner to view these doubtful questions in a more general manner. And, with this view, it becomes, on general principles, important to maintain the functions of the liver, especially when effete substances are accumulating in the blood. Hence, the employment of alteratives, mercurial and others, are often appropriate in the treatment of tuberculosis. The milder class, such as *Pil. hydrarg.*, or *hydrarg. c. creta*, alone or combined with rhubarb, or calomel combined with alkalies, may become necessary. The following will be found a very eligible formula:

℞ Hydrarg. chlorid. mit. grs. xv.
Pulv. Rhei,
Sodæ Bicarb. āā ℈j.
Sacch. alb. ʒss.
M. Ft. pulv. v.

One of these powders given at night, and followed, if necessary, in the morning, by fluid extract of rhubarb or senna, will usually fulfill the indications.

There are, however, two particular conditions in which purgatives and alteratives become especially important, namely: in the bilious temperament, and during the employment of cod-liver oil. My own observations have led to the conviction that persons of a bilious temperament often require mercurial altera-

tives and even active purgatives; and without attention to this condition, the digestive function becomes impaired and the tubercular disease rapidly advances. There is no class of patients in whom tuberculosis is so obstinate and uncontrollable as those who have a well-marked bilious temperament; and I am inclined to believe that a part of the difficulty arises from the physician's overlooking the importance of the hepatic function, and thus permitting it to become inactive.

The second condition especially demanding the use of alteratives, is where cod-liver oil has been employed unremittingly for a considerable period. In such cases it will usually be found that patients become *bilious*, the appetite fails, bowels become torpid, with a coated tongue, and similar signs of hepatic disorder. The introduction of a large amount of carbonaceous material, in the form of oil, necessarily imposes on the liver increased action; otherwise the refuse portion accumulates in the system and induces morbid results. Hence, purgatives become necessary under such circumstances.

There is another practical consideration important to be remembered in this connection. In the bilious temperament cod-liver oil is often not well borne, nor are its effects so efficacious as in other constitutions. Hence, the two special conditions requiring the use of purgatives are brought together, and consequently that class of remedies must be more freely employed than under any other circumstances. I am fully convinced that, in the bilious temperament, the occasional exhibition of purgatives will enable the patient to take the oil more freely, and with greater benefit.

But, aside from the action of alteratives on the hepatic function, there is strong reason to conclude that even smart purging is often useful in the initial stages of tuberculosis. Certainly the eliminating powers of the alimentary canal must be regarded as highly important in this form of constitutional disease; but the extent to which purgation should be carried admits of doubt. In all cases *constipation* should be avoided; and where this tendency exists, my own experience is decidedly in favor of not only maintaining a regular action of the alimentary canal, but also to interpose, at suitable intervals, decided purgation.

I regard it as exceedingly unsafe to permit the alimentary canal to remain, in any considerable degree, locked up; and while we should carefully avoid undue irritation, and unnecessary exhaustion, by these agents, it is still highly important to resort occasionally to decided purgation. And especially at the moment local deposits are commencing, is it important to maintain a soluble state of the intestines; for, on general principles, I believe the *derivative* action to be highly important under such circumstances. For this purpose certain mineral waters, in which chloride of sodium predominates, may be safely and beneficially employed. Among these I would especially mention the Blue Lick and Louisville Artesian waters. The former contains considerable sulphur, and is, therefore, especially valuable, but the proportion of salt is insufficient, and hence that agent should be added at the moment of its use. I would further remark, that the occurrence of spontaneous diarrhœa in this stage of the disease should not be too speedily checked, at least so long as it remains within moderate limits, for such an evacuation may, to some extent, prove critical, or at least beneficial.

The condition of the urinary secretion also demands particular attention, although our knowledge must be regarded as very indefinite on this subject. In tuberculous subjects the urine appears to contain less solid constituents, particularly the nitrogenized elements, while the salts, especially the phosphates, are in excess. In the advanced stages the uric acid is found largely in excess. It has a low specific gravity, and readily undergoes decomposition, becoming alkalescent. These conditions of the urine represent rather the state of the general system than a disorder of this particular function; but, at the same time, we can draw some legitimate therapeutical indications from its condition. In the first place, as an eliminating organ, it is important that its function be maintained at a physiological point, and there can be no doubt that when it becomes deficient either in quantity or quality, it must exercise more or less influence on the general system. But we observe especially that the nitrogenized animal products are deficient, while the phosphates are in excess. This condition indicates

that the eliminating action of the kidneys has materially diminished, for while the metamorphosis of the general system has increased, the amount of nitrogenized products is greatly lessened. We can evidently base on this fact an indication for treatment; but whether we should resort to diuretics, or depend on the effects of tonics and stimulants, to restore the vitality of the system, may fairly be made a question. It has appeared to me, however, that the employment of diuretics, such as colchicum, exercised a beneficial influence, and, in fact, diminished the tubercular deposits. But it must be admitted that this branch of the therapeutics of tuberculosis is by no means settled, and is, therefore, open to further observation. The predominance of uric acid in the advanced stage of phthisis is clearly due to the rapid disintegration of the tissues and the diminished power of oxygenation, and, therefore, does not admit of relief by agents addressed to the kidneys, but so far as it is within the reach of remedies, they must be directed to the general system.

Emetics constitute an important means of *evacuation*, and perhaps also of elimination, in the sense here indicated. But, independent of this view, emetics may often be advantageously employed to arouse the action of the chylopoietic viscera, and thus to promote assimilation. I have no doubt, from my own observations, that, under favorable conditions, the occasional interposition of a smart emetic or purgative (one or both, according to indications) will prove valuable in the treatment of tuberculosis. This course is particularly indicated when other agents, such as cod-liver oil and iron, have been long used; for, under these circumstances, the system becomes so habituated to their action that the salutary influence seems to be lessened; so that the occasional suspension of this class, and the substitution of evacuants, becomes highly important. But to what extent emetics are capable of eliminating tubercle, or tuberculous materials, is uncertain. Sir James Clark speaks of tubercles being dislodged from the mucous membrane of the air-passages by emetics; but the facts have not been very clearly developed. It is well known, however, that emetics have been extensively employed by medical practitioners, and, as some

have alleged, with great success; but, as this question will be more fully stated under the head of miscellaneous remedies, I forbear further remarks on the subject in this connection.

3. *To promote the Absorption of Tubercles.*—Pathologists consider the absorption of tubercles, or tuberculous matter, as so doubtful, if not impossible, that a discussion of the subject may be considered entirely improper. Still, there is reason to believe that the deposits of tubercular material are not so completely removed from the laws controlling other varieties of exudation, as to require us to reject as absurd the view here indicated.

The absorption of tuberculous matter, in some of its phases, has been admitted by Fournet, Carswell, Andral, Boudet, Hasse, and Ancell; but, in most instances, preliminary softening seems to have been indicated. There are two points, however, which merit attention; first, Can tuberculous material, in its most incipient state, be absorbed? and, second, After it becomes crude, can it be liquefied and pass into the circulation?

In regard to the first question, it is to be remarked, that in its most *incipient* state, tuberculous matter is probably fluid, and in that condition there is no reason to doubt that it may admit of absorption. The possibility of such a result can not be denied; but, inasmuch as the deposit usually rapidly increases and speedily becomes concrete, the chances of absorption must be regarded as very slight. Still, if the tubercular condition could be suddenly changed, and the exudation thus arrested, it is not improbable that absorption might take place. Under ordinary circumstances this fortunate result could hardly be anticipated; but where the tuberculous constitution is but partially developed, and the tendency to exudation inconsiderable, we would not be justified in rejecting the possibility of such arrest and absorption. Cases have come under my observation in which a strong probability existed of the deposit of tuberculous effusion, and the final cessation of the signs afforded a fair presumption of the arrest of the process. The immediate physical sign which has seemed to me indicative of this condition, is a peculiar, slight, tearing sound, heard with both inspiration and expiration, of limited extent, but permanent in its development. The sound is more intense than the crumpling

of Fournet, and is what I have described under the name of *tubercular crepitus.* It conveys to the ear exactly the impression of the air-cells expanding in an adhesive liquid, which offers some resistance, but yields with a slight, half-liquid, *sticky* sound. This sign I have observed in many cases in which a tuberculous condition or tendency was supposed to exist, but without any other physical evidence of deposit; and, in due course of time, I have witnessed the disappearance of the sign, and a complete restoration to health. In fact, all the circumstances clearly indicated to my mind, that tuberculous effusion had really occurred, and that it was ultimately *absorbed.* And, even in the absence of demonstrative evidence, which is an impossibility, the position is not so much at variance with the acknowledged laws of exudation and absorption as to require its unconditional rejection, and, therefore, I feel inclined to adopt it.

The second condition under which absorption may occur is after *softening* has taken place. If tubercles are limited in extent, and the deposit ceases, it is probable that the liquefied mass may be absorbed, leaving only a slight contraction, or, at most, cretaceous deposits. Indubitable evidences of absorption of tubercular matter from the bronchial glands has been furnished by Hasse and others; and Rilliet and Barthez report a case in which the contents of a gland were completely absorbed, without communication with the bronchia. Hasse dwells especially on the fact, that in some examples, the remains of cavities in the lungs present no tubercles in the adjacent walls, which is contrary to the usual condition, and is, he thinks, evidence of absorption having occurred.

Under all the circumstances, therefore, I feel justified in the introduction of this third indication, "*to promote the absorption of tubercular matter.*" Doubtless, however, the most philosophical mode of viewing the subject, is, to look upon the suspension of the tuberculous process as an essential preliminary step to the absorption of the effused substance. Thus, if we can arrest the evolution of tubercle while the deposits are small in extent, we may hope for absorption, or, at least, that the effusion will not increase; on the contrary, it will be in vain to attempt to

promote absorption unless we can, at the same time, check effusion, for the two processes are antagonistic.

We have already seen that stimulants, tonics, nutrients, and, in fact, the hæmatics generally, are the agents which tend to arrest the evolution of tubercle; but it could not be supposed that the same medicines would directly induce absorption, although, indirectly, by improving the tone of the system, such might be the result. Hence, to promote the absorption of tuberculous material we must leave the hæmatics, and resort to agents, if not precisely opposite in character, at least such as do not operate exclusively to improve the condition of the blood. In this class of medicines we find mercury, iodine, bromine, and similar agents, while there are still other remedies, such as the alkalies, which may promote solution, and thereby favor absorption.

It is well known that mercury has often been employed in scrofula, while iodine is acknowledged as a favorite agent in that form of disease; but it must be confessed that these potent medicines have often been administered without any definite idea of their mode of action, and, consequently, too frequently with injurious results. They can not be advantageously employed when the blood is impoverished and the system greatly debilitated; hence they are inapplicable to the advanced stages of tuberculosis, and should be restricted to the early period of local deposits. If, therefore, these sorbefacients are administered in the proper form and at the right period, there is reason to hope that they may act favorably on recent deposits. The preparation of mercury best tolerated by the system, and, therefore, the most appropriate for this disease, is the bichloride or the proto-iodide. The particular advantage of the bichloride is that it may be employed for a long period of time, without generally inducing ptyalism, or causing any form of *mercurialismus;* while, at the same time, it will aid in the resolution of exudations, as far as such medicine can act in that direction. The dose should be small, not exceeding the thirtieth of a grain, and its administration long continued.

The preparations of iodine are employed for a similar purpose, that is, to promote the liquefaction and absorption of

exudations. But iodine, in any of its forms, can seldom be employed for a long period without inducing certain morbid results, which require its suspension. The iodides of potassium or sodium can be used for a greater length of time than the article in substance; but even these preparations are apt, finally, to induce, in most constitutions, morbid results, and, in some examples, can not be tolerated at all. The preparation which I employ, as a general rule, is the iodide of sodium, which is, usually, preferable to the iodide of potassium. I seldom deem it necessary to give more than five grains at a dose, repeated three times a day, dissolved in fluid extract of sarsaparilla, or any other simple vehicle. It is necessary that the effects of iodine be carefully observed; and when any of its morbid influences are detected, it should be at once discontinued, or the dose greatly reduced. These morbid effects consist in derangement of the stomach, loss of appetite, thirst, soreness of the tongue and mouth, and, at times, general febrile excitement. Iodine may also be administered by inhalation; this is Piorry's favorite method, and may, doubtless, often prove advantageous. Indeed, we can perceive a pertinent reason for introducing this substance directly into the pulmonary tissues, when we desire to act on deposits at that point.

As combining the effect of both mercury and iodine, the proto-iodide of mercury may be substituted for the preceding preparations. Its liability, however, to induce ptyalism is a serious objection to its use, although, in small doses, it may often be given for a considerable period without detriment to the system. The dose should not exceed a quarter of a grain, repeated twice a day. The following formula is employed by Dr. Green:

℞ Hydrarg. proto-iodid. grs. ij–iij.
Potass. iod. ʒss.
Syr. sarsaparil. ℥iv. M.

A tea-spoonful to be given three times a day.

In this formula there is evidently a decomposition, metallic mercury being precipitated; but it is claimed that the elements recombine, forming the hydrargyro-iodide of potassium.

There are some other agents which may be mentioned in this

connection, especially the actæa racemosa, or cimicifuga. It was first recommended by Dr. Hildreth, in incipient phthisis; and although its mode of action is not well defined, yet it seems to me that it may aid in promoting absorption of the elementary deposits of tubercle. The fluid extract is the most eligible preparation, of which half a drachm is a medium dose. It may be advantageously conjoined with the bichloride of mercury in the following form:

℞ Fluid ext. sarsaparil. ℥iij.
Fluid ext. cimicifuga, ℥j.
Hydrarg. bichlorid. gr. j. M.
A drachm to be given three times a day.

The great objection to the employment of these agents is, that they deteriorate the blood, and thereby promote, rather than remove, tubercular exudation; and, with this view, they are generally discountenanced. But it is evident, that the error consists in a reliance upon these agents *exclusively*, while, in fact, we should give them conjointly with those of a sustaining character. This is the great practical rule—the hæmatics should be employed jointly with the resolvents. Thus we may administer iron, cod-liver oil, and stimulants at one hour, while, at another period of the day, we employ mercury or iodine. The proper period for the administration of the hæmatic class is *after* meals, that is, toward the completion of chymification; while the absorbents are more appropriately taken into an empty stomach. In this manner, we may appropriately administer the tonics after, and the absorbents before, meals, without any interference with each other.

This I regard as the desideratum in the employment of the absorbents. The system is fully sustained by the tonics, stimulants, and nutrients, which are the proper agents to arrest the evolution of tubercular matter; while, at the same time, the absorbents can be given without increasing the debility. Thus, the double object of arresting the evolution, and promoting the absorption of tubercle, may be accomplished at the same time, without one action interfering with the other, and without either acting injuriously on any function or tissue.

It is important to remark, in relation to this whole subject, that absorbents, in the sense here referred to, can not be employed, with any hope of success, except in an early period of the deposits; for, when a certain stage has been reached, it becomes impossible to remove tubercles, except by the process of softening and elimination through the bronchi. Hence, if absorption without softening is to be accomplished, the effort must be made at an early period. When, therefore, the physical signs are barely sufficient to disclose the local disease, and the spirometer shows a vital capacity scarcely reduced below the physiological standard, we are assured that the deposits have but just commenced, and the effort to remove them may be properly made.

When, however, the deposits have become extensive, and all hope of absorption has necessarily been abandoned, the attention should be directed to the limitation of the process, and to preserve the pulmonary structures in as healthy a state as possible, so that the process of softening may take place under the most favorable circumstances. In many important particulars, the treatment which is appropriate to the first period must be greatly modified. It is questionable, indeed, whether tonics, stimulants, and nutrients are demanded, or will be borne to the same extent in this as in the earlier stage. The lungs, in this stage, have reached a higher degree of morbid action; capillary circulation becomes obstructed, and there is a tendency to local excitement and general febrile reaction, and a very slight extraneous excitant is capable of developing more or less local inflammation. Hence, the active exercise, stimulants, and full nutrition must, at least, be greatly reduced, and the system maintained in a state of comparative quietude. Great perturbation of the functions is now to be avoided; the circulation and respiration should be maintained in a state of comparative tranquillity; while the functions of the skin and alimentary canal require to be well sustained. The aliment should be simple and unirritating, and somewhat below the usual quantity. The patient should carefully avoid exposure to a cold or damp atmosphere, and sudden transitions from heat to cold.

These precautions are obviously important, in order to avoid

the occurrence of local excitement, either of a congestive or inflammatory character; for, indeed, the most untoward accident which can occur is the supervention of excitement of the pulmonary tissues at the time softening is commencing. Such excitement, which is very liable to occur, renders the process of disintegration rapid, and the morbid action extends, in an undue degree, to the adjacent pulmonary parenchyma; and, doubtless, also, the increase of irritation serves to promote the exudation of tubercular matter, and thus materially augments the extent of the local disease.

SECTION III.

TREATMENT OF THE STAGE OF SOFTENING.

The stage of softening represents a period when phthisis can no longer remain stationary, nor can it be made to recede or undergo resolution. On the contrary, when the softened tubercular matter is in considerable quantity, absorption seldom takes place, and elimination through the bronchial tubes is the only mode by which it can be removed. Admitting the possibility of small, scattered tubercles softening, and ultimate absorption taking place without entering the bronchial tubes, such examples must still be regarded as the exceptional condition, while elimination is the ordinary course. But, unfortunately, the process is by no means so simple as the terms would indicate; on the contrary, this stage of the disease is very complex, embracing new local pathological changes, and progressive deterioration of the general system.

In this stage the new morbid action which is recognized is of an inflammatory character, with fresh exudations of tubercular matter and degraded lymph. The whole action, taken together, constitutes an inflammatory condition, although it is of a low grade and specific character, inducing around the softened parts white or grayish consolidation, instead of red hepatization, as in pneumonia, which readily softens and disin-

tegrates. Hence, an important pathological condition connected with the stage of softening, which we are called on to remedy, is the occurrence of local inflammatory engorgement, with the continued exudation of tubercular matter and degraded lymph. These processes are variable in extent, but always more or less present. The following are the therapeutical indications in this stage:

I. To maintain the constitutional vigor.
II. To arrest the further deposit of tubercles.
III. To limit the process of inflammatory exudation and softening in the pulmonary tissues.

I. *To maintain the Constitutional Vigor.*—The means by which the constitutional vigor may be maintained, as far as practicable, include diet, exercise, and tonic medicines. The regulation of these will depend on many contingencies surrounding each individual case.

1. *Diet.*—The proper regulation of the diet in this stage is highly important, and requires even more discrimination than the preceding stage. All derangement of the stomach should be carefully guarded against; indeed, the intimate relationship existing between the digestive and pulmonary organs renders it highly important to preserve the function of primary digestion in as healthy a condition as possible. Any irregularity of diet, or improper article of food, or undue quantity, can not fail to exercise an unfavorable influence on the pulmonary disease. As a general remark, the diet should be simple and unirritating, but, at the same time, sufficiently nutritious. Overstimulation of the digestive function can not fail to prove injurious to the lungs, and hence the food should possess less of the exciting properties than would be appropriate in an earlier stage of the disease.

In regard to *quantity*, I am convinced that an undue anxiety to *sustain* the system prompts physicians to permit the introduction of too much food, and that the most serious consequences often follow this indiscretion. The *appetite* is far from being a correct guide in this condition of the system; for it

will be remarked that primary digestion is often well sustained, while the system at large continues to waste, and, therefore, the desire for food will prompt the patient to take a larger quantity than can be assimilated in the tissues. Hence the evil effects arising from the introduction of too much food will be witnessed in the stomach, consisting in impaired digestion and the sympathetic irritation of the lungs; and, still more remotely, it will be observed in the contamination of the system with crude materials which can not be assimilated.

In the first example, all observation proves that if we continue to task the stomach to its full extent of physiological action, it will ultimately become debilitated, or even suffer from irritation, more or less severe. This occurs when persons are otherwise in perfect health, and it will much more readily take place when the system has been long debilitated by a constitutional disease. There is, indeed, as phthisis advances, a gradual lowering of the digestive powers, and this downward tendency is rapidly increased by overindulgence in articles of diet. Hence, the continued indulgence in stimulating food and drinks must necessarily impair the tone of the stomach, and induce irremediable dyspepsia.

But another evil of great magnitude is the introduction into the circulation of more nutritive materials than can be appropriated to the support of the tissues, and, as a consequence of this condition, the system becomes surcharged with effete substances. Nor will these effete elements obtain ready elimination from the system, for the emunctories are usually impaired, and, therefore, the refuse material is unduly retained. The different classes of food will produce special effects in this secondary relation; thus, if too much nitrogenous material is introduced, the urinary secretion will become involved; while a superabundance of carbonaceous food will result in overtasking the biliary organs. In the first instance, lithic acid will predominate in the system, acting most unfavorably on the nervous function; while in the second, the carbon induces congestion of the liver, and impedes the pulmonary circulation.

In regulating the diet, therefore, according to these general rules, patients should be restricted to moderate quantities of

animal and vegetable substances of nutritious qualities, but always in such proportions as will digest with ease and facility. Among the animal substances we may mention beef, lamb, venison, fowls, milk, eggs, birds, oysters, and fish. Of the vegetables the most appropriate are potatoes, (Irish and sweet,) rice, turnips, and beans, including, also, light bread, well baked. In the use of these and similar articles of diet, much will depend on the taste and peculiarities of patients; but in general, the list will be found sufficiently extended, and requires only the special regulation in regard to quantity.

A special remark is required in relation to *milk* diet. This substance has often been urged as an appropriate diet for consumptives, but generally without designating the stage in which it should be employed, or the particular rules governing its use. Hippocrates recommended milk in phthisis, provided the patient was free from fever. Galen mentions its use as being of ancient date in his time. Trallian states that persons who used milk early in the disease, and long continued, all recovered. Van Swieten commends the milk diet, and mentions that a young lady used human milk for a year with complete recovery. It is believed by some that the immunity from phthisis observed in the Steppe of Kirghis, is due to the extensive use of a drink consisting of fermented milk.

Without attaching much weight to many of the statements which have been made on this subject, I am strongly inclined to the opinion that milk constitutes a valuable variety of food in many cases of phthisis. Its elementary composition affords *à priori* evidence in favor of its beneficial influence in weakened assimilation; and the presence of the nitrogenous, oleaginous, and saccharine substances, furnishes a compound specially adapted to tuberculous conditions. It is evident that this fluid admits of ready assimilation, and that, while it affords all the elements necessary for the repair of the tissue and support of animal heat, it will be less liable to introduce effete or unassimilable substances into the blood, than the more highly-organized animal products. It may be remarked, also, that during infancy, when the change of the tissues is rapid, and the delicacy of the digestive function forbids the use of strong

articles of diet, milk furnishes the materials for the rapid and healthy growth of the body; and, although the condition in tuberculosis can not afford a parallel to the formative period of life, yet the lowered state of assimilation, and the tendency to rapid change of the structures, exhibits some degree of analogy to that primary state in which milk proves so beneficial. It is clearly a desideratum in all cases of weak nutritive forces, (particularly secondary,) to furnish the system with those materials which are most readily assimilated to the tissues, and contribute to the sustenance of animal heat, and hence, milk can scarcely fail to prove beneficial in this advanced stage of tuberculosis.

The particular kind and preparation of milk must be left largely to the preferences and tastes of the patient. The milk of the cow, ass, and goat have been employed, while, for children, some would prefer human milk. Probably the most decided effects have been witnessed from the use of goat's milk, which is known to be very congenial to the systems of debilitated children. But there is no sufficient reason why the cow's milk may not be employed with great, if not equal advantage, care being taken to procure it from a healthy animal. Some have manifested a decided preference for new milk just from the cow, and there is a probability of its being more digestible than after cooling; but, above all, the unskimmed article should be used, the cream being secured with the other constituents. This point is important, for milk, deprived of its oleaginous property, loses much of its value to the consumptive.

Whey has also been extensively, and often beneficially, employed in the treatment of scrofulous and tubercular patients. The whey of goat's milk has been highly esteemed, but its superiority over that of the cow is purely conjectural. In Germany and Switzerland whey is very extensively employed, and even institutions have been established for carrying into effect this particular treatment. As a general remark, however, it must be admitted that whey containing only the saccharine or carbonaceous element, must, in a majority of cases, prove inferior to the milk containing in addition the oleaginous and nitrogenous compounds.

It remains an undetermined question, how far a *pure* milk diet is admissible in tuberculosis; that is, whether it would be judicious to limit the diet exclusively to milk, or to compounds of which that article is the basis. Doubtless in children such a course would be proper; and in adults milk might safely be made the principal article of diet, requiring merely modifications in its mode of preparation. Thus, by way of variety, it might, at times, be taken fresh from the cow, at other times boiled, or thickened with flour, rice, tapioca, arrow-root, and similar farinaceous articles. It may be remarked further that fresh cream will often prove highly beneficial, although its properties are different from those of milk, and could not be used as an exclusive diet for any considerable length of time.

Another article of diet peculiarly adapted to many cases of tuberculosis is soft eggs. Indeed, these may be advantageously combined with milk in various forms, and would add to the efficacy of that article. Milk and eggs, where the digestive organs are delicate, are greatly preferable to the grosser forms of food, and will often exercise a most favorable influence over the course of a tuberculous affection.

2. *Exercise.*—The limitations of exercise and exposure are much more strictly defined in this than the early stage. There exists, in a general sense, a tendency, during the process of softening, to inflammatory action, and the repetition of such excitement is highly prejudicial, inasmuch as fresh exudations of tubercular matter take place at each increase of vascular excitement. And the vitality of the system being lowered by the morbid state, the powers of resistance are proportionally lessened, and hence patients will not bear exposure to cold or damp air, nor exercise amounting to fatigue. Either of these conditions prove peculiarly prejudicial and should be carefully avoided. Nevertheless, patients in this stage require sufficient exposure to fresh air to sustain the vital powers, and should, therefore, be required to exercise regularly in suitable weather, and to a moderate degree. The amount of exercise, however, must be determined mainly by the strength of the patient; in some cases, even in an early part of the softening, the debility is very great, while, in others, a good degree of strength is

maintained. These variable conditions necessarily modify each case; but, in all examples, we should never forget the tendency to local excitement, and the evil consequences which follow. Hence, night air, wet weather, and sudden changes should be carefully avoided.

The *modes* of exercise are also important. Walking, in this stage, can hardly be recommended. The excitement of the circulation, and the exhausting effects of exercise on foot, more than counteract the advantages of fresh air; while riding on horseback, or in a carriage, secures all the advantages, without the evil effects. But whatever mode may be adopted, we may safely settle on the conviction that, in this stage, exercise is not curative, but simply protective; indeed, it is a transition period, which must necessarily advance, and we seek, therefore, merely to preserve the general system in a state of as great vigor as the progress of the disease will permit.

3. *Tonic Medication.*—The lowered condition of the vital powers demands the use of tonic medicines, especially the preparations of iron, quinine, and the vegetable bitters. Any of the chalybeates may be beneficially employed, the choice among the various preparations depending, to some extent, on accidental peculiarities. Among the most appropriate may be mentioned the phosphates, muriated tincture, and the iron by hydrogen. The combination of quinine with iron is a valuable compound, and especially so when chills occur, as is often the case in this stage. The following is a very good formula:

℞ Pulv. Ferri,
Quin. Sulph. āā ℈j.
Sulphur. Sub. ʒss.
M. Ft. pil. xxx.
One pill to be administered three times a day.

The muriated tincture of iron possesses the advantage of improving the appetite, and acting on the urinary secretions, and hence, in particular cases, will be found of great value.

It is a question, in my mind undecided, how far alcoholic stimulants and cod-liver oil are appropriate in the stage of softening. My own impression is, that they have a much more

limited application than in either the early or latter stages, and that, if employed at all, their use must be restricted and carefully guarded. Whatever opinion we may entertain in relation to the nature of the process by which tubercles are deposited, it must be admitted that the act of softening is connected with a condition more or less allied to inflammation, and that any considerable degree of stimulation will aggravate rather than benefit the local disease. The alcoholic spirits, being absorbed and largely exhaled from the lungs, act very directly on the pulmonary tissues, and can not fail, when taken in large quantities, to augment the destructive process. In addition to this, the mucous membrane and secreting structures of the stomach suffer in the same manner, and, finally, a dyspeptic condition results from overstimulation. The liver, also, from a too liberal use of alcoholic stimulants, becomes affected, which completes the series of morbid actions resulting from this cause. Indeed, we can not conceive of a more destructive course of medication in this stage of phthisis than a free use of distilled spirits, for, in all cases, serious injury to the digestive function inevitably follows; and the disturbing effects of this derangement will more than counterbalance all the good effects, real or imaginary, which arise from its use.

But while I would thus condemn the free use of these agents, it may be admitted that brandy and whisky can be beneficially employed to a very limited extent. When the system is free from fever, and the appetite fails from debility, small portions of these articles may be resorted to; but the quantity should not exceed from one to four drachms, and this should be taken near the time of eating. But, as a general rule, wine will be found far preferable, in this stage of phthisis, to distilled spirits; it possesses less irritating properties, will be better borne by the stomach, and possesses nutritive qualities; hence, the advantages are altogether on the side of wine, and we should give it the decided preference. Malt liquors, also, may be safely and often advantageously employed in this stage. Well-brewed ale and porter often agree with the system, and the union of mild tonic and stimulating properties give these agents peculiar and important advantages. Indeed, as a rule, malt

liquors are preferable to all other beverages for consumptives, while wines rank next, and distilled spirits are least desirable of all.

The employment of *cod-liver oil* in this stage is, also, less efficacious than at an earlier or later period. It may be given to a limited extent; but I have a strong conviction, founded on observation, that the very free use of the oil in this stage tends to obstruct the pulmonary capillaries, and thereby to favor the local disease. It has often been suspected of inducing unfavorable effects on the pulmonary capillaries, causing obstruction, and even inflammation; and as the process of softening is allied to fatty degeneration, there seems but little propriety in saturating the system with oil at the time softening is going on. There are few practitioners, I apprehend, who would give cod-liver oil in the stage of resolution in a hepatized lung; and, although the conditions of the system in the process connected with resolution in pneumonia, and the breaking up of tubercle, are by no means parallel examples of softening, yet the rules which would forbid it in one would be equally applicable in the other. The objection is, that while it does not prevent the deposit of tubercular material, nor arrest inflammatory softening, it does impede absorption, and tends to induce pulmonary obstruction.

But besides these objections to cod-liver oil, it will generally be observed that the digestive powers are greatly weakened in this stage, and that the oily preparations are usually ill borne, and strongly tend to derange still further this function. Hence, if the oil is employed at all, it should be given in small doses, not exceeding one or two drachms, and intermitted when unpleasant effects arise. In this careful manner of exhibition, it may prove useful; while, if pressed to a greater degree, it becomes offensive and injurious.

Finally, the most appropriate means of sustaining the constitutional vigor, during the stage of softening, are embraced in the general terms of moderate, nutritious diet; the preparations of iron, quinine, and the vegetable bitters; the careful employment of stimulating beverages and cod-liver oil, together with well-regulated out-door exercise. Among these

medicinal agents, none will prove more beneficial than iron and quinine.

II. *To arrest the further Deposit of Tubercles, and to limit the Process of Inflammatory Exudation and Softening in the Pulmonary Tissues.*—It must be admitted that the considerations embraced under this head are of vital importance; for, unless the deposit of tubercular matter and the inflammatory softening in the pulmonary tissues can be arrested, recovery becomes an impossibility. The subject, however, is replete with difficulties, and few practitioners will approach the treatment of this stage of the disease with any great confidence in the results; but, at the same time, the enlightened therapeutist will place a due estimate on the morbid action which is in progress, and apply his agents, as best he can, to the condition which is known to exist. The general indications are embraced under the following subdivisions: 1. A tonic and sustaining treatment. 2. Change of climate. 3. Counter-irritation.

1. *A Tonic and Sustaining Course.*—But little can be added to what has already been stated in relation to sustaining the vital powers. The general course adopted to sustain the constitutional vigor is equally efficient in fulfilling the present indication. Indeed, the evolution of tubercular matter is to be arrested by such means as maintain the constitutional vigor, and hence tonics, nutrients, and stimulants are the only reliable agents, aside from the possible specifics, in accomplishing this object. The blood and the nervous system should be sustained by the employment of iron and quinine, and such additional treatment as the peculiarities of each case may require. Few agents will exercise a more beneficial influence, in this stage, than a combination of iron and quinine, and especially where there exists a tendency to chills and sweats. The formula already given, including sulphur, will be proper in the present stage, or any of the preparations of iron will be found beneficial; the muriated tincture, the compound syrup of the phosphates, are excellent preparations, and will be found well adapted to particular cases. The vegetable bitters are, at times, useful in sustaining the tone of the stomach; the compound tincture of bark, prep-

arations of gentian, quassia, and columbo, are all valuable in certain cases.

2. *The Influences of Climate.*—The influences of *climate* in arresting the further deposit of tubercles, although less important than in an earlier period, is, nevertheless, not to be neglected in the stage of softening. The climatic influences on the early stages of the disease, and the rules by which patients should be governed, have already been stated; and although the same principles are, to a certain extent, applicable to the stage of softening, yet there are important modifications and special rules to be observed in this more advanced condition. The rules heretofore given indicate that, in the early stages, warm climates, such as the southern portion of the United States, are the most beneficial; and that the cool and variable latitudes serve rather to promote and aggravate the disease. When, however, the stage of softening has arrived, patients no longer bear with impunity the warm and humid atmosphere of the South. The effect of such an atmosphere is to increase the debility, and with it, the night-sweats and sputa, and thus to hasten the progress of the disease. Such an atmosphere is directly opposed to the maintenance of the constitutional vigor, and is, therefore, necessarily prejudicial.

But, on the contrary, patients laboring under the influences of softening tubercles, with the vitality of the general system lowered, are not in a condition to encounter a cold or variable atmosphere; for the effect of such vicissitudes must be to modify, in an unfavorable manner, the pulmonary circulation, and often to excite inflammatory action. In all stages of phthisis, out-door exercise is highly important, and the patient should be placed in an atmosphere which will permit him to spend at least a portion of time in the open air; but in cold and variable regions, the morbidly-excitable state of the lungs in these advanced cases forbid that course, and, consequently, such localities should be avoided. If the patient resides in a cold latitude, he must necessarily remain housed during the greater portion of the winter, and he thus loses the advantage of exercise and fresh air.

In attempting, therefore, to select a suitable climate for the

stage of softening, the obvious indications are to avoid the two extremes; that is, to protect the patient, on the one hand, against the debilitating influences of a warm and humid atmosphere, and, on the other, to shield him from the dangers of Northern cold and vicissitudes. Hence a medium latitude, such as Tennessee, portions of North Carolina, or even Texas and Northern Mexico, during the winter, would afford sufficient protection from cold, while the temperature would not prove debilitating. But, in all instances, the locality selected should be sufficiently elevated, and free from excessive moisture. But, in some of the regions referred to, the changes of temperature are exceedingly sudden, and, therefore, dangerous. Thus, in Texas, the occurrence of a cold wind known as "northers," rapidly reduces the temperature from a genial warmth to a degree of chilliness requiring heavy clothing. These changes are hazardous to consumptives in the stage of softening, for they readily light up inflammatory action, with all its evil consequences; and hence, if patients are situated in such localities, it is imperative that they at once seek shelter, and remain housed until the cold wind abates.

There can be no doubt that a genial atmosphere, but short of debilitating heat, is that which is best adapted to the stage of softening; and if patients are unable to avail themselves of the advantages of a change of climate, they should be protected by artificial means during cold and inclement weather. It will be far better, indeed, that patients should be subjected to confinement even to close rooms during unfavorable seasons, than to risk the effects of a harsh atmosphere. In the United States, north of the thirty-eighth parallel, the winters are severe and changeable, and the springs damp and cool. The latter season is peculiarly dangerous; and numerous cases have come under my observation, in which patients have contracted cold, (inflammatory action,) in the month of March, from which they never recovered. Hence, patients residing in these latitudes should carefully avoid exposure, for the evils of being too closely housed are far less than the dangers of cold. Patients, under these circumstances, should never venture into a cold atmosphere without being protected by Jeffrey's or some similar

respirator; but even this is not a sufficient safeguard, for it is not alone through the pulmonary system that cold air acts injuriously, but it is rather by its influence on the general surface.

In general terms, a patient with softened tubercles should seek a mild, equable, and moderately dry air, which will permit almost constant out-door exercise, without the danger of exciting inflammatory action. In such an atmosphere the stage of softening will pass more kindly than in any other condition, and, consequently, the possibility of cure will be greatly increased.

3. *Counter-irritation.*—Counter-irritation, in some of its varied forms, has been employed from the earliest period. Hippocrates advised cauteries made alternately in the back and breast; Themison ordered external ulcers to be kept open for a long period; Hildanus used a seton in the nape of the neck; and Trallian is said to have successfully cauterized a man on the *head* for a cough.

The importance of counter-irritation, however, in some of its varied forms, can scarcely be overrated in this stage of phthisis. But, in order to secure any decided advantage, the local action must be long-continued, or frequently repeated. The choice of counter-irritants will depend greatly on constitutional peculiarities, as well as the pathological changes taking place. The tendency, in such examples, is to local excitement, and although the process is of a low grade, it is, nevertheless, essentially inflammatory; and the degree of acuteness, as well as the rapidity of the morbid changes, will aid in determining the counter-irritant best adapted to the case. Thus, if there is much acuteness of action, or if the process of disintegration of the pulmonary tissues is rapid, *blisters* will be found preferable to all other modes. But when the disease manifests a low grade, and is slow in its progress, *pustulants*, such as the croton oil, should be employed.

If we apply blisters, they should be from three to four inches square, applied under the clavicles, and permitted to heal without protracted discharge. It is far preferable to repeat the application frequently than to set up a chronic discharge, which would weaken and greatly annoy the patient. With this view,

blisters should be dressed with dry lint or cotton, or, at most, with a little simple cerate. Croton oil may be employed, in most cases, with great advantage; but where the skin is very delicate it should be used at first sparingly, otherwise the irritation may induce febrile excitement, and thus react unfavorably on the local disease.

The tincture of iodine is often a beneficial counter-irritant; and it is particularly so where much consolidation exists in the pulmonary structure. Doubtless the iodine produces its specific effects, in addition to its action as a counter-irritant, and, in this manner, aids in the removal of obstructions. It can be conveniently applied with a camel's-hair brush, and should be repeated once a day until sufficient action is induced. In most cases the ordinary tincture will be sufficiently strong; but if a greater degree of excitement is required, we may safely apply a much more concentrated solution.

Setons and issues are of doubtful propriety; they annoy the patient, and are entirely too *local* in their action to prove very beneficial in a disease occupying a considerable extent of an organ like that of the lungs. Indeed, in all forms of pulmonary diseases requiring counter-irritation, the action should occupy a considerable extent of surface, otherwise the pulmonary circulation will not be materially modified.

Liniments are comparatively unimportant; but dry friction, in all cases, by exciting a healthy glow of the cutaneous vessels, will prove beneficial, and, in some examples of limited action, may be chiefly relied on. Generally, however, a higher grade of excitement is required than can be produced by mere friction, and hence blisters and pustulants become our chief reliance.

But, whatever may be the mode of counter-irritation, it should be persisted in for a long period; indeed, its continuance must be proportioned to the duration of the disease itself. There are, however, certain important rules which should be observed in order to procure the full advantages of this method of treatment. In the first place, we should carefully avoid too much excitement, especially when the skin is delicate and the nervous system irritable; for, if this precaution is not observed,

the patient may be seriously injured by the febrile reaction. Again, it is highly important to observe carefully and minutely the progress and degree of the local action; thus, if from cold or other cause an increase of acuteness is discovered, the immediate application of a blister becomes of the highest importance, in order to check, by revulsive action, the morbid exudations which would surely follow the slightest increase of vascular excitement. And, lastly, counter-irritants should be occasionally suspended; otherwise, the skin takes on morbid action, becomes thickened and inactive, and the effects of derivative influence is mainly lost. Hence, after their use for a month, an intermission of a week or two will prove grateful to the patient, and useful in future treatment.

SECTION IV.

TREATMENT OF THE STAGE OF CAVITIES.

The stage of *excavations*, which is generally known as the *third* stage, may justly be regarded as merely an advanced period of the disease; but as the local changes present conditions different from the preceding state, and the constitutional disturbances exhibit certain peculiarities, it becomes proper to consider this period separately from mere softening. When large cavities form, the sputa become copious, with severe and harassing cough, great emaciation, often colliquative sweats and diarrhœa, hectic fever, lateritious deposits in the urine, failure of the appetite, and impaired digestion. I believe, however, that the tuberculous matter is less copiously deposited than in the preceding stages, and, indeed, often measurably ceases; but the organic changes of the pulmonary structures, and the impaired state of the whole organism, renders recovery doubtful at best, and often an impossibility. If the morbid action occupies both lungs to a considerable extent, recovery may be considered impossible; but if cavities exist alone in one side, while the other remains free from disease, some

degree of hope may be entertained. The indications of treatment may be arranged under two heads:

I. To sustain the vital powers.
II. To promote the healing of cavities.

I. *To sustain the Vital Powers.*—Under this head are embraced tonics, stimulants, nutrients, clothing, and climate.

1. *Tonics.*—The importance of chalybeates and other tonics in this as in the other stages of phthisis, can admit of no doubt, nor can they scarcely be misapplied. But while this is true, the selection of particular agents requires some discrimination. Thus, absorption becomes difficult in this advanced stage, and the chalybeates should be perfectly soluble, and free from exciting effects. Hence, pills are always objectionable, and liquids, especially watery solutions, being more readily absorbed, should be preferred. The soluble citrate of iron, or the ammonio-citrate, are among the best preparations, and are comparatively free from exciting properties. It is important, also, that iron should not be administered in very large quantities; indeed, the irritability of the mucous membrane of the alimentary canal, and the diminished absorbing powers, would forbid the administration of full doses. With these limitations, iron may justly be esteemed an indispensable agent in this, as in the preceding stages.

But, in addition to the preparations of iron, there are other tonics equally important. The vegetables often become exceedingly valuable in sustaining the tone of the stomach and in promoting digestion. Among these, the infusions of columbo and gentian may be esteemed the best; but most of the class may be advantageously employed in a majority of examples. The cold infusion of the *prunus virginiana* is an agreeable and often beneficial tonic, especially when the stomach is irritable.

2. *Stimulants.*—By stimulants I mean the alcoholic preparations, including whisky, brandy, wine, and ale. I have no hesitation in stating that no class of medicines are more beneficial in this stage than the different preparations belonging to this class. The general debility demands a decided stimulant;

and while the tonics are being administered, the stimulants should be conjointly employed. Thus, while iron serves to improve the blood, and quassia assists in restoring the tone of the stomach, brandy, whisky, or ale are necessary to arouse the nutritive, circulatory, and nervous functions. The choice of agents will depend largely on the peculiarities of the patient and the condition of the stomach. Of the ardent spirits, I would, as a rule, prefer whisky, but, in some cases, brandy is more agreeable and efficacious. *Whisky punch* is a preparation which is often of singular value; indeed, patients can partake more freely of whisky combined with milk, than most of the ardent spirits, and being highly nutritious, its good effects are shown in the rapid increase of the nutritive functions. Ale is also an agent of great value, and will agree with many patients better than distilled spirits. It possesses the advantage of a valuable tonic, and no inconsiderable nutritive properties in addition to its stimulating effects.

In the employment of these agents, however, the greatest precautions are necessary, especially in reference to their effects on the stomach. With feeble or impaired digestive powers, and a mucous membrane readily taking on excitement, the stimulants should not be given in concentrated forms, nor in large quantities. If these rules are disregarded, the tone of the stomach is speedily impaired, the appetite lessened or destroyed, and the whole system seriously injured. As a rule, stimulants should be given at or near the time of eating, so that they may aid in promoting the appetite and digestion, while the mucous membrane is protected from overstimulation.

3. *Nutrients.*—This class embraces diet in a general sense, the administration of cod-liver oil, *medicinally* considered, and all substances which are susceptible of assimilation, or which supply carbon for the development of animal heat. In relation to *diet*, it need only be observed that the function of nutrition having been reduced to the lowest point, substantial nutrition is imperatively demanded; and if we are unable, either from want of appetite or inability to digest, to introduce nutritive substances into the system, the hope of curing the disease with medicines alone will prove utterly futile.

The condition of primary digestion must determine mainly the articles of food to be employed; and as this function is quite variable in its activity, we must adapt the food to the peculiarities of each case. Thus, in some examples, digestion is performed with tolerable ease even in the last stages of phthisis; while in others the functions of the stomach become depressed to the lowest point, and but little appetite for food exists. In those cases in which digestion is performed in a tolerable degree, the patient should be allowed solid and substantial animal food, such as has been formerly mentioned, but the quantity should be sufficiently restricted to secure easy and complete digestion. Indeed, all disturbance of the digestive function should be carefully avoided, for the sympathetic influences exerted on the pulmonary organs will prove highly prejudicial. With this view of the subject, it will be readily conceded that a small quantity of nutritious food, well digested, will prove far more valuable than double the quantity imperfectly chymified. Hence, the physician should carefully adapt the *quantity*, no less than the *quality*, to the digestive powers of the stomach. And, in attempting to regulate the quantity of food, we can not always rely on the statement of patients, for I have observed that they often declare their digestion to be good, when further inquiry reveals the fact that they have frequent eructations, distention and uneasiness of the stomach, with more or less acidity. In all such examples the diet should be restricted, and carefully adapted to the powers of the stomach.

In another and more unfortunate class of cases the appetite fails, the powers of digestion are reduced to the most feeble condition, and patients are unable to take solid food. Nor will the ordinary soups or liquid diet prove more successful, for acidity usually takes place, and patients suffer from gaseous distention of the stomach. It is necessary, therefore, to employ concentrated preparations of animal food, such as essence of beef, calf's-foot jelly, sweet cream, and similar articles, which require but little digestion, are readily absorbed, and afford substantial nourishment. There are some patients with whom new, unskimmed milk, or even cream, will agree, and with such the milk diet is exceedingly valuable. In this condition patients

are reduced to the delicacy of infants, and they should be treated accordingly; hence, the milk of the goat, ass, or cow may become a second time the natural nutriment for such weak digestive organs. The addition of lime-water to milk will, at times, serve to prevent the formation of acid, while it does not impair the nutritive qualities of the fluid, nor prove unpleasant to the taste. Boiled milk, with or without the addition of tapioca, arrow-root, or other farinaceous articles, will agree with some stomachs better than the raw material; while, in others, milk-whey will be tolerated when the other preparations prove offensive. This careful course of dieting, with mild tonics and stimulants, will often restore the digestive powers so that more substantial food will be tolerated.

The administration of *cod-liver oil* becomes highly important in this stage; and, although it is given as a *medicine*, it is mainly, if not exclusively, a *nutrient*. It happens unfortunately, however, in too many cases, that the stomach will not tolerate the oil to any considerable extent, and its disturbing effects counterbalance all the benefit arising from the small quantity introduced into the system. When patients are unable to take solid food, cod-liver oil will not be well borne; indeed, it is usually rejected in such cases, and no benefit is derived from its use. Under such circumstances the oil must be withdrawn, or administered in a modified form, such as an emulsion with gum arabic, or, what is better, the yelk of an egg. A preparation is known in market as *Queru's Jellified Oil*, which consists of cod-liver oil solidified by the addition of gelatin and sugar. This preparation, although not a true emulsion, will sometimes be borne better than the natural oil. The emulsion with the yelk of eggs, freshly prepared, is a very eligible form; and, when rubbed with mint-water, and taken in wine, constitutes by no means an unpleasant draught.

The great point, however, is to introduce the oil, as largely as possible, into the system; for if cavities are ever healed, it must be by the arrest of further decomposition of the body, and thus giving to the tissues a recuperative tendency. At the same time, the phosphates of iron and lime (especially the latter) will materially contribute to the chances of recovery.

The formula which I prefer is a mixture of the oil and phosphates, in the manner to be mentioned hereafter.

When the oil can not be taken, or even conjointly with it, fresh butter, sûgar, and other carbonaceous articles may be used. There can be no doubt that sugar, as a carbonaceous article of diet, is valuable in sustaining animal heat and in preventing the waste of the tissues. The syrup of rock candy (crystallized sugar) or that article in substance, is the best saccharine preparation. But it is a curious fact that sugar must be taken in large quantities in order to be well received by the stomach; indeed, small portions often derange digestion, while larger ones prove eminently nutritious.

4. *Clothing.*—The calorific power being materially impaired in this stage of the disease, the system requires to be well protected by suitable clothing. Flannel worn next the skin, in cold and variable seasons and climates, is indispensable, while the body is further protected by suitable woolen apparel. But in warm climates and seasons we should be careful not to oppress the patient with too much clothing; otherwise, debilitating perspiration will ensue, which can not fail to prove prejudicial. Hence, the clothing requires to be regulated with care and judgment, so that the patient may be protected from the influences of cold, on the one hand, and on the other, secured against the debilitating effects of too great warmth of the surface. But, in all cases, the cutaneous circulation should be maintained in a state of some activity; for which purpose we may employ warm baths made stimulating with salt or mustard, or, what is even better, dry friction. The greatest benefit will be derived from stimulating the cutaneous vessels, and should be daily put in requisition.

5. *Climate.*—The influences of climate in this, as in other stages of phthisis, are exceedingly important, and should not fail to secure careful attention. In the preceding stages of the disease, I have recommended warm or mild latitudes; but in this advanced condition patients require a more bracing atmosphere, which serves to sustain the failing powers of life. In this stage, the formation and deposit of tubercular matter is comparatively limited, and consequently, neither the arrest of development,

nor the elimination of its elements, demands particular attention, nor is there the same tendency to local inflammation that is met with in the stage of softening; hence, the condition of climate which we particularly seek is that of an invigorating character, without possessing the harshness of extreme Northern latitudes. Sea-coasts, valleys, and damp localities should be particularly avoided, while the preference should be given to considerable elevations, or mountainous regions. In our own country few situations will be found more valuable for a summer retreat than the mountainous regions of Pennsylvania and Virginia, ranging between the thirty-eighth and forty-first degrees of north latitude. In these situations the atmosphere is pure and bracing, and permits regular out-door exercise. The great Northwestern region of Minnesota, as far north as the forty-fifth parallel, is a most favorable atmosphere, possessing, indeed, all the advantages required in this stage of the disease.

During the winter season, Arkansas, East Tennessee, and portions of Georgia and North Carolina afford safe retreats for patients debilitated with phthisis; but in no instance should they seek an extreme Southern atmosphere, particularly the low and damp situations. Mountainous regions, however, even further south, are measurably free from the objections to which I allude, and may often be sought with safety. This is especially true of the elevated and more northern portions of Texas. Probably few regions of country would prove more propitious than Santa Fé, situated on the thirty-sixth parallel of north latitude.

Sea voyages should, also, be classed with the invigorating agents. If the patient retains a fair degree of strength, we may reasonably anticipate beneficial results from sea voyages; but, in order to prove curative, they must be long continued or frequently repeated. Patients, indeed, should live on the ocean, so that the full revolutionary effects of sea air may be obtained. The stage in which sea voyages prove most beneficial are the early and the late, passing by the stage of simple softening.

The general principle, however, upon which I insist is, that phthisical patients advanced to the stage of cavities should

seduously avoid warm, moist, and relaxing climates, for these increase the debility, the expectoration, and colliquative sweats, and thereby hasten dissolution. On the contrary, a cool and dry atmosphere, with considerable altitude, should be selected; and, indeed, patients should be made to endure as much cold as their enfeebled constitutions will bear. And in determining this question individual peculiarities should always be consulted; there are some patients, apparently in the same stage, who bear cold much better than others, and all such should be sent as far North as their conditions will permit. Hence, I have not sought to furnish a list of localities suitable for this stage of phthisis; but merely to indicate the general qualities of climate best adapted to such patients, leaving the practitioner to make a selection in accordance with the peculiarities and conveniences of patients. The general principle, however, to which I have alluded is one of importance, and should not be overlooked in this last struggle for life.

II. *To promote the Healing of Cavities.*—The general course of tonic and invigorating remedies, as detailed in the preceding pages, necessary to sustain the vigor of the constitution, become indispensable in fulfilling the present indication; for every agent, medicinal or hygienic, calculated to improve the tone of the general system, will tend more or less to promote the healing of cavities. But besides these measures, there are certain additional means which appear to promote, in a more direct manner, the healing of cavities, and, therefore, require to be separately considered. It may be here remarked, that for this purpose our forefathers proposed some very extraordinary means, and our cotemporaries have been scarcely less fertile in suggestions. De Bligny relates a desperate case of consumption cured by a sword accidentally penetrating the chest; and Gilchrist suggested an opening in the affected side, which, by causing inaction of the lung, might promote the cicatrization of the cavities. More recently, M. Piorry has proposed external *compression*, with the view of approximating the surfaces of cavities, and thus favoring their ultimate closure; while Dr. Green, of New York, has injected a solution of nitrate of

silver, with the view of changing the action of diseased surfaces. And a class of practitioners still bolder, have sought to heal cavities by penetrating their walls, and thus applying medicinal agents directly to the diseased part. Among the remedies, however, which are more promising, we may mention the use of the phosphates of iron and lime; the hypophosphites of lime and soda; sulphur, and various inhalations.

In this advanced stage of phthisis, when large caverns have formed in the pulmonary organs, the phosphates of iron and lime seem to possess the double advantage of imparting tone to the system, and supplying the blood with elements which favor the process of healing. It may be difficult to explain the exact *modus operandi* of these agents; but the cretaceous transformation of tubercular masses which frequently occurs, furnishes an indication for the use of the calcareous salts. Speculative opinions, however, are less valuable than practical observations, and guided by my own experience, I have no hesitation in believing that the phosphates contribute to the process by which tuberculous caverns are healed. The preparations which I have usually employed are the phosphates of iron and lime, given alone, or conjointly with cod-liver oil. The particular preparation to which I have given the preference is that known as the compound syrup of the phosphates, consisting of the phosphates of iron, lime, and soda, with a considerable excess of free phosphoric acid. This compound I have had still further improved by adding a greater quantity of lime, rendered soluble by the addition of a few drops of hydrochloric acid. In this form it is a very elegant and agreeable preparation, and contains a large quantity of soluble phosphate of lime, being in the proportion of seven grains of the salt to a drachm of syrup. Another excellent formula is that already given, consisting of the phosphates of iron and lime added to cod-liver oil; but in this form the lime is quite insoluble, and, therefore, less efficacious than in the syrup. I frequently employ the following formula:

℞ Ol. Morrhuæ, ℥vj.
Syr. Ferri cum Calc.
Vin. Picis, āā ℥iij. M.
A table-spoonful to be taken two hours after meals.

Or:

℞ Ol. Morrhuæ, Oj.
Ferri Phos.
Calc. Phos. āā ʒiij. M.

Shake well and take a table-spoonful two hours after meals.

With these preparations I endeavor to crowd the system as much as possible with the phosphates, while, at the same time, the other measures in relation to diet, exercise, etc., are strictly enforced. The combination of the phosphates of iron and lime with cod-liver oil, is a valuable mode of exhibiting these articles; and it has appeared to me that, in this stage of the disease, they afford almost the only hope of recovery. If the oil can not be taken, the syrup of iron and lime, with or without the wine of tar, may be employed; but intolerance of oil is nearly always a sign of evil import, and should, if possible, be overcome.

The *hypophosphites* of soda and lime have recently been brought to notice by Dr. Churchill, with the view, as he declares, of introducing phosphorus, in a low state of oxydation, into the system. But neither the alleged *modus operandi* of these preparations, nor the practical results, can be received as well-established facts; on the contrary, a great degree of doubt embarrasses the whole subject. Dr. Churchill does not appear to have adduced any fact to show, that the tuberculous condition consists essentially in a diminution of phosphorus in the system; and, until that theory is established, or rendered probable, we are scarcely justified in relying exclusively on the use of so doubtful an agent. I am, however, inclined to the opinion that both sulphur and phosphorus are beneficial in phthisis; and, perhaps, some evidence of this may be found in the fact that *tubercle* contains neither of these elements. But this is far from proving that a diminution of phosphorus is the essential pathological condition in phthisis, or that the supply of that agent is all that the system requires.

I have employed the hypophosphites in numerous cases of phthisis, (particularly in this so-called third stage,) but, it must be confessed, without any definite results. And this opinion appears to have been fully established by Dr. Cotton, of the

Brompton Hospital. After the composition of these compounds was made known, Dr. Cotton employed the hypophosphites in various stages of the disease, according to the suggestions of Dr. Churchill, but, unfortunately, without any definite results. And Dr. George B. Wood, of Philadelphia, in a communication to the author, observes that he has no confidence in the hypophosphites, and that, after extensive trial, they have been found wanting. We can not, therefore, in the present state of the subject, accept the statements of Dr. Churchill as fully established, but we are left in doubt as to the general results, if, indeed, it is not already certain that a fundamental error vitiates both the premises and conclusions. If, however, any one desires to test still further the hypophosphites, I would advise that they be added to the cod-liver oil mixture, or to the syrup of iron and lime previously mentioned; for in this manner we may secure whatever advantage the articles possess, while, at the same time, we do not abandon the patient to the uncertainties of an agent so doubtful in its character.

There is some reason to believe that *sulphur*, either in substance or in sulphurous waters, possesses some efficacy in this stage of phthisis. Dr. Copland remarks that sulphur, in the treatment of phthisis, has fallen into disuse, but that he has seen much benefit from it in several states of the disease. I have employed it frequently, and, at times, with apparent benefit; but, being unwilling to trust alone to so feeble an agent, it has usually been combined with other articles, especially the cod-liver oil. Three drachms to the pint of oil makes a proper proportion; and if there is much dryness of skin, or evidence of cutaneous disease, it may prove beneficial. The sulphuretted waters have been employed for a similar purpose; but we could scarcely anticipate much benefit from them in this advanced stage, particularly if great debility, accompanied by sweats and diarrhœa, be present. Sulphur, therefore, may, in certain cases, prove beneficial in the stage of caverns, but its range of action is limited and uncertain.

The *inhalation* of various substances has often been resorted to in phthisis; and if such agents can prove beneficial in the disease, we might reasonably expect to witness their good effects

in the stage of caverns. From the earliest periods of medical history the treatment of phthisis by inhalations has had its advocates and vaunted cures; but the final judgment of the profession has been against this mode as a curative measure. The inhalation of oxygen, hydrogen, carbonic acid, chlorine, iodine, the vapor of tar, and almost every conceivable article susceptible of volatilization has been resorted to; and while the regular profession have been experimenting with these agents, quacks have seized the opportunity to impose on the credulous and unsuspecting with the specious but false idea, that medication directly applied to the diseased part was the only proper course.

Numerous agents have been recommended for the purpose of inhalation. Galen sent his patients to Tabias, near Vesuvius, to breathe the sulphurous atmosphere; Bennett recommended fumigations, with sulphur and other agents, in closets or chambers; Dr. Mead advised frankincense, storax, etc.; Van Swieten employed frankincense, storax, amber, and benjamin; Bonet directed vapors of turpentine and opium; Sir Alexander Crichton strongly insisted on the efficacy of tar-vapor, diffused through the room, and breathed for a considerable period; while Sir Charles Scudamore is equally sanguine in the use of a weak preparation of iodine and tincture of conium. M. Gannal commended the inhalation of chlorine; and Piorry, it is well known, employs iodine by inhalation, frequently repeated, and in large quantities. Dr. Turnbull recommended the iodide of ethyle, while ether, chloroform, creosote, and the various balsamic agents, have been employed by others. All these agents, and many more, have been used again and again by the profession, until their virtues have been fully tested; and the result has been, that, in the deliberate judgment of experience and observation, inhalations have an exceedingly limited range of action in the treatment of phthisis. I do not mean to say, however, that this mode of medication is absolutely worthless; but it is evident that, in most instances, inhalations merely palliate the urgent symptoms arising from irritation, or, in some still rarer cases, contribute to the healing process in cavities. It is possible, indeed, that when the deposition of

tubercular matter has measurably ceased, and the interior of a cavity is merely in a suppurative condition, the inhalation of tar, creosote, naphtha, chlorine, and similar agents, may promote the healing process. The agents which are most beneficial in these cases are those already mentioned, administered by means of inhalers, or diffused through the atmosphere of a room.

It is difficult to give definite formulæ for these preparations, for the degree of concentration must be varied with the condition of the patient; and the only safe rule is the amount of irritation induced at the moment of inhaling. If chlorine is employed, it may be diffused through the atmosphere of the room by pouring hot water on chloride of lime, or the aqua chlorini may be received through an inhaler. In either case, the concentration of the medicine should not be such as to cause irritation, and should never exceed a degree which can be breathed freely by the patient. Creosote, tar-vapor, and naphtha may be inhaled with safety, either separately or in combination. The following formula will meet many cases:

℞ Tinct. conii, ℥ij.
Creosote, ℥j. M.

One to two tea-spoonfuls may be added to the water in the inhaler, and used for five, ten, or fifteen minutes, according to circumstances. If much irritation is present, hydrocyanic acid may be substituted for the creosote. I have employed, also, carbonic acid, (or, rather, carburetted hydrogen,) as obtained from burning charcoal, with some advantage, especially where profuse suppuration was present. The method is, to ignite charcoal in a portable furnace, such as that employed for domestic purposes, and, after all smoke has disappeared, introduce it into the patient's room, regulating the quantity by opening or closing doors and windows. An atmosphere thus charged may be safely and often advantageously breathed for half an hour, twice a day, the usual effect being to check the profuse suppurative action. Chlorine, which, at one time, seemed to promise so much, has not retained the confidence of the profession, but has measurably fallen into disuse; but there are cases with profuse suppuration, and especially when accompa-

nied by fœtid expectoration, that receive some benefit from this agent, although we can scarcely estimate its powers above those of a palliative. The inhalation of iodine, in this stage, can promise very little good, if, indeed, it is not generally prejudicial. As mere palliatives, in examples of severe paroxysmal coughing, a few drops of ether or chloroform, or the two combined, will often prove of great comfort to the patient, although they can promise nothing in the way of cure.

Upon the whole, therefore, inhalations occupy a subordinate position in the cure of phthisis. In the early stages they are scarcely needed; during the suppurative period, they are often injurious; and in the stage of excavations, no reliance can be placed on their curative powers. Of late, however, unscrupulous empirics have deluded a credulous public with the plausible idea of making medicinal applications directly to the diseased part; but no well authenticated case of true phthisis has, according to the best of my knowledge and belief, ever been cured in this manner. The highest position, therefore, which we can assign inhalations, is that of a mere palliative; and, even in this sense, the range of action is quite limited, and, indeed, comparatively unimportant.

In addition to the inhalation of vapors, the insufflation of powders has been occasionally resorted to, as well as the introduction of liquids. Pulverulent substances, such as the nitrate of silver, mixed or even pure, may be insufflated with safety, and, at times, with advantage. I have used the pure nitrate without inconvenience arising from its strength; but, generally, from one-tenth to one-half should be the proportion of the silver, the diluting substance being sugar of milk. It is questionable, however, whether these powders penetrate much beyond the larynx, and hence their agency is most important when laryngeal irritability predominates.

The preceding statements in relation to the treatment of the stage of cavities, embraces the principal means which the physician can employ, variously modified to suit individual cases; and, while a few such advanced cases may ultimately recover under judicious management, a much larger number will fall victims to the intractable nature of the disease. If both lungs

are involved, but little hope need be entertained; but if one side remains healthy, and the cavities are not too extensive in the affected part, the possibility of recovery should prompt us to the persevering use of appropriate remedies.

SECTION V.

TREATMENT OF INCIDENTAL SYMPTOMS.

Numerous incidental symptoms and complications arise in the course of phthisis, which demand treatment either to promote the cure, or to contribute to the comfort of the patient. Among the incidental symptoms the most important are—cough, febricula, hæmoptysis, dyspnœa, hectic fever and night-sweats, indigestion, diarrhœa, and thoracic pains.

1. *Cough.*—As cough is one of the most constant symptoms in phthisis, running, indeed, through all its stages, and often becoming exceedingly distressing, its treatment assumes a high degree of importance. The causes of this symptom are various. The essential *tuberculous* cough depends on the irritation excited by the morbid deposits in the pulmonary tissues, and the changes which they undergo; or, it may arise from excitement of the mucous membrane of the bronchi and larynx.

The true tuberculous cough, arising from the essential local irritation of the disease, admits only of palliation, for its removal would imply a cure of the disease itself. The degree of cough is exceedingly variable in different individuals; in some examples, it is so mild as scarcely to demand even palliative treatment; while, in other cases, it becomes so violent as to be exceedingly distressing to the patient. In the early stages of the disease, and prior to the occurrence of softening, the cough is dry, comparatively slight, and is seldom manifested in severe paroxysms. It is, therefore, a cough arising from the deposit of new substances in the tissues of the lungs, independent of mucous disease, and, consequently, is not to be relieved by the ordinary expectorants. Indeed, the only agents capable

of affording relief in this form of cough, are the *anodynes;* and although these admit of considerable variation, yet the *opiates* will be found the only reliable preparations. Small doses of morphine, of opium, or of Dover's powder may be employed; but I have usually found better results from the salts of morphia than any other opiate. The morphine may be given in the form of syrup, powder, or pill, alone or combined with other agents. The following formula I have found quite valuable:

℞ Morphiæ Mur. gr. j.
Ext. Conii gr. xxiv.
Pulv. Ipecac. gr. ij.
M. Ft. pil. viij.

Take one or more pills, according to circumstances.

If the preparations of opium are found objectionable, conium, hyoscyamus, belladonna, etc., may be resorted to in the following or any other convenient combination:

℞ Ext. Belladonn. grs. v.
Ext. Conii ℈j.
Ipecac. grs. ijss.
M. Ft. pil. x.

The combination of *antimony* with morphine is often exceedingly valuable, especially if any febrile symptoms are present. I usually direct the following mixture:

℞ Syr. Prun. Virgin. ℥ij.
Ant. Tart.
Morph. Acet. āā gr. j. M.

Dose a tea-spoonful, *pro re nata.*

It should always be remembered, however, that opiates tend to impair the digestive powers, and hence they should be employed as sparingly as the circumstances will permit. Indeed, these preparations should not be given constantly, but merely occasionally, as the symptoms become more severe.

In some cases cough is aggravated by vascular fullness of the part, and hence the relief which is at times observed to follow hæmoptysis. When this condition is present, counter-irritants,

such as dry or wet cups, pustulants, etc., become valuable aids in relieving the cough.

When the stage of softening arrives, and tuberculous sputa begin to appear, the cough becomes more severe, not infrequently paroxysmal, and demands, in part, different treatment from the preceding condition. It is true the opiates still remain the basis of treatment, but their effects may be aided by the stimulating expectorants, antispasmodics, and alkalies. In this stage of phthisis, while the process of softening is going on, there is more or less irritation of the bronchial mucous membrane, which contributes to the aggravation of the cough. The following formulæ will prove advantageous in many cases:

℞ Syr. Senegæ,
Syr. Scillæ,
Vin. Picis, āā ℥j.
Ant. Tart. gr. j.
Morph. Acet. grs. ij.
M. Tea-spoonful, *pro re nata.*

Or:

℞ Pulv. Scillæ,
Quin. Mur. āā grs. viij.
Morph. Mur. gr. j.
Sulphur, ℈j.
M. Ft. pil. viij.
One pill *pro re nata.*

A saturated tincture of the sanguinaria, to which morphine has been added, proves a grateful anodyne and expectorant.

℞ Tinct. Sanguin. Sat. ℥j.
Morph. Acet. grs. iij–v.
Ol. Gaulth. gtt. v. M.

Twenty drops may be taken, on sugar, at night. (Green's formula.)

As the stage of softening advances, and the excavations enlarge, opiates become less important in the treatment of cough, while the stimulating expectorants, alteratives, and even decided stimulants, are most valuable. Naphtha, creosote, acetic ether, and similar agents, often prove useful, especially when the cavities are large, and the expectoration profuse. Dr. Turnbull particularly commends the acetic ether, and I have used it with advantage in the following form:

℞ Æther. Acet. ℥j.
Morph. Acet. gr. j.
Syrup, ℥ss. M.

Half a tea-spoonful may be given three times a day.

Or the following:

℞ Acetone, ʒij.
Morph. Acet. gr. j.
Syr. Prun. Virgin. ℥ij. M.

Tea-spoonful three times a day.

In these formulæ the morphine may be omitted, at the discretion of the practitioner. Carbonate and muriate of ammonia often prove useful in promoting expectoration in this stage of the disease, although they can not be classed with the expectorants.

When the mucous membrane of the bronchi becomes extensively involved, the antimonial preparations, combined with morphine and the stimulating expectorants, constitute the best course of treatment. The formulæ already given, embracing these articles, will be found equal to any others; to which we should add counter-irritation, and the inhalation of soothing agents, such as warm vapor, tincture of conium, hydrocyanic acid, chloroform, and ether.

In that variety, associated with, or depending upon, laryngeal irritation, local applications of nitrate of silver, iodine, and counter-irritation become necessary. The local application of the nitrate of silver is highly valuable, and will often do more to relieve the irritation than any other agent. The solution should range in strength from ten to forty grains to the ounce of water, and be applied every day or two. Morphine is also exceedingly valuable, alone or combined with squills, ipecac, or conium. The inhalation of weak preparations of iodine, or, if too much irritation exists, of tincture of conium, with hydrocyanic acid, as previously mentioned, may be used. Sulphur, also, will be found valuable in some cases, either by fumigation or in substance. Counter-irritation with croton oil is decidedly advantageous, especially where much vascularity of the fauces is perceptible.

It should always be remembered, however, in relation to this whole subject, that a phthisical cough is not to be cured by the usual expectorant and anodyne cough mixtures; and that these agents should be used as sparingly as possible, merely with the view to palliation; for their extensive employment impairs the digestive function, and, in that sense, proves decidedly detrimental. These preparations are designed merely to alleviate distressing symptoms, and they should not be given continuously, but only occasionally, as circumstances require; thus, an anodyne preparation at night will be found, in a majority of cases, quite sufficient.

2. *Treatment of Febricula.*—The febricula which occurs in phthisis anterior to the supervention of hectic, usually results from chills; and, as the calorific power is low throughout the early stages of the disease, these phenomena are by no means infrequent. As a general rule, the tendency of all febrile affections in the tuberculous conditions is to impair the pulmonary functions, and thus to augment the special lesion. Hence, the necessity for treatment in such examples.

When chills and febrile movements are observed, we should at once resort to quinine and anodynes for the purpose of preventing a repetition of the paroxysm, while we protect the lungs, as far as practicable, during the febrile excitement. Quinine and Dover's powder, singly or combined, fulfill the first indication; while mild diaphoretics, such as the spirits of mindererus or acetate of potash, with spirits of nitre, or a little opium, usually meet the second. If there is any marked tendency to pulmonary congestion, cups should be applied to the chest, or sinapisms and blisters, according to the peculiarities of the case. At the same time the bowels should be freely opened; indeed, mild purgatives are highly important in such conditions, and should never be neglected.

3. *Treatment of Hæmoptysis.*—Hæmoptysis occurs under very different pathological conditions, as well as in variable quantities. In the early stages of the disease it is the result of mechanical obstruction or temporary engorgement; while, in the latter period, or that of excavations, a large vessel may be opened by ulceration, and fatal hemorrhage ensue. In other

cases, blood may exude from the walls of cavities, and thus produce a daily discharge even in considerable quantities. I have known a case in which this variety of hæmoptysis occurred every night for weeks in succession.

In the early stages, if the hemorrhage is copious, it should be very promptly arrested, and for this purpose no agent is more efficacious than common salt. It should be taken dry, and as freely as the stomach will bear; while, at the same time, cups should be applied to the chest, and, if necessary, blood abstracted. If the pulse is full and strong, the abstraction of blood will prove decidedly beneficial; and this may be accomplished either by venesections or cups, the choice depending on the condition of the patient. In addition to salt, various other agents are employed, such as gallic acid, tannin, opium, sugar of lead, spirits of turpentine, alum, the mineral acids, ice, and cooling beverages generally. Alum and sulphuric acid constitute an excellent astringent mixture, and may be employed with advantage in many cases. The gallic acid, however, with opium and lead, is a very efficacious astringent. But the selection of an agent, or a course of treatment, must vary with the condition of the patient; and hence, we bleed and give cooling beverages in one class, while we resort to turpentine, astringents, and tonics in the opposite variety.

If the hemorrhage is passive, and small in quantity, it is usually regarded as unimportant; but my impression is that even a small hæmoptoe furnishes an indication for treatment which should not be disregarded. If the action is of a low grade, decided counter-irritation should be at once resorted to, together with such astringents as may be required; and these agents, especially dry cups, sinapisms, blisters, and pustulants, should be unremittingly continued, until the exudation of blood ceases. When, however, there is *overaction*, bloodletting is the safest and surest remedy, and, therefore, should not be neglected. Some practitioners fear the depressing effects of bleeding; but, on the contrary, much greater evils flow from the mental anxiety and physical depression incident to hæmoptysis, than could possibly arise from the judicious abstraction of blood.

When the hemorrhage is very profuse, inducing great weak-

ness, full doses of gallic acid, alum, with sulphuric acid, should be given, the utmost quietude enjoined, the cough relieved by anodynes, and the patient allowed pellets of ice, while the usual external applications are at the same time required. Many of the ancient physicians resorted to the external application of cold; and Van Swieten states that Felesco, a celebrated physician of Rome, not only gave cold water internally, but applied sponges, dipped in cold water, to the naked breast. It is probable, indeed, that in profuse and dangerous hemorrhage, the application of ice to the chest might prove salutary, but its employment would certainly require caution and discrimination, and should not be long continued. Pellets of ice, however, may be taken freely internally; and the apartment should be well ventilated with fresh and cool air.

4. *Treatment of Dyspnœa.*—This symptom occurs in phthisis when connected with an asthmatic constitution, a nervous or excitable state, or in the advanced stage of the disease. When resulting from an asthmatic complication, stimulants, antispasmodics, and even nauseants become necessary. Among the antispasmodics lobelia, asafœtida, and valerian will be found preferable; but it is not often necessary to resort to nauseants. The following preparation will often act with remarkable efficiency, especially when the attacks are paroxysmal:

℞ Tinct. Lobelia inflat.
Fluid Ext. Valerian,
Lac Asafœt. āā ℥j M.

Give a tea-spoonful every hour, until relief is obtained.

Morphine may be added to this mixture, or to the lobelia alone, if the other ingredients are objectionable. In the nervous variety of dyspnœa, valerian, asafœtida, and morphine, or Dover's powder, will act beneficially. If any marked degree of congestion exists, dry cups and other counter-irritants must be added to the list. The dyspnœa of the advanced stage is irremediable, but may be mitigated by counter-irritants, antispasmodics, anodynes, and stimulants, or by the moderate inhalation of chloroform or ether.

5. *Treatment of Hectic Fever and Night-sweats.*—Hectic fever, depending on the advanced condition of the tubercular disease, general and local, does not admit of cure; nor can the tendency to night-sweats, which arises from the same source, be entirely removed. But, while these secondary symptoms can not be entirely suspended, they may be so far mitigated as to contribute materially to the comfort of the patient. The fever can be best mitigated by anodynes, diaphoretics, and tonics. Thus, morphine, solution of the citrate of potassa, acetate of ammonia, and quinine are the most efficient agents; and, as the object is to allay irritation, the anodynes become the most appropriate medicines. The following, among other formulæ, will be found useful:

℞ Liq. Potass. Cit. ℥ijss.
Morph. Sulph. gr. ss.
Syr. Limonis, ℥ss. M.
Dose: half an ounce, as circumstances may require.

Sponging the body with tepid water, acidulated with vinegar, or salt and water, will generally prove grateful and refreshing, and often mitigate the evening exacerbations of fever.

The attention of the physician, however, is usually directed to the colliquative sweats which follow the evening exacerbation of hectic, and which prove uncomfortable and debilitating to the patient. So long, however, as the fever continues, the period of remission will be marked by the occurrence of perspiration, and hence the treatment of the two are intimately associated. It has been found by experience that quinine, the mineral acids, oxide of zinc, and some of the astringents, such as gallic acid, prove most beneficial. My own experience is in favor of quinine and sulphuric acid, and oxide of zinc, which may be given separately or combined. The following often succeeds:

℞ Quin. Sulph. ℈j.
Acid. Sulph. dil. ʒij.
Aq. Menth. Pip. ℥jss.
Syr. Limonis, ℥ss. M.
Dose: ʒj as may be required.

The following pills will often prove efficient:

℞ Oxide Zinc,
Quin. Sulph. āā grs. xv.
Acid. Gallic. ʒss.
M. Ft. pil. xv.
One pill three or four times a day.

The oxide of zinc has been particularly extolled, but it has appeared to me inferior to the other articles named; but it may be, at times, advantageously combined with quinine. Dr. Theophilus Thompson particularly commends four grains of the oxide of zinc, with the same quantity of extract of henbane. A very efficient night pill, in such cases, consists of four grains of zinc, two of quinine, and the eighth of morphine. But I would advise that the zinc be not long continued. In addition to these remedies, sponging the surface with acids and astringents proves useful, while the bed-clothing is made light, and the room well ventilated.

6. *Indigestion and Diarrhœa.*—Andral made the observation, many years ago, that in persons dead of phthisis, the mucous membrane of the stomach exhibited various morbid conditions, among which he enumerated redness, with more or less thickening, especially at the great curvature; softening, with or without redness; a dark slate color; thickening, or hypertrophy, extending beyond the mucous tissue, and consisting in induration and tubercular deposits. He concluded, finally, that one-half of those who die of phthisis are subject to chronic or acute gastritis.

These facts, together with the more recent observations, clearly prove that the stomach and intestines are strongly prone to derangement in the advanced stages of phthisis, and that the consequent impaired digestion constitutes an important symptom. We can not, however, concur in the opinion of Andral, that these affections are so commonly inflammatory; on the contrary, they are much more frequently due to simply impaired nutrition, general and local, or to mere functional derangement. It is true, however, in a certain proportion of

cases, that the mucous membrane becomes strongly injected, in circumscribed patches, to which the symptoms of indigestion, associated with slight pain and tenderness, succeed.

If an individual has not been habitually dyspeptic, anterior to the advent of phthisis, the gastric derangement usually comes on at a somewhat advanced period; or if it supervenes early in the disease, the exciting cause may be traced to injudicious medication, the use of indigestible food, or to the improper employment of alcoholic stimulants.

The pathological conditions may, in a general sense, be referred to the following varieties: Inflammatory excitement; impaired biliary and mucous secretion; nervous derangement; and simply loss of tone. The former condition, consisting of moderate vascular excitement, but sufficient to induce slight tenderness on pressure, a little increase of thirst, intolerance of stimulating food and drinks, with a tendency to constipation, often arises in the early stages of the disease, as a consequence of taking too large quantities of stimulating food and drinks. When this occurs the stimulants should be withdrawn, a few leeches applied to the stomach, occasionally followed by a blister, the administration of simple purgatives, and the patient kept for a time on farinaceous diet. This simple course will usually relieve the stomach from its embarrassment, and permit its functions to be restored; but if neglected, or the stimulants be improperly continued, the morbid action may be goaded into permanent inflammation, with all the consequences of organic changes of the mucous membrane. I can not but think that a vast amount of mischief arises from the incautious continuance of stimulating food, under the circumstances indicated; and that the fear of debility, either from the withdrawal of stimulating aliment, or the application of a few leeches, is an evil incomparably less than the dangers arising from over-excitement.

In another form of dyspepsia we find marked evidences of deranged secretions, such as constipated bowels, loss of appetite, coated tongue, and so on. This condition will frequently be observed in persons of the bilious temperament, and where cod-liver oil has been freely exhibited. The temporary occur-

rence of this variety of derangement is best corrected by the administration of *Pil. Hydrarg.*, followed by mild aperients, such as fluid extract of senna and rhubarb. The diet should be carefully regulated, and the usual tonic medicine withdrawn until the gastric derangement subsides.

In another variety of deranged secretions we find no evidences of biliary affection, but the patient is troubled with frequent acid eructations, showing impaired secretion of gastric juice, with a predominance of acids. This condition is not infrequently due to exhaustion from over-feeding, mental anxiety, or undue bodily fatigue. The most effectual remedies, after the removal of the cause, will be found in the moderate use of tonics and stimulants, and a judicious limitation of food. Among the tonics, quinine, bismuth, nitrate of silver, and tincture of bark will be found the most efficacious. I have often derived great benefit from the following compound:

℞ Quin. Sulph. grs. x.
Bismuth Nit. ℈j.
Calc. Phos. ʒss.
Sac. Lac. ʒj.
M. Divide in x powders,
And take as circumstances may indicate.

The addition of a small quantity of capsicum will frequently be found to increase the action of the tonic.

The nitrate of silver, in many of the forms of diarrhœa, even where considerable irritation exists, is often useful, especially combined with bismuth, thus:

℞ Argent. Nitrat. grs. vj.
Bismuth. Nitrat.
Ext. Lupuli, āā ℈ij.
M. Ft. pil. xij.
A pill to be given two or three times a day.

Nervous dyspepsia, although less common than the preceding varieties, is occasionally observed, especially in persons of a nervous temperament, and possessing naturally delicate digestive powers. It is evinced by painful sensations in the epigas-

trium, as often when the stomach is empty as during digestion, but is free from the signs of inflammatory action. Such examples may be cured or alleviated by the use of anodynes, tonics, and stimulants. The preparations of opium, conium, hyoscyamus, or, what is sometimes better, the extract of Indian hemp, are the most reliable agents. The valerianate of quinine, conium, and iron may be employed with benefit. Thus:

℞ Quin. Valerian.
Pulv. Ferri, āā grs. xv.
Ext. Conii, ʒss.
M. Ft. pil. xv.

One pill may be given morning, noon, and night.

When simple debility exists, that is, a loss of digestive power without any special evidences of inflammatory action, deranged secretions, or impaired innervation, the simple tonics and stimulants are the proper remedies.

The use of small quantities of brandy is one of the most efficient agents; it imparts action to the stomach, promotes digestion, and improves the appetite. It should be taken just before, and repeated an hour or two after meals. The quantity should always be small, often not exceeding a tea or dessert-spoonful. Quinine and the vegetable tonics generally will prove useful; and the muriated tincture of iron will, at times, produce highly beneficial results. I have, also, known common salt, in five-grain doses, materially assist in restoring the tone of the stomach under these circumstances.

In those more advanced conditions, when impaired digestion is a part of the progressive debility and tubercular derangement, a palliative course embraces the whole duty of the physician. With this view we prescribe anodynes, antacids, stimulants, and tonics, according to the wants of each patient, without any expectation of affording more than temporary relief. With these views we resort to morphine, lime-water, brandy, nitrate of bismuth, hydrocyanic acid, conium, and similar agents. Creosote, naphtha, and tar-water are occasionally beneficial; and the latter is especially commended by Dr. Turnbull, who believes it is serviceable in allaying sickness

and vomiting, while, at the same time, it relieves fever and checks perspiration.

The same general remarks will apply to the *diarrhœa* of advanced phthisis. The opiates and astringents constitute the classes of medicines usually employed; and among these, morphine, bismuth, nitrate of silver, and tannin are the most valuable. But it will be found in these cases that medicines speedily lose their effects, and, therefore, require to be changed. And this remark applies to every agent connected with the advanced stages of the disease; indeed, we are often required to substitute an intrinsically inferior article simply to secure a *new* action on the system.

7. *Thoracic Pains.*—The causes capable of producing thoracic pains, are inflammatory action, limited congestion, and nervous irritation. If clear evidences of pleuritic inflammation exist, we should at once resort to the abstraction of a few ounces of blood by cups, the application of a blister, and the internal administration of anodynes. But if local congestion alone be the cause, dry cups, sinapism, or other derivatives will usually prove sufficient. If, on the contrary, the pain be of nervous origin, the veratria ointment, or the exhibition of anodynes internally, will prove most advantageous. The external anodyne applications are usually most efficacious when applied between the shoulders; although, at times, they may be used immediately over the seat of pain. Dry friction, also, by invigorating the capillary circulation, will often prove beneficial in both the congestive and nervous forms; or the combination of stimulating liniments will subserve the same purpose.

SECTION VI.

TREATMENT OF COMPLICATIONS.

The more common complications which we meet with in phthisis, are pneumonia, pulmonary congestion, bronchitis, pleu-

risy, disease of the larynx, diseases of the heart, and derangement of the liver.

1. *Pneumonia.*—Pneumonia is liable to occur in phthisis, as a complication of the essential morbid action of tuberculosis. Limited inflammation (or inflammatory softening) is a necessary attendant upon tuberculous softening; but the pneumonia which is here alluded to occurs as an independent disease, and is produced by the ordinary causes which induce idiopathic inflammation of the lungs. Thus, a tuberculous subject is exposed to a cold, damp, or variable atmosphere, and the consequence is pneumonic inflammation, more or less extensive. The tendency, in such cases, is to develop inflammation in the vicinity of the tubercular masses, and hence pneumonia of the upper portion of the lungs is quite common. But this rule is by no means uniform; for examples have frequently come under my observation, in which the disease involved also the base of the lungs. The treatment of pneumonia, as it occurs at the apex or the base, presents some peculiarities, and hence the necessity for the distinction.

Inflammatory action of the lungs, during the progress of phthisis, is always to be regarded as a most unfortunate event; for the intercurrent morbid action promotes the exudation of tubercular matter, and hastens the softening of tubercles; and its occurrence should, therefore, not only be carefully guarded against, but, on its supervention, prompt and efficient remedial measures are imperatively demanded. As a precautionary measure, patients should be instructed to avoid unnecessary exposure to a cold, damp, and variable atmosphere, and to protect the system, by proper clothing, against the evil effects of sudden transitions from heat to cold.

The measures necessary for the removal of this complication, vary with the activity of the inflammation, constitution of the patient, and other incidental conditions. If the inflammation is located in the lower lobes, with decided reaction in a constitution not greatly debilitated, the abstraction of blood will be found not only beneficial, but even essential to the welfare of the patient. The impression that any amount of bleeding will necessarily augment the tuberculous *dyscrasy*, and, there-

fore, be productive of more harm than good, is, I am satisfied from extensive observations, positively erroneous. On the contrary, the mitigation which follows bloodletting will more than counterbalance the debilitating effects of depletion.

The quantity of blood abstracted, however, must be carefully proportioned to the condition of the patient, but should never be large. The most appropriate *method* of bleeding is by means of cups, which proves equally efficacious with any other mode, while we secure, at the same time, the valuable effects of counter-irritation. Cupping to the extent of five or six ounces, repeated or not, as circumstances may indicate, will serve to check the inflammatory action, and prepare the way for other remedies. If the symptoms are somewhat active, we may next resort to antimony and opiates, either in the form of tartar emetic and morphine, in solution, or pulv. Doveri and pulv. antimonialis, in powders. But whatever the form in which these agents are employed, they should be administered cautiously, and in small quantities; for while their discreet use must prove highly beneficial, any excess of debilitating medicines becomes injurious.

In addition to a mild antiphlogistic course, counter-irritation should never be neglected; indeed, it constitutes one of the most important remedial measures, after appropriate depletion. Dry cups, sinapisms, blisters, and, finally, pustulants, may be brought into requisition according to the indications of the case. The repeated applications of blisters is often highly valuable, especially after depletion, or in those examples which do not require antiphlogistic remedies. Sinapisms, and hot turpentine stupes may often be used with great advantage, especially at a period too early for blisters.

In those examples in which the grade of action forbids antiphlogistics, dry cups, sinapisms, turpentine, and pustulants become appropriate, while at an early period sustaining remedies, medicinal and nutritive, must be brought into requisition.

When the inflammation is located in the upper lobe, and in immediate relation with tubercular deposits, a different course is required. Even idiopathic pneumonia, in this location, requires less depletion than when located at the base; and when

occurring as a complication of tubercles, debilitating agents should be cautiously used, or entirely interdicted. The most judicious course of treatment consists in counter-irritation, very moderate (if any) use of antimonials, a properly regulated diet, and the occasional use of salines. Very minute doses of antimony, not exceeding the twelfth or sixteenth of a grain, may be often advantageously employed; and if the cough is much aggravated, opiates may be added. But decided and persistent revulsives and counter-irritants, such as dry cups, blisters, and pustulants must be sedulously employed until the inflammatory symptoms subside.

In both varieties of the disease, it becomes necessary to suspend the usual remedies, if they be of a tonic and stimulating character, employed in the general treatment of phthisis; and, also, to regulate the diet according to the degree of fever, and the strength of the patient, and to employ mild cathartics as may be required. And in returning, again, to the usual remedies, it is important that the transition should not be too early, otherwise subacute inflammation may be kept up with the most injurious consequences.

2. *Pulmonary Congestion.*—During the progress of phthisis, persons of a delicate constitution and weak circulation, and who become exposed to the causes which ordinarily induce pneumonia, are liable to pulmonary congestion, which is evinced by some degree of dyspnœa, at times slight febrile movement, and locally by the frequent occurrence of the subcrepitant rhonchus. The physical signs are most apparent at the base, but at times may be absent. It is not usual to find the disease obstinate or protracted; but in some examples it may advance to actual inflammation, although usually stopping short of consolidation. The proper treatment consists in dry cups, sinapisms, turpentine, and blisters. Depletion would generally prove injurious, while even stimulants, such as ammonia and quinine, become appropriate.

3. *Bronchitis.*—The occurrence of acute capillary bronchitis during the course of phthisis, demands prompt and efficient treatment. If decided febrile action, with aggravation of cough, supervene, blood may be abstracted by means of cups, followed

by sinapisms or blisters. The internal remedies should embrace anodynes, antimonials, and purgatives. My own experience leads me to place great reliance on opiates, alone or combined with antimony or ipecac. If the secretion of mucus becomes abundant, no agent will so speedily arrest it as opium; while, at the same time, the anodyne proves grateful and soothing to the patient. When the activity of the disease has been subdued, or in cases where the morbid action has been passive from the beginning, the stimulating expectorants, combined or not with alkalies, become appropriate remedies; and the following formula, among others, may be advantageously used:

℞ Fluid Ext. Cimicifuga,
Syr. Senega,
Vin. Picis, āā ℥j.
Liq. Potass. ℥ss. M.

A drachm to be taken every four or six hours.

Pustulation of the chest with croton oil, and the inhalation of anodynes, become useful as the disease advances. Purgatives, also, contribute to the relief, and even mercurials may be necessary when, as often happens, the liver becomes engorged or inactive.

4. *Pleurisy.*—The occurrence of pleurisy sufficient to excite *fever*, should be met promptly with the local abstraction of blood, the application of blisters, and the exhibition of antimony and opium. These remedies should be, of course, proportioned to the violence of the disease; thus, a limited pleurisy, evinced by pain and friction-murmur, but without fever, requires merely blisters and anodynes, while the more extensive and acute demands bloodletting. The importance of pleurisy, under these circumstances, relates rather to its secondary effects, namely, the exudation of lymph, and the subsequent adhesion of the pleural surfaces. Such a condition materially interferes with the expansion of the lung, and, therefore, proves detrimental in phthisis. It becomes important, therefore, to limit the plastic exudation, as far as possible, and thus arrest the evil of adhesions. The existence of *pleuro-pneumonia* constitutes a

formidable condition, which should be treated in accordance with the preceding principles.

5. *Diseases of the Larynx.*—The affections of the larynx, which usually require attention, are erosion, ulceration, follicular disease, œdema, and general inflammation. These various conditions are liable to occur in different cases, and always prove exceedingly annoying and injurious to the patient. As a general remark, topical applications, especially the nitrate of silver, become indispensable. When, however, much tenderness exists, the application of leeches, counter-irritants, and anodynes are required. The general principles, however, of treating these affections of the larynx are given under the head of laryngeal phthisis, and, therefore, need not be enlarged upon in this connection.

6. *Diseases of the Heart.*—Two opposite conditions of the heart occasionally require attention during the progress of phthisis, namely, hypertrophy and weakened action. *Hypertrophy* is evinced by strong impulse and increase of the dull space; it more commonly occupies the right ventricle. When this latter condition exists, the blood is driven with undue force into the lungs, which proves, to a certain extent, prejudicial. It doubtless augments the tubercular deposits, induces congestion and dyspnœa, and predisposes to hemorrhage. With the view of lessening this action, occasional cupping over the cardiac region, and the internal exhibition of veratrum viride, or digitalis, may be productive of good. At the same time, the patient's exercise should be somewhat restricted, and he should be especially enjoined to avoid protracted walks or sudden exertion.

A *weakened* action of the heart may depend on dilatation, with thinning of the walls, and softening of the fibers. Such conditions materially embarrass the circulation, and, therefore, affect tuberculous patients in an unfavorable manner. The treatment must be mainly tonic and stimulating, very nearly similar to that which is appropriate for the phthisis itself; but, as special remedies, we may mention brandy, quinine, and iron.

7. *Derangement of the Liver.*—The liver is liable to functional and organic derangement, aside from the more specific lesion of

fatty degeneration. It occasionally becomes inactive, partially engorged, or even decidedly irritated. *Hepatic phthisis* has been described by most writers; but, instead of constituting a distinct species, it is usually simply a complication. But the derangement of this organ always exercises a most prejudicial influence over the progress of phthisis, and should, therefore, be promptly treated. Mercurial alteratives, and counter-irritants are the proper remedial measures; followed by muriate of ammonia, taraxicum, or nitro-muriatic acid. The muriate of ammonia is a remedy of considerable value, and may, at times, even supersede mercurials. If the patient is taking tonics and stimulants, especially cod-liver oil, they should be suspended during the alterative treatment; while quinine may be employed with the view of preventing undue debility.

In the preceding remarks on the treatment of the diseases which more commonly complicate phthisis, but little reference has been made to the current treatment of the primary affection. It may be stated, therefore, in general terms, that it is often necessary to suspend the specific treatment, or, at least, to modify it in a material manner, so that it may not conflict with the management of the complication. But it should be remarked that much care is requisite in this respect; for, while we endeavor to prevent the interference of incompatible modes of treatment, it is also important to sustain the system, especially if much enfeebled, by the continuance of tonics and stimulants. Hence, even opposite modes of treatment must occasionally be more or less combined.

CHAPTER II.

TREATMENT OF INFLAMMATORY AND ACUTE PHTHISIS.

THE varieties of phthisis, which are embraced under this head, are quite different in character, and require almost opposite modes of treatment; nevertheless, for convenience sake, the two forms will be mentioned in connection. The varieties here referred to are the *inflammatory* and the *acute*. These terms are employed, as heretofore explained, to represent different forms of disease, or, at least, different in their etiological relations. Thus, the *inflammatory* species indicates that form in which pneumonia, bronchitis, or pleurisy has acted as the inducing cause, and which becomes chronic; while the term *acute* phthisis is intended to represent that rapid tuberculosis which, by its own force, destroys life in a comparatively short space of time.

1. *Treatment of Inflammatory Phthisis.*—It has already been shown, in the section treating of the varieties of phthisis, that pneumonia, bronchitis, or pleurisy is capable, under certain circumstances, of becoming the inducing cause of phthisis; that is to say, inflammation of the pulmonary structures, occurring in the *tuberculous constitution*, becomes capable of developing tubercles, which pass more or less rapidly through the stages of deposit and softening. In such examples, the pneumonia, instead of undergoing resolution, becomes *chronic*, and thus goes on conjointly with the tuberculous disease. It is, indeed, chronic pneumonia complicated with tubercular deposits. But, in other cases, the pneumonia is secondary in occurrence, but in its general progress, bears the same relation to the tubercular disease. Hence, it is a point of the highest importance to prevent the

occurrence of these inflammatory affections in persons whose constitutions are predisposed to tuberculosis, or, when they do occur, to seek their removal as speedily and as completely as possible. The treatment of the initial inflammation, therefore, is legitimately embraced in the treatment of inflammatory phthisis.

Pneumonia leading to phthisis is presented under three forms, which it is important to distinguish: 1. Pneumonia of the lower lobes. 2. Pneumonia of the upper lobes. 3. Vesicular Pneumonia. These several forms exhibit different characteristics, which should be clinically separated. I will advert first to pneumonia of the lower lobes.

The treatment of pneumonia occurring in the tuberculous constitution embraces many points of difficulty, especially in relation to the propriety of depletion. The first practical axiom, however, which it is important to understand, is, that the disease should be met promptly and efficiently. With this view, I should not hesitate, in pneumonia of the *lower* lobes, to abstract blood, and employ antimony and morphine; but, at the same time, extreme or very active depletion is uncalled for, and may prove injurious. A moderate abstraction of blood by cups, and small doses of antimony and morphine, are the appropriate remedies for the early stage; but, speedily following this, decided revulsive action on the surface should be resorted to, either in the form of rubefacients or vesicants. Dry cups may follow the wet; sinapisms, turpentine stupes, and, finally, blisters, according to the stage of the disease and condition of the patient, are our most valuable remedies. Cathartics, also, are highly valuable, and even smart purgation should not be deemed improper. For this purpose the mercurials, alone or combined, are not only *safe*, but valuable remedies; indeed, the liver is usually engorged, and the cholagogue action of mercury is highly important. No apprehension need be entertained in relation to the evil effects of mercury as a purgative or cholagogue, while its good effects can scarcely be secured by any other agent. It is not desirable, however, to urge the mercurials to the point of ptyalism; for although the clinical facts are few which indicate its evil effects, yet we rather dread its secondary influence on the plastic elements of the blood.

When the violence of the disease has been checked, it is important to promote the absorption of the plastic exudation, and thus prevent the occurrence of chronic disease; for it can not be doubted that it is the duration of the local affection which constitutes the great danger. Our ability to promote the absorption of lymph is somewhat limited; nevertheless, there are some remedies capable of accelerating the removal of the exudation by interstitial absorption. With this view we should continue the counter-irritants, (blisters or pustulants,) and administer internally the iodide of sodium or potassium, the former being preferable. An excellent compound is the following:

℞ Fluid Ext. Cimicifuga,
Syr. Senega, āā ℥ij.
Iodide Sodium, ℥j. M.

A tea-spoonful to be given three times a day.

This preparation stimulates the pulmonary capillaries, and thereby promotes absorption. At the same time, the strength should be carefully sustained by tonics, particularly iron, and nutritious diet. The cod-liver oil is inappropriate so long as fever remains, but may be used when the disease becomes chronic.

When the disease becomes chronic, and tubercles are found among the morbid products, we can no longer depend on antiphlogistic treatment; but the chief reliance must be placed on tonics and nutrients, very nearly in the manner we would treat ordinary cases of chronic phthisis. There are, however, a few precautionary precepts which deserve consideration. In the first place, we must not change from the partial antiphlogistic course to the purely tonic and stimulating agents too abruptly; instead of this there is an intermediate course, embracing counter-irritants, diaphoretics, quinine, and iron, which will be found beneficial, while cod-liver oil and brandy would prove too exciting. We may safely continue, also, the use of the iodides, in conjunction with iron, so as to secure the combined effects of sorbefacients and tonics. I greatly prefer, in such cases, the separate administration of iodine and iron; for example, the

iodide of sodium administered *before* meals, and a simple preparation of iron *after* eating, will usually succeed better than the *iodide of iron*. Quinine, iron, and morphine, in small doses, will often prove eminently serviceable in this stage of the disease.

Another important practical rule is, to avoid *overfeeding*. In this form of inflammatory phthisis I have found it exceedingly injudicious to permit the patient to indulge in a full and stimulating diet; on the contrary, while the food is sufficiently nourishing, it should be nicely adapted to the wants of the system, and not of a character, or in sufficient quantities, to prove oppressive to the digestive organs, nor to introduce too much nutritious material into the blood. The powers of secondary assimilation are greatly weakened, and crowding the system with nutritive elements, especially the nitrogenous, beyond its capacity to completely dispose of them, must lead to unfavorable secondary changes. In the main, a bland farinaceous diet, with moderate quantities of animal food, adapted, in quantity, to the stage of disease, will be found, in the end, better than to urge upon the patient full meals of highly stimulating food.

In the last place, decided and protracted counter-irritation should be resorted to, in such forms as the circumstances may indicate. As a general rule, I prefer blisters to pustulants, and even setons and issues may become highly valuable. I believe, however, that the application of tincture of iodine will frequently act most beneficially, and probably aid directly in resolving the consolidated lung.

Inflammation of the *superior lobes* is of more serious import than the preceding, and demands a somewhat different course of treatment. The pneumonia located in this portion of the pulmonary structures manifests less activity, in all its aspects, than when in the lower portion of the lungs; thus, there is less fever, cough, and sputa, and the disturbance of the respiratory movements is often inconsiderable. Hence the treatment can not be, to any considerable extent, depletory, but we must rely on revulsives, diaphoretics, or the mildest febrifuges. Occasionally a few cups may be applied, but more commonly dry ones

will be preferable; while, internally, Dover's powder, with pulvis antimonialis, are more judicious than morphine and tartar emetic. Blisters should speedily follow cups, and the alterative action of iodine may be resorted to at an early period. The iodide of sodium or of potassium may be given at an early period, and will often act beneficially in removing the adventitious deposits. The strength must be early supported; and as tubercular deposits take place, or rapidly extend, the treatment scarcely differs from that which is appropriate in chronic phthisis. The inflammatory deposits will usually give way under the use of iodine, iron, and blisters; while the subsequent treatment, if tubercles become developed, must rest on those principles which govern our course in the ordinary forms of the disease.

The *third* variety of pneumonia is the vesicular form, which gives rise to the *gray granulations*. As previously explained, this form of so-called tuberculosis is due to inflammation and the exudation of lymph, at least approaching an organizable quality. The disease is often very extensive; indeed, I have known examples in which the physical signs could be heard in every portion of the lung, from base to apex. In this form of disease *hepatization* does not occur; nor is there a direct tendency to resolution, or, more remotely, to softening. Thus, the affection is obstinate, and often fatal without further change of structure. In the *treatment*, moderate depletion is usually requisite; but as the febrile reaction is not very decided, bleeding should generally be employed only to a limited extent. A few cups, followed by fomentations, with small doses of antimony, are usually all the depletory agents required. As the febrile action subsides, the iodide of sodium is required; and my impression is, that its continued use exercises an important influence over the semi-plastic granulations; while, at the same time, counter-irritation, by means of pustulants, is preferable to blisters, especially on account of the extent of tissue involved, which is often a whole lung.

This is the variety of tubercle which Rokitansky thinks may become "cornufied," that is, slightly shriveled and hardened, by which all tendency to increase or to softening is lost, and the granules remain inert. I think the preparations of iodine,

even by inhalation, together with counter-irritation, after the subdual of the primary fever, are the most reliable measures to arrest the progress of these morbid deposits.

The treatment of the *laryngeal* variety differs from that of the simple chronic form of phthisis, in the necessity for agents directed to the fauces, larynx, and trachea. The constitutional treatment is, in part, the same; that is, in both varieties tonics and nutrients are demanded, but in the laryngeal form *stimulants* are scarcely admissible. Indeed, as a general rule, alcoholic preparations prove injurious, by increasing the laryngeal irritation; and if any form of stimulants can be tolerated, it will be the malt liquors, but even these may prove prejudicial.

The local remedies must be varied to suit the peculiarities of different cases. When the disease is detected in an early stage, leeches often prove eminently useful; indeed, I am fully persuaded, that in the initial stage the judicious employment of leeches, counter-irritants, and the internal application of the nitrate of silver, may arrest the disease. The application of leeches, conjointly with tonics, particularly the chalybeates, can not be safely omitted; for, inasmuch as the arrest of the disease depends largely on the subdual of the local affection, depletion becomes an indispensable remedy. Internal applications, such as the nitrate of silver, and counter-irritation, all succeed far better after the abstraction of a small quantity of blood. This is, therefore, one of the forms of phthisis in which depletion is imperatively demanded.

Various topical applications have been recommended, among which the nitrate of silver, in solution, stands pre-eminent. There can be no doubt in relation to the power of the solution of this agent to subdue chronic inflammation of the fauces and larynx, and hence its great utility in this form of phthisis. The strength of the solution and mode of its application must vary according to the circumstances of each case. As a rule, we should commence with the weaker preparation, (about ten grains to the ounce,) and gradually increasing the strength to two scruples, or a drachm of the salt to an ounce of distilled water, if the condition seems to require it. As to the mode of application, the sponge is generally preferable, and it should be applied first

to the fauces, and afterward passed down to the larynx, the aperture of which should usually be penetrated. It is not necessary, however, always to enter the larynx, for the application to the fauces, and the sponge pressed on the epiglottis, will often be sufficient. When, however, the irritation is persistent, the larynx should be penetrated, if it can be accomplished with facility. It will be found that great differences exist in different persons; in some cases the parts are too irritable, and the formation of the throat so narrow and contracted, as to render the operation difficult. However, where excessive irritability of the larynx exists, that condition may be lessened by the cautious application to the adjacent parts; or, what is still better, the patient may be made to inhale a little chloroform, which will greatly facilitate the operation.

If the sponge is employed for the purpose of entering the larynx, it should not be very large; indeed, the ordinary whalebone and sponge, as sold in the shops, is altogether too large for this purpose. But instead of sponge, the curved syringe may be employed, and, in the hands of some, will often succeed the best. Or, if both these methods fail, the salt may be introduced by insufflation. For this purpose, the nitrate of silver may be diluted with sugar of milk, made into an impalpable powder, and introduced through a glass tube. The strength may vary from one to three grains of the salt to ten of sugar of milk; but the pure nitrate of silver may be inhaled without risk, as I have often witnessed. One grain of the mixture, placed in a glass tube, having the caliber of the eighth of an inch, and passed far back over the tongue, may, by a forcible inspiration, be inhaled with but trifling inconvenience. Any other article, such as nitrate of bismuth, acetate of lead, tannin, etc., may be used in a similar manner.

Vapors and gaseous medications may be inhaled with advantage. Tar, volatilized by boiling, creosote, chlorine, hydrocyanic acid, conium, preparations of opium, and all similar articles, may, at times, become valuable. When there is copious expectoration, of a purulent character, tar, creosote, and similar agents will prove most valuable; but if a high grade of irritation exists, without copious secretion, the anodynes will be most

appropriate, such as tincture of conium, hydrocyanic acid, a watery solution of opium, etc. The vapor from a decoction of poppy-heads, or a watery solution of opium, will often prove very soothing, and especially when the tinctures can not be borne.

In addition to these measures, counter-irritation, by means of croton oil, tincture of iodine, or blisters, becomes indispensable. Pustulation with croton oil will generally succeed best, but all in turn may become necessary.

The treatment of laryngeal phthisis may be thus summed up: leeching, counter-irritation, nitrate of silver, and various vapors and gases, as topical applications, together with tonics and nutrients, such as the chalybeate preparations and cod-liver oil. Stimulants, however, should be used cautiously or entirely avoided. The sulphurous mineral waters will often prove valuable in this form of phthisis, and, when practicable, may be employed conjointly with the general treatment.

2. *Treatment of Acute Phthisis.*—The *acute variety of phthisis*, as that term is usually employed, admits of but little treatment; that is, it is evidently a form of disease in which the morbid action is so extensive, and the changes so rapid, that all modes of treatment prove futile. It is, indeed, a condition in which the system is, as it were, *saturated* with tubercles, and the lungs become speedily infiltrated with the morbid deposits; and the changes which occur after the deposition are equally rapid, softening and elimination taking place in a most speedy manner. So rapid, indeed, are these changes, and so inveterate is the morbid action, that all remedial agents are placed at defiance, and the disease marches steadily on to a fatal issue.

If the physician deems it expedient to attempt more than the simplest palliation, he may resort to extensive counter-irritation, stimulants, and tonics; but these agents will do no more than retard the progress to a very limited extent, and often, indeed, seem to make no sensible impression on the march of the disease.

CHAPTER III.

SPECIAL QUESTIONS IN THE TREATMENT OF PHTHISIS.

THE preceding remarks embrace a systematic account of the principal remedies, medicinal and hygienic, which have been found useful in phthisis; but some of these, about which differences of opinion exist, demand a more extended notice, among which may be enumerated climate, sea-voyages, gestation, and topical medication.

1. *Change of Climate.*—The subject of climatic influences in the treatment of phthisis has necessarily attracted a large share of attention; and while some have expressed the greatest confidence in the efficacy of particular localities, either to prevent or cure the disease, others have appeared almost entirely skeptical in regard to such influences, and therefore counsel patients to remain at home. Doubtless this whole subject has been rendered obscure by a want of attention to the peculiarities of each individual case, including the stage of disease, the temperament of the patient, his cast of mind, and mental cultivation. And, as intimated in a former section, the different *stages* of the disease require very different climates, and hence no single locality can reasonably be expected to meet the wants of all patients. The great desire appears to have been to secure a mild and equable climate, in which the atmospheric vicissitudes are limited, and the extremes of heat and cold restricted within moderate limits. But while these conditions of climate are undoubtedly adapted to a certain class of patients, others require altogether different atmospheric influences, in order to secure the benefits arising from a change of climate. There are two classes of persons who may reasonably anticipate beneficial

results from a change of climate: 1. Those in the precursory stage, or the early period of local deposits; 2. Those in whom softening has commenced. These conditions are widely different, and demand climates of almost opposite qualities.

1. *The Climate adapted to the Precursory Stage, or the early Period of Tubercular Deposits.*—The first question which arises in this connection is this: Should patients in this early stage of phthisis be placed in a mild and equable climate, such as Madeira, and there be permitted to remain? It seems to me that every rational consideration forbids such an idea, and that patients so situated must necessarily suffer serious injury. In these early stages of phthisis, patients are already beginning to feel the depressing effects of disease, and, therefore, require all those influences, hygienic and medicinal, which impart tone to the system, and thereby invigorate the nutritive functions. It cannot be presumed, however, that a mild and equable atmosphere will produce this result; on the contrary, the very monotony of the atmosphere must lead to depression, and thereby increase the debility. In order to promote health, the atmosphere should be subject to some degree of perturbation, and even rapid changes, provided these variations are not great or extreme. The steppe of Kirghis, where consumption is almost unknown, is remarkable for its rapid changes, and even severe winds.

But it is evident that these changes, in order to promote health, must be restrained within reasonable limits; for, as already explained, such patients manifest comparatively low calorific functions, and, therefore, do not well sustain a very great degree of cold. The *extremes* of temperature generally prove injurious, and phthisical subjects should select climates free from such elements. It should be remarked, also, that long-continued cold is depressing, and consequently extreme Northern latitudes can not be recommended for consumptives. On general principles it does not appear judicious to send persons predisposed to phthisis, or those in whom the local disease has already commenced, to climates colder than those to which they have become accustomed; for it has often been observed that such changes are apt to give rise to the disease, even when

the class of persons were at home comparatively exempt from it. In a general sense, therefore, persons predisposed to phthisis, or in whom the local disease has already commenced, should seek a moderately warm and dry atmosphere of considerable altitude, and which is subject to sufficient commotion to render it occasionally exhilarating, but free from great extremes. A very warm, stagnant, and moist atmosphere, with but little elevation, would manifestly prove injurious, and there is sufficient ground to justify the conclusion that where the disease is far advanced, *tropical* regions are unfavorable. The conclusions, however, in regard to the effects produced by hot climates, have been usually drawn from cases in which the disease was more or less advanced, and, also, from soldiers and sailors, classes of persons most unfavorably situated. Making allowances, therefore, for these advanced cases and unfavorable conditions, there is no positive evidence to prove that warm, but changeable climates are inimical to those laboring under incipient phthisis, while analogical reasoning, as well as the general laws of the economy, strongly favor the view that *warmth, cæteris paribus*, so far revolutionizes the system as to exercise a favorable influence over this class of patients.

It is evident, however, that the favorable influences of warm climates is very strictly limited to the incipient stages, while we have abundant testimony to prove that when the disease has become established, and the system debilitated, but little good can be derived from warm regions, while, on the contrary, great injury will often result. Various opinions, however, have been expressed on this subject, and many contradictory statements made; but it is probable that the differences arise almost exclusively from confounding several distinct questions. Thus, the prevalence of phthisis among the natives or resident population of a warm country, and the effects of the same climate on new residents laboring under advanced phthisis, are obviously very different questions; nor can laws be applied to a civil population, permanent or transient, which have been deduced from statistics derived from the army or navy.

It is remarked by M. Rochard, that in the torrid zone tuberculosis marches with more rapidity than in Europe; that

physicians of the colonies (French) protest against consumptives being sent thither from France, and that soldiers and sailors attacked are sent home. The reports of Colonel Tulloch also show that English sailors suffer in a larger proportion in Southern latitudes than at home. These facts, however, are not conclusive in the premises; indeed, they simply establish the unhealthfulness of Southern latitudes, without proving that they contribute to the production of phthisis, or that they may not, under certain contingencies, prove salutary to those predisposed to the disease. Take, for example, Gaboon, where the mortality from epidemics is frightful, yet of nine hundred and fifty-two patients, there was not a case of phthisis, and of thirty-one hundred and forty-four marines only *six* were consumptive. By reference to the article Geography of Phthisis, it will be observed that, in many warm or tropical regions, phthisis is rare, which establishes the general fact, that it is not simply heat which proves so injurious, but that the condition of the patient, as well as the other elements of climate, such as altitude and moisture, are the qualifying conditions.

The general fact may be more correctly stated by saying, that patients with decided phthisis are not benefited by hot climates, and that the disease advances with greater rapidity in tropical than in temperate regions. When the system has become debilitated by tubercular disease, the prostrating effects of hot climates prove injurious; but those merely *predisposed* to the affection, or in whom it has made but little progress, may be as much benefited as others are injured by the change.

But most of the statistics on this subject have been drawn from the army and navy, and, therefore, can not properly represent what would occur in civilians. It can not be presumed that sailors, exposed to extremes of heat and moisture, with a diet ill adapted to ward off or relieve tuberculosis; or soldiers, crowded in camps and barracks, and exposed to hardships, scanty diet, and the influences of bad air; could be regarded as fair representatives of what would occur in persons free to select their own residence, diet, exercise, and medication. Persons seeking the tropical regions would naturally select those localities known to be adapted to pulmonary affections, and would, in

addition, be surrounded by all those influences which so materially contribute to health and comfort. Hence, the statistics drawn from the army and navy are utterly fallacious as applied to civilians.

On the European continent, the milder regions presumed to be favorable to consumptives, embrace the southern portions of France, and many points in Italy. But, as will be seen by reference to the section on the *geography* of phthisis, the disease is quite common in these countries, and hence, the favorable influence, if any, is due to the general effects of *change* of climate, rather than to any special influence arising from those localities.

It must be evident that patients residing in England, surrounded by a cool and moist atmosphere, would often be materially benefited by changing, during the winter, to the south of France or the north of Italy, or of migrating to even warmer latitudes. But if the disease has made any marked progress, and even moderate debility is present, these milder regions should be abandoned during summer, and patients should seek the more bracing atmosphere of cooler latitudes, and even mountainous regions. And so, too, of our own country. The residents of the Northern states migrate with advantage to the South during winter; but, on the return of summer, the insalubrious regions of warm latitudes are abandoned, and patients retrace their steps to the North. In this manner a constant change is secured, while patients avoid those extremes which prove so dangerous when the vitality has been lowered by disease.

2. *Climate adapted to the Stage of Softening.*—When phthisis has advanced to the stage of softening, patients require a mild and equable climate, moderately dry, and comparatively free from sudden changes. The vitality in such cases is too much reduced to bear the rigors of cold regions; and if patients in this condition reside in Northern latitudes, they are measurably confined in-door during the winter, and consequently suffer from privations of fresh air. Consumptive patients require out-door exercise; and hence they should be placed in such regions as will permit regular exposure in the open air without incurring

the risk of inflammatory diseases from cold. In regard to moisture, a *medium* condition is important; an atmosphere loaded with vapor becomes oppressive and always injurious, while excessive dryness induces irritation of the mucous membrane of the air passages, and often contributes to the development of bronchial inflammation. Hence, mountains on the one hand, and plains or sea-shores on the other, are equally to be avoided.

In relation to particular localities, the general principles developed in the preceding remarks will be a sufficient guide; but in estimating the qualities of each place, special reference must be had to the condition of the patient on the one hand, and the altitude, moisture, temperature, and prevalence of winds on the other. European patients go to the south of France, Italy, Rome, and to the Island of Madeira; while in the United States, they seek the same regions abroad, and the southern latitudes of our own country. So far as the United States is concerned, I think we have localities superior to those abroad, except, perhaps, the island of Madeira.

The *south of France*, as it is usually understood, embraces regions very different in their climatic conditions, which was long ago pointed out by Sir James Clark. Thus the southwest of France, with a mean annual temperature of fifty-five degrees, is rather moist and relaxing, and, therefore, not well adapted to patients in a state of debility. But, as remarked by Sir James Clark, it may benefit consumptives who suffer with bronchial irritation, or dyspepsia arising from inflammatory action of the mucous membrane of the stomach. This range of climate includes L'Orient, Nantes, La Rochelle, Bordeaux, Montauban, Pau, and Toulouse.

The *southeast of France*, embracing Provence, Montpelier, Marseilles, Aix, and Hyères, is quite different from the southwest; the climate has been characterized as dry, harsh, and irritating. The northerly winds are harsh and severe in winter, and, therefore, not adapted, as a general remark, to consumptives. Such climates are favorable to relaxed systems, requiring the invigorating effects of a dry and cool air; but, as a rule, they are not adapted to the stage of softening. The little vil-

lage of Hyères, situated two miles from the shores of the Mediterranean, is regarded in France as well adapted to a winter residence for consumptives.

Nice is esteemed by many as one of the most favorable localities; but Rochard declares it far inferior to Hyères. M. Barth remarks, that being on the borders of the sea, it is consequently exposed to rains and fogs, that it is traversed by a current which brings humidity, and its temperature is lower and more variable than Hyères. It is exposed, remarks Rochard, to east winds, especially in March and April; and Fodéré observes that the variations of temperature are frequent, and many of the English who seek health there, speedily die. Dr. Pugh observed that many English, on arriving at Nice, were attacked with inflammatory fever, and all suffer more or less with the lungs. M. Bricheteau states that at the hospital one-seventh of the mortality is from phthisis; and hence, Andral remarks, it is injudicious to send consumptives to Nice.* During the winter, however, the climate of Nice presents some very favorable elements; thus, it is protected from the winds of the north and northwest by the Alps, and its atmosphere is comparatively dry, and its temperature mild. The mean temperature of winter is forty-eight degrees, and of spring fifty-six degrees. The place may be regarded as healthy, except that the prevalence of east winds during the spring induces inflammation of the lungs and catarrhal affections, and acute and chronic gastritis are common diseases.

There are no facts to prove that Nice has any special claims as a resort for consumptives. The atmosphere is rather irritating, and, therefore, would prove injurious if much laryngeal or bronchial disease existed; while the tendency to pneumonia during the spring, would render a sojourn at that period hazardous in many cases. It might prove beneficial in persons of a lymphatic temperament, or those in whom softening was unattended by irritation of the mucous tissues.

Italy, from its pure air and brilliant skies, has been highly extolled as a resort for consumptives; but the ideal probably

* Rochard.

greatly surpasses the real. Some localities, however, are greatly superior to others.

Genoa is subject to rapid changes; and its diseases most prevalent are rheumatism, pneumonia, catarrhs, and phthisis, one-sixth of the deaths being from the latter disease. *Florence* is equally exposed to sudden transitions, and the vicinity of snow-clad mountains gives its winds, during winter and spring, an unfavorable character. *Pisa* is more protected, and possesses a milder atmosphere; it is well sheltered from the north and east winds, and its winter climate is regarded as the most equable in the country. It is a milder and softer climate than Nice, and consequently will agree better with patients advanced to the stage of softening. *Naples* bears a strong resemblance to Nice; it possesses a dry and consequently exciting atmosphere, and is, therefore, best adapted to persons of a lymphatic temperament, and those in whom but little irritation exists. But its temperature is variable, the sirocco is often severe, and hence is not well adapted to advanced cases of phthisis. *Rome* is more favorable for consumptives. It is, however, a moist and relaxing atmosphere, and, therefore, many patients in a state of debility would be injured by a prolonged residence. Sir James Clark, however, bears testimony to the favorable influences of this climate; and he declares that he has frequently known persons laboring under grave symptoms of phthisis restored after a short residence in Rome. The character of the climate is best adapted to persons of a nervous temperament, and in whom much mucous irritation predominates.

Venice possesses a more equable climate than most contiguous places. M. Carriere declares that it would be difficult to invent a climate more favorable to consumptives. Of twelve hundred patients admitted to the hospital, only seven or eight were consumptives.

The island of *Madeira*, which has been forcibly, if not truly, styled the *city of refuge* for consumptives, possesses a reputation superior to any other place or country. It is situated in the North Atlantic, lat. 32° 28′ N., long. 160° 54′ W.; and is described as a "mass of basaltic rock," consisting of bold scenery, with a remarkably equable temperature. The greatest heat

does not exceed 74° Fahr., and the lowest does not fall below 63°. Different opinions, however, have been expressed in regard to its beneficial influences in cases of consumption. Drs. Gourlay, Mason, Burgess, and others, assert that no malady is more common in Madeira than phthisis, while Dr. Heineken was led, by his own observation, to a more favorable opinion. Dr. Renton also affirms that the prevalence of phthisis in Madeira has been greatly overrated by Dr. Gourlay; and Sir James Clark, having carefully examined the facts reported by Drs. Renton and Heineken, expresses the opinion that phthisis is not a common disease in this island.

Conflicting opinions have been expressed in relation to the moisture of the atmosphere, and other qualities of the climate of Madeira. Dr. Mason, who was a consumptive, and spent some years in the island, represents the atmosphere as being saturated with moisture, during the principal part of the year, being, in fact, worse than London; that it is impossible to prevent iron from being rapidly oxydized, while deliquescent substances speedily imbibe moisture; that the temperature is quite variable; and, finally, consumption and scrofula are common diseases.

These are most unfavorable statements; but it is probable the picture has been overdrawn. Thus, at Madeira rain falls on seventy-three days in the year, while at London the number reaches one hundred and seventy-eight. The rains generally fall at particular seasons, especially in autumn, while the air of the remainder of the year, says Sir James Clark, is generally dry and clear.

The following statistics, furnished by Dr. Renton, throw some light on the effects of this climate:

Cases of confirmed phthisis	47
Died within six months after their arrival at Madeira	32
Went home in summer, returned, and died	6
Left the island, of whose death we have heard	6
Not since heard of, probably dead	3
Total	47

Cases of *incipient* phthisis	35
Of these, there left the island much improved, and of whom we have good accounts	26
Also improved, but not since heard of	5
Have since died	4
Total	35

These figures, if to be taken as literally true, simply show, what might have been anticipated, that the climate afforded no relief to those far advanced in the disease, but probably hastened their death; while, on the contrary, of those in the incipient stage, a large proportion were permanently benefited. The statement, however, in relation to the *incipient* cases, probably requires some qualification; for it is not certain, nor even probable, that they were all cases of the character assigned them. Still, with all due allowances for errors, we must regard the statement as highly favorable.

The statistics furnished by Dr. G. Lund, as given by Boudin, are highly valuable, and furnish some important facts on the subject.

Of one hundred phthisical patients who arrived at Madeira, in various stages, the disease was arrested in thirty-seven in the first stage, five in the second stage, and five in the third stage. In the same number, eleven, in the first stage, continued to progress, seventeen in the second, and twenty-three in the third stage. The following were the general results:

LIVING.

First stage	43	
Second stage	13	= 66
Third stage	10	

DIED.

First stage	5	
Second stage	11	= 34
Third stage	18	
		100

The length of time during which the disease remained *ar-*

rested appeared sufficient to justify the conclusion that it constituted a cure. Thus, in the *first stage*, it had been arrested from four to ten years in thirteen; three years in two; eight to twenty months in eleven; seven to twelve months in eleven; and there had been relapses in two only. In the *second stage:* In one subject ten years, with one relapse and a second arrest; in a second subject arrested five years; in three others, fifteen months; in one of these a relapse, new arrest for three months, and then had good health. *Third stage:* In one arrested twelve years; two, eight years; two others quitted the isle after three years.

In those in whom the disease continued to advance, its progress appeared somewhat slower than usual. Hence, the author concludes that, in the first stage of phthisis, the chances of arrest of the disease are infinitely greater at Madeira than in England, France, or any cold climate. And, indeed, these, with other facts, justify the conclusion that the island of Madeira, although scarcely the city of refuge for consumptives, is highly favorable to that class of patients, especially those not advanced beyond what is called the first stage.

The preceding remarks, in relation to residences for consumptives, refer to the winter season; but it is, at the same time, to be remembered, that, in most instances, a summer residence in a cooler climate is equally important. This subject, however, will be further developed as we advance, and especially with reference to the United States.

THE CLIMATE OF THE UNITED STATES.

The selection of a winter residence in the United States for consumptives is a most difficult task. Unlike our brethren of Europe, we have no cities of refuge—no Madeiras or Hyères—to which patients can be directed; while probably some of our most favorable positions are but little known, and others present too few accommodations to be made available for invalids. In addition to these difficulties, some differences of opinion have existed among American physicians as to whether consumptives should be directed to warm or cold climates. Dr. Forry, and,

after him, Dr. Drake, entertained the opinion that consumption was more prevalent in the southern than the northern latitudes of the United States; and hence, it was a fair induction, that patients laboring under this malady should be sent to cool instead of warm latitudes. The premises, however, are evidently false, and, therefore, the induction erroneous; for, as previously shown, the statistics on which this opinion was based were drawn from the United States army, and, therefore, did not truly represent the condition of the resident population.

A majority, however, of the profession of the United States who reside in the Eastern, Middle, or Western states, incline to send their patients *South*, and their destination may be Louisiana, Texas, Florida, South Carolina, or even Cuba. But in all this great extent of country, there are but two particular localities which have had much celebrity as resorts for consumptives, and these are Florida and Texas. Nor are there in either of these states any celebrated cities or watering places to which patients can resort; we have here no Hyères, Venice, or Rome; and, indeed, one of the great objections which invalids encounter is an actual want of accommodations, to say nothing of *attractions*, which are so important to some temperaments.

The climate of *Florida* is warm, humid, and relaxing. With a mean annual temperature of about seventy degrees, and an atmosphere saturated with vapor, the humidity, it will readily be conceived, is extreme. The dew point being high, a slight reduction of temperature renders the atmosphere moist. It is true some of the interior points, such as Tallahasse, are less objectionable than the coast; but every portion of the country possesses the elements of climate previously mentioned. St. Augustine, to which consumptives have often resorted, is peculiarly unfavorable; and few have resided long in that locality without serious injury. Patients who have resorted thither have informed me that they found at once the climate unpropitious, and that it was often seriously injurious.

The inference from these facts is, that the climate of Florida, taken in a general sense, is not adapted to phthisical persons advanced to the stage of softening, or in whom much debility exists. And so far as cases of this character have come to my

knowledge, they have invariably been seriously injured,—the debility increased, suppuration extended, and the disease as a whole made rapid advances.

We are not prepared to say, however, that in the early stages of the disease, (especially the precursory period,) the results may not be different; indeed, there are some facts to show that even in this moist and relaxing climate, the revolutionary influences of the change may avert the impending tuberculosis, or even arrest incipient deposits. But the good effects, if they occur at all, are limited to the incipient stages; and even here, the favorable result can be obtained only by a protracted residence in the country.

TEXAS.

A far more favorable region of country than the last noticed, is embraced within the limits of the State of Texas. As a general remark, the climate is mild and genial, sufficiently dry and equable, and with the exception of the "northers" not subject to sudden changes. The country near the Gulf is level, beyond this undulating, while in the northern and western portions, mountains, of the third and fourth magnitude, are encountered. The winds of Texas, for the greater portion of the year, are as shown in the following table. It comprises the mean of five years' observations:

N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	Whole No.
30.6	30.2	40.8	102.5	58.4	23.8	12.9	25.4	= 324.6

San Antonio, situated in 29° 25′ north latitude, has a mean winter temperature of 53°.9, and an annual precipitation of 33.77 inches. The western part of Texas is remarkable for its dry atmosphere; and, indeed, away from the vicinity of the Gulf, the atmosphere is stated to be comparatively dry and elastic. The rapid changes, however, in connection with the *northers*, which are currents of cold air pouring down from the North during winter, constitute the great difficulties which consumptives will encounter. These changes are often sudden and extreme, varying at times fifty and sixty degrees in a few hours.

It is a conceded fact, however, that the climate of Texas is favorable to consumptives, not only during the winter, but also in the summer. Indeed, it is probable that a residence the year round would be preferable to a temporary sojourn during the winter. But, if this course is adopted, it is necessary that the summer should be spent in the more northern portions, where the temperature is seldom oppressive. Indeed, throughout the entire country, the Gulf breeze renders the summer nights cool and invigorating. Examples are by no means rare of persons predisposed to the disease, or with it actually developed, entirely recovering by a protracted sojourn in Texas.

NEW MEXICO.

It is extremely probable, if not positively certain, that the territory known as New Mexico, embracing Santa Fé, is more favorable to consumptives than any point on the American continent, if not in the civilized world. The observations, however, which have been made are too few to warrant generalization; and, indeed, the difficulty of access, as well as the want of accommodations and character of the population will, for a long period, deter even those who have sufficient physical ability, from visiting the country. The Rio del Norte, extending in a northwest direction from the Gulf of Mexico fifteen hundred miles, runs through a sterile valley, which presents great diversity of climate. Thus, Matamoras, a Mexican town, situated below the twenty-sixth degree, and Santa Fé in 35° 41′ north latitude, embracing about ten degrees of latitude, must give rise to great differences in temperature. The surface of the country of New Mexico, generally, is made up of mountain ranges and narrow valleys, which run northwest; the whole exhibiting the marks of volcanic action, and earthquakes are still quite common in many districts. Thus, Assistant-surgeon Hammond states that at Socorro, twenty-eight shocks occurred within fifteen successive months.

The lower portion of the valley of the Rio del Norte is more or less subject to malarious diseases, but this gradually diminishes from Matamoras upward, until it is probably lost at about

the thirty-first or thirty-second degree of latitude. At Santa Fé (35° 41′) the malarious fevers are measurably unknown.

Santa Fé, the capital of New Mexico, is situated in north latitude 35° 41′, west longitude 106° 2′; its altitude above the sea is 6,846 feet. The following summary exhibits its mean annual temperature and quantity of rain:

Spring, 49°.7; summer, 70°.4; autumn, 50°.6; winter, 31°.6; year, 50°.6. Rain, 19.83 inches. Thus, it will be remarked that Santa Fé is several degrees colder than Cincinnati, which is nearly four degrees further north. And Nashville, Tenn., only a half degree further south, has a mean annual temperature of fifty-eight degrees. The difference is, doubtless, owing to the westerly position, the altitude, and mountainous elevations.

The climate of New Mexico is remarkable for its dry and pure atmosphere, and is, doubtless, one of the most salubrious regions in North America. It is, however, variable, and, in the northern portion, these changes are sudden and severe. Dr. Gregg, who made many observations on this climate, states that no atmosphere can be purer; and he remarks that bilious diseases are almost unknown, as are fevers generally, except a single epidemic of the typhoid variety, which prevailed from 1837 to 1839. He expresses the opinion that as great a degree of longevity is attained here as in any portion of the world. "Persons," he remarks, "withered almost to mummies, are to be encountered occasionally, whose extraordinary age is only to be inferred from their recollection of certain notable events, which had taken place in times far remote."

Surgeons attached to the United States army, and who have been stationed in New Mexico, express the most favorable opinions in regard to the salubrity of its climate, and especially in reference to pulmonary diseases. Assistant-surgeon J. F. Hammond, in giving the medical topography and diseases of Socorro, makes the following statement: "*Phthisis pulmonalis* I have never seen in the country, except in two instances: once in an officer of the United States army, and once in an American emigrant. It was developed in each before he left the United States, and each very gradually improved. One resided at Socorro, the other at El Passo del Norte." He also

remarks that intermittent fever is rare, pleurisy and pneumonia still more so, typhoid fever is seldom seen, and typhus is unknown.

It is important to remark in this connection, that the habits of the natives would strongly favor the development of phthisis if there was not some counteracting agency. "In consequence," writes Dr. Hammond, "of the altitude of the country, probably, of the impure atmosphere in their ill-ventilated habitations, of their inefficient clothing, want of cleanliness, want of exercise, scant and little-varied diet, early marriages, and an inherited cachexia, they are born with feeble constitutions," etc.

These are conditions which naturally favor the development of scrofula and phthisis; and we know of no sufficient reason, except climatic influences, why these diseases should not be generated by such gross violation of hygienic principles. The only redeeming elements of diet consist in mingling the fat of the ox, sheep, and goat with their food, and the free use of the milk of the sheep and goat.

The facts in relation to the climate of New Mexico, so far as they have been obtained, go to show that it is remarkable for its salubrity, and is especially favorable in reference to pulmonary diseases. The statements of Dr. Hammond establish the fact, notwithstanding the unfavorable conditions in relation to diet, clothing, and ventilation, that the natives are singularly exempt from phthisis; and, also, that even when the disease has been developed in persons prior to leaving the United States, the most marked improvement takes place. The general qualities of the climate may be stated to be—a clear sky and dry atmosphere, and somewhat frequent changes of wind. "The electric tension of the atmosphere," writes Dr. Hammond, "is very great at times, especially after a fall of rain or snow, and which has melted rapidly. The dry state of the atmosphere, and the large quantity of salines which the ground contains, surcharges the atmosphere, on such occasions, with positive electricity, which is sometimes strikingly exhibited. On the morning of the 29th of December, 1849, snow fell to the depth of two or three inches. It melted rapidly in a few hours, and was followed immediately by vivid zig-zag lightning and thun-

der. There was no rain. The day began and ended with an earthquake; there was a shock at 6 A. M., and one at 8 P. M." —*Statistical Reports.*

We can not fail to remark some general resemblance between the climate of New Mexico and the Kirghis steppe. Both are mountainous, (though in different degrees,) and subject to rapid changes. The inhabitants live on vegetables and dried meat, and both partake freely of milk or its preparations; and both are almost exempt from phthisis.

Further observations are required before we can venture to determine precisely the class of persons in whom the climate of New Mexico would prove most beneficial. *A priori* it would not be adapted to the stage of softening, or persons much debilitated; but, at the same time, the dry and bracing atmosphere, the infrequency of pneumonia, may render it not only bearable, but positively beneficial in this class of patients. The winds which occur are irregular, and frequently change several times in twenty-four hours, (Blodget;) and hence they are less injurious than where they blow continuously from one point of the compass for days in succession. It constitutes, indeed, rather an agitation of the air than continued currents. Doubtless the different latitudes afford a sufficient variety of temperature to meet the wants of all classes; and thus patients could safely remain during summer and winter.

CALIFORNIA.

The facts already stated in the article Geography of Phthisis, would lead us to anticipate favorable results from the climate of California. Indeed, there can be no doubt that the Pacific coast affords a favorable retreat for consumptives; although we are unable, in our present state of knowledge, to present any statistics in support of this opinion. The reports of the surgeons connected with the United States army, are most favorable in relation to phthisis. Surgeon William S. King, in his official report of the diseases at Monterey, classes consumption among the diseases from which the inhabitants are nearly exempt. At Benicia barracks, Surgeon Griffin reports that but one man

had died at that post of phthisis, and he could find but two cases reported since its establishment.

Dr. F. W. Hatch, of Sacramento city, has written an excellent article on the climate of that portion of California, with remarks on the State generally.* It appears from this article that the valley of Sacramento is liable to great extremes of heat and sudden transitions. The mean summer temperature is 70°.96; winter, 48°.85; and of the year, 59°.9. The city is situated in N. lat. 38° 33′; W. long., 121° 20′. It corresponds in latitude with Washington city, D. C.; but there is a marked difference in the temperature of the two points. Thus, while Washington has a mean winter temperature of 36°.1, Sacramento reaches 46°.3—a difference of ten degrees. Dr. Hatch's observations confirm the general impression, that the interior of California is remarkable for its dry atmosphere. The mean annual amount of rain is stated in the Army Reports at 21.32, and of winter 8.56. Dr. Hatch makes the following observations in relation to the dryness of the atmosphere: "Thus, on the 7th of July, 1854, with a meridian temperature of 73°, and a dew point of 45°, there were present only 3.41 grains of vapor of water in each cubic foot of air, against 11.96 grains which it might have held in suspension; on the 14th, 6.79 grains against 15.89 grains; and on the 24th, with a temperature at noon of 94°, there were present only 4.30 grains in a cubic foot, whereas the atmosphere possessed a capacity for 16.84 grains." And he asks the question, whether this dryness of the atmosphere accounts for the slight evils resulting from the extreme vicissitudes of temperature to which the locality is subject? Doubtless this question should be answered in the affirmative.

In relation to the prevalence of consumption, Dr. Hatch states that at Sacramento, of two hundred and sixty-seven deaths in one year, twenty-nine are set down as cases of consumption; and in San Francisco, out of one thousand seven hundred and sixty-five deaths, two hundred and three were from phthisis. This would give the proportion at Sacramento of one in nine, and at San Francisco one in 8.6. It is stated, however, that

one-fourth of those dying at San Francisco were at the Marine Hospital, and were composed of seamen who had contracted the disease elsewhere. It is probable, also, that the same remark will hold good in relation to Sacramento. Certainly these statistics should not be received as evidence that the climate of California is unfavorable to consumptives; and the following extract will serve to show that Dr. Hatch, judging from his own observations, reached a different conclusion: "It would seem that the dryness of our climate, at certain seasons, would render it a favorable one for the diseases under consideration, and there can be no doubt that, for many such cases, such is the fact; while the modifying elements, which have already been referred to in connection with the daily variations of temperature, must render it much less prejudicial than it would otherwise prove to be. It is probable that in many of the mountain countries, above the level of the dampness and fogs which accumulate in the valleys, the condition of the atmosphere may be highly favorable for this class of diseases."

Dr. Hatch also remarks that he has been informed, upon reliable authority, that among the natives of the southern portion of the State, true tubercular phthisis is extremely rare. This opinion is confirmed by others, and is doubtless based on correct observation.

The general impression in relation to the climate of California is that many of its locations are favorable in phthisis; but at the same time we require still more definite information on the subject. It should be remembered that the State embraces widely different localities, between which a careful discrimination should be made. Thus, some are elevated and dry, others low and humid; and the northern portion is considerably cooler and more variable than the southern. That the atmosphere is peculiarly pure and transparent in some localities admits of no doubt; indeed, it evidently rivals the Italian skies in this particular. In illustration of this fact I may mention the statement of Dr. Trask, State geologist, that, at San Pedro, in Los Angelos county, the signal staff of the United States coast survey, with a diameter of only four and a half inches, situated at an elevation of sixteen hundred feet, was distinctly visible to the naked eye a distance

of four miles by air-line measurement, (Hatch.) With these elements, the climate must prove peculiarly valuable to many invalids.

2. *Sea Voyages.*—From the days of Celsus to the present period, sea voyages have by many been held in high estimation as a means of curing phthisis; but at the present period, the opinions of observers are so conflicting that the question must be regarded as unsettled. M. Rochard, (*De l'Influence de la Navigation et des Pays chauds sur la Marche de la Phthisie Pulmonaire,*) the latest authority on the subject, says: "If Celsus, Pliny, and Aretæus recommended sea voyages; if they established the health of Cicero; if Boerhaave, Cullen, and Fothergill testified to their good effects; still no conclusions can be drawn from these statements at the present day." And he proceeds to argue that the pathology and diagnosis were uncertain, and hence the opinions only vague assertions. Rochard's opinion is unfavorable to the good effects of sea voyages. He cites one hundred and sixty-five cases occurring among marines, of whom one hundred and three died at sea, and sixty-two were sent to France or deposited in hospitals. He cites, also, the mortality in the city of Brest. In this marine city of sixty thousand inhabitants, one-sixth of the deaths, in 1853, were produced by phthisis, the total number from this cause being two hundred and forty-five, or one in two hundred and fifty-seven of the population. The author also examines at some length the relative proportion of deaths from phthisis among the land and naval forces, and gives the following results:

In sailors, mean for one year.....	1 in 364
In the army, " " "	1 in 578

Hence, Rochard concludes that phthisis is very common on the sea; and as the sailors were distributed throughout great diversities of climate, including the squadrons of the Mediterranean and the Levant, the coast of Africa, of Indo-China, the South Sea and Oceanica, Brazil, La Platte, Guyana, and the West Indies, he thinks they clearly disprove the common theory. He is decidedly of opinion, therefore, that navigation,

neither as an occupation nor means of cure, is adapted to the consumptive; and this view, he is of opinion, is confirmed by the statistics equally of the French and English navies.

The following are Rochard's conclusions:

1. Sea voyages much more frequently accelerate than retard phthisis.
2. Instead of being rare among marines, it is much more frequent than in the army.
3. Generally, phthisis marches with more rapidity on board ships than on land.
4. The naval profession should be interdicted to persons threatened with phthisis.
5. Consumptives might receive some advantage from navigation, under favorable hygienic conditions, such as change of climate, with favorable season, which can not be secured on board vessels with particular destinations. Land journeys, favorably chosen, and prolonged sojourn, may be beneficial.
6. Hot countries exercise an unfavorable influence, and hasten its course.
7. Countries situated under the torrid zone, (hot properly speaking,) exercise this unhappy influence, and a sojourn in them should be interdicted.
8. Most hot countries situated outside the torrid zone are equally prejudicial.
9. Only in the first stage can we counsel emigration.

Many observers, however, entertain opinions adverse to those of Rochard. In France, sea voyages have been advocated by Bricheteau, Amédée Latour, Dujat, and Fournet; and, in England, Sir James Clark and many other eminent physicians of that country entertain similar views. Bricheteau attributes the good effects to the sea-sickness, which he regards as an indication for the employment of emetics; while Latour believes the beneficial results to arise from the influence of the saline condition of the air. Laennec, it is well known, entertained highly favorable views of the influence of sea air, either by residing on the coast or in long voyages. A long list of individual ex-

amples, in which sea voyages have proved beneficial, might be introduced; but, in the present state of our knowledge, we are unable to offer reliable statistical evidence bearing on the subject.

The facts adduced by Rochard, and which are favorably mentioned by Boudin, are the most recent on the subject, and may be regarded as more authoritative than any others with which we are acquainted. According to these statements, phthisis is much more frequent among sailors than in the army, from which it is inferred that the sea air and sea voyages are unfavorable. It does not appear to me, however, that the facts warrant the conclusions; indeed, in a general sense, statistics drawn from the army and navy are extremely fallacious when applied to civilians. We have already seen the errors into which Forry and Drake were led by depending on the army reports; and I think we shall be equally deceived if we follow the opinions of Rochard.

Instead of creating surprise that sailors should be prone to phthisis, it is, in fact, in strict accordance with the general laws of hygiene, and is precisely what we might most confidently anticipate. They are continually exposed to all the changes of weather; sleep in ill-ventilated rooms, and consequently breathe a vitiated atmosphere; and, in most instances, are served with food ill-calculated to sustain the integrity of the nutritive functions. With all these unfavorable hygienic conditions, it ceases to be a matter of surprise that a sea-faring life should not only fail to prove protective against phthisis, but that it should rather operate as a predisposing cause. And it must be conceded, that an individual undertaking a sea voyage for the benefit of his health, being perfectly able to secure suitable clothing and diet; being free from unnecessary and injurious exposure to winds and rains; from the depressing effects of labor; and, above all, being able to direct his course to the climate best adapted to his condition, must necessarily be in a condition far more favorable than the mere sailor, who is unable to avail himself of any of these advantages. It must, indeed, be a most potent influence which could overcome all the unfavorable conditions to which the sailor is subjected.

While, therefore, we are without definite statistics on this subject, the individual examples in which sea voyages have proved beneficial are too numerous, and too well authenticated, to admit of reasonable doubt. Indeed, if there is any truth in the observation that a mere *change* of climate is beneficial to most invalids, it must be pre-eminently so in traversing the surface of the ocean. Here a constant change and renewal of air, and frequent brisk winds, with their tonic and exciting effects, occur; and the immediate consequence is that an invigorating influence, through the medium of the nervous and the respiratory system, is constantly in action, and can not fail to prove highly beneficial.

3. *The relation of Pregnancy to Tuberculosis.*—This subject, which has been extensively discussed, is evidently one of much practical importance, but still not definitely settled. Some observers entertain the opinion that pregnancy retards the advance of phthisis, while others believe the progress of the disease is accelerated by child-bearing. Doubtless some misconceptions arise from a want of regard to the stages of the disease, as well as other agencies coinciding with the influences of pregnancy.

The experience of M. Dubois led him to believe that pregnancy exercised an unfavorable influence on phthisical subjects. MM. Grisolle and Dubreuilh have investigated this subject with great care, and both reach the conclusion that the influence of pregnancy over phthisis is prejudicial. Grisolle gives the results of twenty-seven cases of phthisis associated with pregnancy. In twenty-four of these the organic disease is alleged to have commenced during pregnancy, while in three the rational signs of tubercle already existed. In all these examples the pulmonary disease was not retarded by the occurrence of pregnancy, but in all it made rapid progress. But it was observed by Grisolle that *delivery* exercised less influence over the march of phthisis than is generally supposed; indeed, the disease goes on much as before; while in some less intense cases it is at times retarded, or may be more or less perfectly arrested.

Dr. Cotton expresses, as the result of his observations, that where a hereditary tendency to phthisis exists, there is much danger of the disease being called into activity by the process

of gestation, especially if it occur frequently, or at too early an age. He also remarks that it is common to observe, at the Hospital for Consumption, young females becoming rapidly phthisical after giving birth to their first or second child. According to the observations of Dr. Cotton, gestation does not induce phthisis, except in the diathetic state; and when tubercles already exist, it has the effect to retard their progress; but, when pregnancy is completed, the pulmonary disease is often accelerated. But he states also, that while some females become rapidly tuberculous under the influences of child-bearing, others enjoy an immunity during repeated pregnancies, but finally become consumptive when they cease to bear children.

Some of the statements of Dr. Cotton are at variance with those of Grisolle, particularly in reference to the progress of phthisis after accouchement. According to Grisolle's observations, the disease may be retarded after delivery, while Dr. Cotton rather inclines to the opinion that the puerperal state accelerates the disease.

Dr. Turnbull (*On Consumption*, etc.) believes pregnancy exercises a retarding influence over the progress of consumption; and he relates an example in which one lung was destroyed by tubercular disease to nearly one-half its extent, and yet the morbid action was arrested for a time. And Dr. Theophilus Thompson makes the statement that, in London, married women enjoy an especial immunity from phthisis. Rokitansky admits the antagonism of phthisis and pregnancy, and ascribes it to the venosity of blood during gestation, which is induced by the imperfect expansion of the chest. Dr. Copland (*Dict. Prac. Med.*) remarks that pregnancy arrests the progress of tubercular consumption, if the disease is not too far advanced; but that when pregnancy occurs at an advanced stage of phthisis, the child is born with tubercles, and the mother rapidly sinks.

Dr. Edward Warren (*Prize Essay*, etc.) argues that a direct antagonism exists between the constitutional effects of pregnancy and phthisis. Thus, pregnancy induces an exaltation of the vital functions, while phthisis depresses them. He is of opinion, also, that pregnancy diverts the forces and fluids *from* the lungs, and *to* the uterus.

In reviewing what has been written on this subject, aided by my own observations, it seems to me apparent that too wide a range has been given to the inquiries. Thus, the influences of pregnancy over the march of phthisis have been made to embrace the advanced as well as the early stages of the disease; and as very different results will be observed under these varying conditions, it is not surprising that great discrepancy of opinion should exist. In addition to this, there are many modifying influences acting on individual cases, which change the results, and prevent the development of the natural tendency of pregnancy. It would require, therefore, very broad statistics, and these strictly classified according to the stage of the disease, to become authoritative.

I have no doubt, judging from my own experience, that a *healthy* pregnancy, occurring in the precursory stage of phthisis, exercises a strong influence in preventing the development of disease; and even when tubercles have been deposited, to a limited extent, there is often, if not generally, a retardation of their development. It has occurred to me often to observe that in females, hereditarily predisposed to phthisis, repeated pregnancies improved the constitution, and tubercular disease was not established. And this general fact is in accordance with the observations of Dr. Theophilus Thompson, that, while in England at large the proportion of phthisical females is greater than males, in London, the reverse is true, especially among *married* women.

But there are many qualifying circumstances which have an important bearing on the subject. Thus, if there is great disturbance of the stomach during gestation, and the nutrition of the system is thereby impaired, the results will generally prove unfavorable. Again, if pregnant females are placed under unfavorable hygienic relations, if there is a deficiency of food, clothing, and the ordinary comforts of life, the whole tendency is necessarily unpropitious. Miscarriages, by their debilitating influence, are observed to be particularly unfavorable; and I have known instances of females becoming tuberculous under the depressing effects of this cause.

But in a more advanced stage of the disease, where, for ex-

ample, tuberculization is extensive, with softening and the formation of cavities, pregnancy seldom accomplishes much good. It is true there are examples in which the pulmonary affection appears to have been retarded, or even arrested, at least, for a time; but these are rather, exceptional cases, while the general result is a hastening of the local and constitutional disease. The disturbing influences of pregnancy, in a weakened constitution, will more than counterbalance any antagonism existing between these conditions.

It is probable, also, that most of these cases, both incipient and advanced, might be materially modified by appropriate constitutional treatment during the progress of pregnancy. Thus, if a pregnant female is laboring under incipient phthisis, or the constitutional tendency to that disease, it may often be prevented, and the process of gestation enabled to revolutionize the system, by a tonic course of treatment. The continued use of cod-liver oil, during several successive pregnancies, I have known of the most marked influence in improving the health, and, doubtless, in preventing the development of tubercles. In addition to this important influence over the mother, it exercises an equally beneficial effect on the fœtus in utero; and hence such females are far more likely to bear healthy children, even free from the tuberculous taint, than those who do not take this valuable precaution.

4. *Topical Medication.*—As understood at the present time, topical medication signifies the application of medicinal agents to the pharynx, larynx, trachea, and bronchi; and in a still more restricted sense, it is understood to indicate the introduction of nitrate of silver, by means of the sponge-probang, or injected through an elastic tube, for the cure of laryngeal and pulmonary diseases. For a number of years past, it has been known that foreign bodies may enter the larynx, without inducing marked irritation; and Baron Larrey states that in attempting to pass elastic tubes into the stomachs of soldiers, for the purpose of conveying nutriment, they often went into the larynx without causing inconvenience. Trousseau and Belloc recommended cauterization of the larynx, and Sir Charles Bell, as early as 1816, applied the solid nitrate of silver to an ulcerated

epiglottis. But we are indebted to Dr. Horace Green, of New York, for systematizing this practice and demonstrating its practicability. The old idea that the mildest substances could not enter the larynx without causing suffocation, has been found utterly fallacious, and it has now been proven that the sponge-probang, and elastic tubes, can be introduced into the larynx wihout serious inconvenience to the patient. Having been in the habit for years of introducing the sponge into the larynx, and more recently the elastic tube, I am not permitted to doubt the practicability of these operations.

The utility of topical medication, under proper restrictions, can not admit of a reasonable doubt; indeed, a majority of physicians now resort to the use of the probang when the fauces and larynx become affected. In most instances, however, the probang reaches no further than the fauces, and, at most, is merely pressed on the larynx; but there can be no question that it is often far better to penetrate the larynx itself, and thus reach the seat of local irritation.

But there is another method of topical medication, namely, injection of the bronchial tubes, which is not so well understood. This method is peculiar to Dr. Green, and its merits or demerits are not generally known. In several publications which Dr. Green has made on this subject, the difficulties and advantages of catheterism of the bronchial tubes are clearly set forth; and, according to his experience, many cases were greatly benefited by this course of medication. For myself, I have not had that extended experience which the author of the practice can claim, and, therefore, his testimony is more important and reliable. However, having witnessed the introduction of the tube by Dr. Green, I have followed his directions, and have frequently injected solutions of the nitrate of silver; and although my experience is too limited to speak decidedly in favor of the measure, yet I can safely say that, in my hands, no *injury* has followed the procedure, but benefit, in certain cases, seemed to ensue. Hence, relying on the statements of Dr. Green, and my own more limited experience, I shall continue to make observations on the subject.

Some misapprehension evidently exists in relation to the ob-

jects which those who inject the bronchial tubes have in view. It is not claimed that pulmonary cavities can always be injected, but it is rather *bronchial* than *cavernous* injection which is expected to be accomplished. Still, when the bronchial communication with a cavity is free and direct, there is no reason why the cavity itself may not be injected; but it must be admitted, that when the opening is not free or direct, and when the cavity is not favorably located, injection becomes impossible.

The object in injecting the bronchial tubes is to apply the nitrate of silver directly to the irritated mucous surfaces of the bronchial tubes, and, in certain cases, directly to cavities. There can be no reasonable doubt, that when this can be accomplished, the good effects will be as positive and extensive as when the same agent is applied to the fauces or the eye.

It must not be inferred, however, that topical medication, in any of its forms, is designed to supersede constitutional treatment; on the contrary, it is a mere adjuvant, placed in the same category as the application of nitrate of silver to strumous inflammation of the eye. Thus, in those cases manifesting much faucial or laryngeal irritation, it should never be neglected, but should be used in connection with constitutional treatment.

PROGNOSIS CONCLUSION.

We have now passed in review the principal facts bearing on the pathology, causes, symptoms, and treatment of phthisis; and, in conclusion, what can be said of the *curability* of the disease? Very different opinions exist on this subject. Thus, the general professional, as well as popular opinion, inclines to the view that phthisis, when fully established, is measurably if not absolutely incurable; while, on the other hand, many of the modern writers take a much more hopeful view of the question.

The only method by which a satisfactory conclusion can be reached on this subject, is in basing an opinion on the stage of the disease, and the incidental circumstances and conditions which characterize each individual case. Thus, the forming or precursory stage is very largely amenable to proper hygienic and medicinal treatment; while the stage of tubercular softening or caverns, if extensive and occupying both lungs, is almost necessarily fatal. Hence, taking the two extremes, the prognosis would be exactly opposite—one stage being nearly always curable, the other as constantly incurable. And between these extremes we meet with every possible intermediate grade, and the prognosis will be modified accordingly.

But a fair statement of the question would be this: In a case of medium intensity and duration, say a moderate amount of tubercles in one or even both lungs, with a fair degree of constitutional vigor, can we give an assurance of ultimate recovery? There are few examples, I apprehend, in which an unconditional opinion in favor of recovery could be given; but under what may be deemed favorable circumstances, we are not required, by the present state of science, to condemn the patient to a

hopeless prognosis. My own experience has taught me to believe, that where tubercles exist, to a moderate extent, in one lung only, and the patient retains a fair degree of strength with healthy digestion, the chances, with proper treatment, are in favor of ultimate recovery.

The present state of science justifies the assumption that tuberculous exudation is susceptible of absorption; and, furthermore, that tubercular consolidations may liquefy and return to the circulation, or be eliminated through the bronchial tubes, leaving, in either case, a condition of actual cure. When softening and elimination take place, the resulting excavation may fill with inorganic substances, or a low grade of organic material, contract, and remain stationary; or, the cavity may recede only partially, and, becoming lined with a pseudo-mucous tissue, continue in an open but inactive state. It is possible, also, that the walls of small cavities may unite, leaving a mere cicatrix as the only anatomical evidence of the lesion. In either of these cases, (except the first,) the cure is, anatomically, incomplete; but inasmuch as all morbid action ceases, and the general health improves, the patient may be clinically regarded as restored to health.

We are further to consider, however, the differences between a mere *suspension* of disease and a permanent *arrest* of all further morbid tendency. In many cases of phthisis, the general health may be so far restored, and the local affection so completely suspended as to impart to the patient the aspect of returning health, and yet the mitigation of the disease may prove only temporary, and at a period more or less remote, the morbid condition will reappear and progress to a fatal issue.

But the cases of *permanent* cure are sufficiently numerous to become an important element in prognosis, and to assure the physician that phthisis is, to a certain extent, a curable disease. It requires, however, a very careful analysis of a case to arrive at a reliable prognosis, and in making such an attempt the physician should inquire into all the facts, proximate and remote, bearing on the case, and from these deduce his conclusions. It is unsafe to base a prognosis on a mere name, or a single symptom or condition.

The conditions which justify a favorable prognosis may be thus stated:

1. When the tubercles are limited to one lung, are not very extensive, and have not been associated with inflammation, either as a sequence or an inducing cause.
2. The general health remaining in a fair condition, without rapid emaciation, fever, or derangement of digestion.
3. A hereditary tendency to phthisis being slight or entirely absent.
4. The patient possessing naturally a good constitution, with a sanguineous or nervo-sanguineous temperament.
5. The occupation being favorable, or at least not of a character to induce phthisis, or the patient being in a condition to make a change to a more suitable business.
6. The patient having confidence in his medical attendant, and a willingness to submit to treatment, and the ability to avail himself of all incidental means and conditions capable of favoring his recovery, including a change of climate.
7. A cheerful and hopeful mental constitution, and a desire to contribute his share to the successful treatment.

These are the conditions which justify a favorable prognosis, although patients may, and often do recover, when the circumstances are much less propitious.

The unfavorable elements of prognosis may be thus enumerated:

1. When tubercles occupy both lungs, to a considerable extent, or involve a large portion of one.
2. When the disease has advanced to the stage of softening, with extensive disorganization of the pulmonary structures.
3. The general health being greatly impaired, as shown by the existence of extensive emaciation, deranged digestion, hectic fever, and night-sweats.
4. A decided hereditary tendency to phthisis, and especially if received by a son from a father, or a daughter from a mother.
5. A naturally feeble constitution, with a phlegmatic or bilious temperament.

6. The occupation being unfavorable, and the patient not able or willing to make the proper change.

7. The patient being of a fickle disposition, wanting confidence and perseverance in medical treatment, and unable or unwilling to secure the advantages of a change of climate, and other incidental means of relief.

8. A desponding and gloomy cast of mind, with a presentiment of a fatal issue.

In considering these elements of prognosis, it is not necessary that either class should be fully represented in any given case; but the more of these conditions met with in any single example, the more decided and reliable will be the prognosis. It is the presence of a fair proportion of these elements of prognosis which we are to look for, and on which our conclusions should be based.

In accordance with my own observations, I am fully satisfied that, in the favorable class of cases, and with judicious treatment, a fair proportion may recover; and further than this, I am equally assured that in examples presenting even more unfavorable elements of prognosis, a smaller but still encouraging number may secure either temporary suspension of disease, or even permanent relief.

But, unfortunately, a large (perhaps the larger) number, at least in this country, do not seek reliable aid until they have passed the period of cure, or even of palliation. Our country abounds with designing charlatans who falsely proclaim their ability to cure consumption with certainty and facility; and the press teems with alluring advertisements and inspiring certificates, proclaiming the discovery of specifics before whose magic power disease recedes, as the night before the rising sun. And pale victims crowd these halls of false promises and heartless deceptions, eagerly grasping the gilded bubbles; but, alas! the dream is not realized, and the deluded victim finds relief in his narrow house, while the heartless mountebank goes on dispensing false promises, and reaping a golden harvest. What a retribution must come upon the deceiver who thus makes

merchandise of human life; and scarcely less is the responsibility of those who from reprehensible design, or mistaken philanthropy lend their names to certificates in relation to subjects of which they have no competent knowledge. Let prudent men, and public functionaries generally, whose influences are too often surreptitiously obtained, ponder well these terrible truths, and act as wisdom, justice, and humanity dictate.

Finally, when these palpable evils shall have been abated, and patients learn to seek the aid of enlightened physicians during a curable stage of disease, the proportion of recoveries will be largely augmented, and phthisis will no longer be regarded as the OPPROBRIUM of our profession.

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